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The Impact of HACCP on Costs and Product Exit

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ABSTRACT

Detailed information on firm level food safety costs is reported. Survey data for small and very small meat processors are modeled. Economies of scale in implementing Hazard Analysis Critical Control Point (HACCP) systems are investigated. Results indicate that even after controlling for scale, very small plants incur higher compliance costs. Diseconomies of scope are assessed using the probability and number of products discontinued due to HACCP. Such "partial exit" is positively related to the current range of items produced and the need for facility modification. However, no evidence is found for higher levels of partial exit in very small plants.

Key Words: *HACCP, economies of scale, firm and product exit, food safety strategies, meat processing.*

The Hazard Analysis Critical Control Point (HACCP) system has been the subject of intense political, technical, and economic analysis in recent years. This paper continues this assessment, presenting findings from the analysis of data gathered from meat processing plants in Texas on two impacts of the United States Department of Agriculture (USDA) rule that have previously received limited attention. Specifically, the cost of implementing the requirements in small and very small meat processing plants and the potential reduction in the product range offered by these plants termed "partial or product exit" are modeled. The importance of plant size, sales, process complexity, related infrastructure and training costs are evaluated for their roles in determining the overall impact of the rule.

The number of meat processing plants in Texas declined by about 53 percent from 1982 to 1996 leading to great concern in the industry about how to enhance the profitability of meat plants and prevent further exit. Siebert, Nayga, and Thelen (2000) found that for smaller meat plants, return on assets (ROA) averaged 63 percent among the top quartile of plants examined. However, the bottom quartile's ROA averaged only 8 percent, making such firms highly susceptible to any of the multi-dimensional risks inherent in today's food processing industry. Food safety-risk mitigation strategies in particular are becoming increasingly important and, therefore, are the focus of this paper.

There are concerns that the USDA HACCP rule may have disproportionally impacted smaller meat processors and led to a reduced number of products being offered by the firms. This paper attempts to examine this using data collected through a survey of meat processors

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in Texas conducted in 1999 prior to full implementation of the rule (small plants were required to have a HACCP system in place by January 25, 1999 and very small plants by January 25, 2000).[1] The data set has a range of small and very small plants.

Background

Reactions to public health risk have brought about sweeping changes in the U.S. meat processing sector. USDA's *Pathogen Reduction; Hazard Analysis and Critical Control Point (HACCP) Systems; Final Rule* (USDA 1996) represents possibly the largest single regulatory change to impact the meat industry. It requires almost all meat and poultry processors of all sizes to implement sophisticated HACCP-based systems *for each product or process*.[2] Unnevehr (2000) presents an excellent range of economic evaluations of the USDA rule and other applications of the HACCP system around the world. These studies include analyses of the costs and benefits and potential market structure impacts of HACCP-based systems and serve as the basis for this paper.

The meat slaughter and processing sectors are characterized as having a "dual" market structure. While heavily concentrated for large plants, there remains a large number of small and very small federal and state-inspected plants. It is these smaller plants that may potentially be most influenced by the HACCP rule. Such changes in market structure are discussed in MacDonald and Crutchfield (1996). The authors highlight the importance of considering plant heterogeneity (such as firm size and product mix) in forecasting HACCP compliance costs in order to determine if separate benefit measures for such plants are necessary (p. 1290). The regulatory impact assessment of the final rule argues that any cost disadvantage placed on smaller plants would be negated by the extended timeframe allowed for compliance (USDA 1996, p. 38986). The forecasted final implementation costs of the regulation were estimated to be between $0.0011 to $0.0013 per pound, with annual recurring costs of between $0.0015 and $0.0018 per pound. These projections differ significantly from the total cost measure (the sum of recurring and non-recurring costs) reported in this paper (averaging just under $0.05 per pound—see Table 1 and discussion below). This average compliance cost of $0.05 per pound may be compared to the estimates of Antle (2000) who modeled HACCP costs, determining a range of $0.03 to $0.17 per pound (p. 93). Further, reporting on survey results conducted prior to full HACCP implementation, Nganje and Mazzocco (2000) found a range of compliance costs between $0.0004 and $0.4351 per pound. Clearly there is considerable variability and uncertainty in each of these measures. Our own survey respondents reported per pound costs between $0.02 and $0.20 per pound.

The concern that economies of scale may be sufficient to promote exit mandates the close modeling and monitoring of *ex ante* and *ex post* exit and entry rates for the segment of most concern—namely the very small plants (Anderson et al. 1998). However, effective market structure may alter without complete exit if the HACCP rule has diseconomies of scope as well as economies of scale. This aspect of partial exit is explored below.

Although less research has focused on this aspect of HACCP, the potential is briefly explored in the regulatory impact assessment of the final rule (USDA 1996). USDA estimated that, on average, very small plants would require 2.29 HACCP plans. It is upon this forecast that their calculations of economies, or diseconomies, of scope are based. Each HACCP plan will accrue non-recurring (prep-

[1] Small plants are defined as having between 10 and 500 employees and very small establishments are those with fewer than 10 employees or annual sales of less than $2.5 million.

[2] An opportunity is provided for plants to become "custom exempt/retail" and withdraw inspection. This is allowed only for a business that slaughters animals or processes meat for the owners of the animals or products, labeling such "Not for Sale." This privilege may be removed if USDA believes the plant is operating under insanitary conditions that could pose a health risk.

aration and implementation)[3] and recurring (on-going training, record keeping, and annual plan reassessment) costs. Our two estimates of product and process complexity (RANGE and MIX—see below) average more than 3. This, in part, may be due to the more complex nature of the plants in our Texas data set compared to the national average. Many produce multiple processed meat products involving meat from several different species. While imperfect proxies of the actual number of distinct HACCP plans, these variables do suggest that the USDA forecast may be biasing down implementation (and probably annual) costs.

In a related study, Martin and Anderson (2000) identified diseconomies of scope (through process complexity) in other agribusiness firms adopting HACCP-based systems (see pp. 24–25). The authors also restated an earlier finding that smaller meat and poultry processing companies usually have more complex processes than larger plants (taken from Anderson et al. 1997).

The firms examined in this study manufacture smoked meats and are located throughout Texas. They perform processing steps such as seasoning, blending, grinding, smoking, cooking and packaging, with only a few firms performing the slaughter step. In addition to their primary activity of meat processing, a few of these firms operate meat markets, restaurants, and/or small food distribution businesses. These firms are small and cater to local tastes and play an important role within their communities. They are differentiated from one another based upon the unique varieties of sausages and other products, the family history of their business, and the cultural activities of their area. The products of different firms are distinguished from one another on the basis of region, brand name, size, shape, meat content, seasoning, grind (texture), color, natural casing and packaging. The uniqueness of these products gives rise to more concerns about the potential impact of HACCP on these firms' costs and product exit.

[3] Initial training costs may also increase with the number of HACCP plans if distinct staff are required for each product or process.

Procedures and Data

In order to examine the impact of HACCP upon small and very small meat processors, a draft questionnaire was developed with the help of the CEO of the Southwest Meat Association, and a Meat Extension Specialist. This questionnaire was pre-tested by means of on-site visits to ten meat processing firms from October 1998 to February 1999. Following revisions from the pre-testing, a final questionnaire was sent to 137 firms via fax and mail during March and April 1999. The administration protocol consisted of first calling a firm to see if they were interested in participating. If they did not object, a survey was immediately faxed to their location. Mail was used for those firms not having fax capability. Following distribution, telephone calls were made to those firms failing to respond within two weeks. Such calls continued until either a completed questionnaire or a refusal was received. In total, 84 firms completed the questionnaire. However, some questionnaires contained omissions. Thus the effective response rate was 71 firms, or 52 percent.

Table 1 presents the three dependent variables examined. One of the dependent variables used is the firm's realized or predicted[4] HACCP compliance costs (HCOST). This variable was determined by asking, "What do you project to be your cost of implementing HACCP per pound of product produced?" (Of the 71 otherwise complete surveys, only 64 firms responded to this question). The mean level of cost was just under \$0.05/lb. The second dependent variable is a binary variable reflecting whether products will be discontinued due to HACCP or not (DISCONT). The third dependent variable, the number of products which firms predicted would be discontinued due to HACCP (PCUT), had a mean level of

[4] Note that small firms reported actual values (HACCP already implemented in January 1999) and very small firms reported forecasted values (HACCP to be implemented by January 2000). However, several of the very small plants had implemented HACCP prior to their deadline. In the modeling below these differences are captured in the H2000 and CUSTX dummy variables.

Table 1. Definitions and Descriptive Statistics for Model Variables, n = 71 firms

Variable Description	Variable Name	Mean	Standard Deviation	Min.	Max.
Dependent Variables					
The firm's cost of implementing HACCP, cents per pound.[1]	HCOST	4.813	3.749	2	20
Will products be discontinued due to HACCP? (yes = 1, no = 0)[2]	DISCONT	0.268	0.446	0	1
The number of products to be discontinued due to HACCP.	PCUT	1.155	2.645	0	15
Independent Variables					
The number of convenience prepared products.	RANGE	3.493	3.273	0	10
The number of different items within sales mix.	MIX	3.521	1.472	1	7
Will a new facility be built due to HACCP? (yes = 1, no = 0)[2]	BUILD	0.0423	0.203	0	1
Will the current facility be expanded due to HACCP? (yes = 1, no = 0)[2]	ADDFAC	0.0704	0.258	0	1
Will the current facility be modified due to HACCP? (yes = 1, no = 0)[2]	MODFAC	0.366	0.485	0	1
The number of formally HACCP trained employees.	HAEMP	1.958	1.314	0	8
Will new staff be hired due to HACCP? (yes = 1, no = 0)[2]	NEWEMP	0.465	0.502	0	1
The total number of employees in the firm.	EMP	17.817	18.917	2.5	75
Company annual sales (%)	SALES	2,626,400	4,003,200	150,000	25,000,000
Is the firm's facility over ten years old? (yes = 1, no = 0)[2]	AGE10	0.817	0.390	0	1
Do HACCP requirements begin in January 2000? (yes = 1, no = 0)[2]	H2000	0.775	0.421	0	1
Will the firm claim custom exempt status? (yes = 1, no = 0)[2]	CUSTX	0.0845	0.280	0	1
Do any customers require Federal or State Inspection? (yes = 1, no = 0)[2]	CUSTIN	0.537	0.440	0	1

[1] N = 64 (see text for explanation).
[2] The mean of the dummy variables can also be interpreted as percentage reporting a "yes."

1.17. This is about a third of the average number of items currently offered by the firms.

The independent variables are also exhibited in Table 1. To determine the impact of economies of scope we constructed two measures of plant complexity. RANGE is the reported number of convenience prepared goods (e.g., packaged beef with BBQ sauce) produced by the firm. The range of this variable is from 0 to 10. Second, MIX is a count variable taken from a list of seven possible types of products offered by the firm. This list includes sausage, ham, jerky, fresh meats, other smoked products, other (cooked), and other (raw). These two imperfect measures of plant diversity are thought to be indicative of the number of distinct HACCP plans that are required.

Also included as independent variables are a number of dummy variables regarding the plant: the intention, due to HACCP, to add an entirely new facility (BUILD); to expand (ADDFAC), or modify (MODFAC) the current facility, and if the current facility is over ten years old (AGE10). Data for the need to hire new staff (NEWEMP), the mandatory HACCP compliance date of January 2000 (H2000), the intention to drop inspection requirements and go custom exempt (CUSTX), and the demand of customers that the facility be inspected by a Federal or State agency (CUSTIN) are also reported. Other relevant variables include the number of employees formally trained in HACCP (HAEMP), the total number of employees working for the firm (EMP), and the company's annual sales (SALES).

Among responding firms, 78 percent met the "very small" classification and, therefore, faced a HACCP compliance deadline of January 2000. Just over 8 percent planned to switch to custom exempt status in lieu of compliance, while the remaining 14 percent were small firms already in full compliance. One dramatic impact of HACCP is evident from the fact that 37 percent of respondents indicated they would at least modify their facilities to comply with the rule. USDA (1996) suggested that very small plants would, on average, train at least two workers in HACCP techniques. Our measure (HAEMP) averaged just under 2 with per worker training costs reported to be just over \$1000. This led to per-plant training costs that were significantly lower (\$2025) than those presumed by USDA (\$5028).

Models and Hypotheses to be Tested

The data are evaluated with three pairs of econometric models, as discussed below. Each pair of models is constructed using alternative measures of plant complexity (RANGE or MIX) and scale (EMP or LNSALES—the natural log of SALES transformed due to scale differences between the variables).

Models 1 and 2

Models 1 and 2 examine the effect of process complexity, facility modifications, plant size, and other factors discussed above on costs of implementing HACCP. The models are presented in equation (1) with the hypothesized signs included in parenthesis. Model 1 uses the MIX and EMP variables. Model 2, on the other hand, uses the RANGE and LNSALES variables. These models were estimated using White's heteroskedastic-consistent covariance matrix to correct the estimates for an unknown form of heteroskedasticity.

$$\begin{aligned}(1)\quad \text{HCOST} = \text{f}\{&\text{RANGE } (+) \text{ or MIX } (+),\\ &\text{BUILD } (+), \text{ ADDFAC } (+),\\ &\text{MODFAC } (+), \text{ HAEMP } (+),\\ &\text{NEWEMP } (+), \text{ EMP } (-)\\ &\text{or LNSALES } (-), \text{ AGE10 } (+)\\ &\text{H2000 } (+/?), \text{ CUSTX } (+/?),\\ &\text{CUSTIN } (-/?)\}\end{aligned}$$

Costs are expected to be positively related to process complexity (RANGE or MIX). Similarly, facility modification variables (either adding new buildings—ADDFAC, expanding or redesigning current facilities—MODFAC) are hypothesized to increase the cost of compliance. As the number of HACCP trained employees (HAEMP, NEWEMP) rises, the implementation cost is also expected to rise. The indicators of plant scale (EMP and LNSALES) are expected to have negative signs indicating economies of scale in implementing HACCP. Older plants (AGE10) are presumed to require additional or more complicated redesign leading to higher costs. The next two variables are interesting and difficult to sign. *Ex ante* it may be expected that very small plants and those that choose to become custom exempt forecast higher HACCP compliance costs (recall the omitted dummy variable category is small plants which were required to be HACCP compliant by 1999). Therefore, the parameters on the dummy variables for very small plants and custom exempt plants (H2000 and CUSTX respectively) may be expected to take a positive sign. However, no known previous study has tested this. Also it is unclear if, once plant size is controlled for (with the scale measures), any additional impact should remain. Finally, it is not immediately clear which sign is expected for the parameter associated with the customer inspection variable (CUSTIN). Prior customer requirements for tight process control (as indicated by the federal/state inspection requirement) may subsequently lead to lower implementation costs (i.e., "good" firms are selected/signaled by meeting this qualification and thus require limited changes to attain full compliance).

Models 3 and 4

Models 3 and 4 examine the effect of process complexity, facility modifications, plant size, and other factors on the probability of HACCP leading to product withdrawal or exit (equation 2). Model 3 uses the MIX and EMP variables. Model 4, on the other hand, uses the RANGE and LNSALES variables.

(2) Pr(DISCONT=1)
= f{RANGE (+) or MIX (+),
BUILD (+), ADDFAC (+),
MODFAC (+), HAEMP (−/?),
NEWEMP (−/?), EMP (?)
or LNSALES (?), AGE10 (+),
H2000 (+/?), CUSTX (+/?),
CUSTIN (?)}

These models were estimated using a probit regression due to 0–1 dummy dependent variable. Generally the hypothesized relationships discussed above for the implementation cost equation (models 1 and 2) are expected to have similar effects on the probability that we see partial exit. However, two of the employee variables (number of people trained and number of new hires) may differ. If a plant chooses to formally train a larger number of workers in HACCP or hire extra workers it may then be able to support the previous range of products, being better able to manage a larger number of HACCP plans. It is not clear if there should be economies of scale effects on the probability of product withdrawal. While it is presumed that smaller plants proportionately have more complex processes and more numerous products, our current scope variables (RANGE and MIX) may be sufficient to account for these differences. Hence the lack of clear theoretical signs on the scale variables (EMP and LNSALES).

Models 5 and 6

Models 5 and 6 are intended to examine the effect of process complexity, facility modifications, plant size, and other factors on the number of products withdrawn due to HACCP (equation 3). Similar to the other models, Model 5 uses the MIX and EMP variables. Model 6, on the other hand, uses the RANGE and LNSALES variables.

(3) PCUT
= f{RANGE (+) or MIX (+),
BUILD (+), ADDFAC (+),
MODFAC (+), HAEMP (−/?),
NEWEMP (−/?), EMP (?)
or LNSALES (?), AGE10 (+),
H2000 (+/?), CUSTX (+/?),
CUSTIN (?)}

These models were estimated using White's heteroskedastic-consistent covariance matrix to correct the estimates for an unknown form of heteroskedasticity. Similar hypotheses as those discussed for Models 3 and 4 are applied in these models.

Results and Discussion

The parameter estimates and standard errors of Models 1 and 2 are exhibited in Table 2. The R-squared values of these models are 0.253 and 0.287, respectively. These values are rea-

Table 2. Regression Results—Costs of Implementation

Variable	*Model 1* Coefficient (Standard Error)	*Model 2* Coefficient (Standard Error)
Constant	0.812	−2.456
	(2.133)	(5.440)
MIX	−0.248	—
	(0.251)	
RANGE	—	0.248*
		(0.121)
BUILD	6.136*	6.065*
	(2.263)	(2.562)
ADDFAC	−1.746*	−0.791
	(0.880)	(0.964)
MODFAC	0.998	1.176
	(1.094)	(1.095)
HAEMP	0.394	0.430
	(0.354)	(0.330)
NEWEMP	0.968	0.777
	(0.879)	(0.852)
EMP	0.024	—
	(0.021)	
LNSALES	—	0.135
		(0.307)
AGE10	0.094	−0.0002
	(1.065)	(1.080)
H2000	3.148*	2.873*
	(0.979)	(1.194)
CUSTX	4.686*	3.929*
	(1.909)	(1.983)
CUSTIN	−0.306	0.144
	(0.977)	(0.970)
N = 64	R^2 = 0.253	R^2 = 0.287

* Denotes statistical significance at the 0.05 level.

sonable considering that the data used in the analysis are cross-sectional. Results are similar regardless of whether the "MIX and EMP" or "RANGE and LNSALES" variables were used in the model with the exception of RANGE being statistically significant (and positive as predicted) in Model 2. This may provide some evidence (though weak) of the existence of diseconomies of scope—the more classes of product the firm prepares, the higher are its compliance costs (about 0.25 cents per pound). Based on the other statistically significant estimates, results indicate, as suggested, that those firms that will be building a new facility due to HACCP have higher costs of implementation (1.75 cents per pound) than those firms that do not have plans to build a new facility. For these plants, the coefficient indicates that per-pound compliance costs are \$0.06, larger than the overall USDA estimates which did not include such plant modification costs. Firms that stated they would expand their current facility showed a statistically significant and negative impact on compliance costs that differs from our hypothesized sign. This may be due to the relative cost of adding versus building plant capacity. Interestingly, firms in which HACCP requirements begin in January 2000 (the very small firms) and those plants choosing to become custom exempt have higher HACCP implementation costs (range from 2.8 to 4.7 cents per pound) than those firms that had already implemented HACCP. However, after controlling for this difference, there is no evidence of further economies of scale as demonstrated by the lack of statistical significance for the measures of plant size (EMP or LNSALES).

The parameter estimates and standard errors for Models 3 and 4 are presented in Table 3. The McFadden R-squared values of these models are about 0.414. The prediction success tables are exhibited in Table 4, with percentage of right predictions of 85.9 percent for Model 3 and 84.5 percent for Model 4. The empirical estimates in both models are similar. The results indicate that firms that are expanding their current facility due to HACCP are more likely to discontinue some products due to HACCP.[5] Similarly, firms that will hire new staff due to HACCP are more likely to discontinue some products due to HACCP. This sign is the reverse of that hypothesized. Taken with the finding related to the expansion of the plant, this may provide evidence of some form of consolidation through expansion of more profitable product lines. Interestingly, the very small plants are less likely to discontinue products than small firms, as reflected in the statistically significant negative coefficients of

[5] The average number of products offered by those who indicated that they will discontinue some products due to HACCP is 3.36 which is lower than the average 3.5 products of the whole sample used.

Table 3. Regression Results—Probability of Product Withdrawal

Variable	*Model 3* Coefficient (Asymptotic Standard Error)	*Model 4* Coefficient (Asymptotic Standard Error)
Constant	−0.172	0.094
	(1.323)	(3.237)
MIX	0.070	—
	(0.170)	
RANGE	—	0.028
		(0.064)
BUILD	6.347	6.386
	(171.57)	(170.60)
ADDFAC	1.835*	1.870*
	(0.878)	(0.940)
MODFAC	0.694	0.680
	(0.485)	(0.480)
HAEMP	−0.410	−0.382
	(0.252)	(0.233)
NEWEMP	1.323*	1.331*
	(0.479)	(0.475)
EMP	−0.003	—
	(0.017)	
LNSALES	—	0.002
		(0.208)
AGE10	−0.147	−0.214
	(0.574)	(0.575)
H2000	−1.616*	−1.737*
	(0.823)	(0.807)
CUSTX	−0.341	−0.404
	(1.221)	(1.228)
CUSTIN	0.100	0.119
	(0.598)	(0.604)
N = 71	McFadden R^2 = 0.413	McFadden R^2 = 0.414
	percent right predictions = 85.9	percent right predictions = 84.5

* Denotes statistical significance at 0.05 level.

H2000 variable. This result is contrary to our prior expectations that very small plants would incur higher levels of partial exit. It may be explained by the forecast (*ex ante*) nature of the data for the very small plants. The very small plants in our sample may have underestimated their need to withdraw products. This issue merits further follow-up studies.

Estimates from Models 5 and 6 are exhibited in Table 5. The dependent variables in these models represent the number of products discontinued due to HACCP. Again the different models provide comparable estimates. One of the measures of process complexity (MIX) provides some evidence that there may be small diseconomies of scope. Results indicate that 0.335 of a product will be discontinued on average per one unit increase in the number of items within a firm's sales mix, *ceteris paribus*. Both models highlight that firms that are building a new facility or expanding their current facility expect to discontinue more products (range from 1.03 to 2.52 products) than others, perhaps indicative of further plant rationalization.

It is interesting to note that our measures of plant size or scale (EMP or LNSALES) are not statistically significant in the models. As stated above this may, in part, be due to the nature and timing of the survey, with forecast

Table 4. Prediction Success Tables for Probability of Product Withdrawal Models (Models 3 and 4)

		Actual	
		0	1
Model 3			
Predicted	0	49	7
	1	3	12
Model 4			
Predicted	0	48	7
	1	4	12

(very small plants) coefficients being less reliable than those based on actual observations (small plants). An alternative explanation is that the presence of the dummy variables for very small (H2000) and custom exempt (CUSTX) plants accounts for any "gross" economies of scale, with the plant size variables being able to explain little further variability in the dependent variables.

Concluding Remarks

HACCP has been referred to as the "mega-reg" of all regulations affecting the food industry, particularly meat processing firms. An important and valid concern that needs to be evaluated is the effect of HACCP implementation on firms' costs and product exit, especially for the small and very small firms. This paper adds to the assessment of the *ex post* and *ex ante* HACCP compliance costs for small and very small plants, respectively. This paper also examines the issue of product exit (reduction in the range of products offered) that has not been considered to date. On the implementation cost issue, results generally indicate that the addition of a new facility due to the regulation, whether the plant selects a custom exempt status, and the date of implementation of the HACCP regulation are significantly related to HACCP implementation costs. Results also suggest that even after controlling for scale, very small plants still incur higher compliance costs than small plants. Concerning the product exit issue, results generally indicate that the addition of facility and staff due to HACCP and the required starting date of implementation affect product exit. However, the results do not supply evidence that very small plants have higher levels of product exit than small firms. The number of product withdrawals is shown to relate to the building or expansion of facility due to HACCP and the number of items within the sales mix. This paper, therefore, presents some evidence of economies of scale and diseconomies of scope in implementing HACCP in smaller meat processing firms. These findings will allow new small firms to anticipate changes that will be occur due to HACCP implementation, enhance strategic planning for ex-

Table 5. Regression Results—Number of Products Withdrawn

Variable	*Model 5* Coefficient (Standard Error)	*Model 6* Coefficient (Standard Error)
Constant	0.025	−1.947
	(1.591)	(3.850)
MIX	0.335*	—
	(0.176)	
RANGE	—	0.103
		(0.098)
BUILD	2.296*	2.523*
	(1.016)	(1.159)
ADDFAC	1.326*	1.032*
	(0.473)	(0.417)
MODFAC	1.044	0.853
	(0.825)	(0.809)
HAEMP	−0.435	−0.367
	(0.241)	(0.221)
NEWEMP	0.994	1.024
	(0.711)	(0.690)
EMP	−0.002	—
	(0.013)	
LNSALES	—	0.195
		(0.216)
AGE10	0.474	0.304
	(0.422)	(0.405)
H2000	−1.039	−0.852
	(0.737)	(0.775)
CUSTX	0.442	0.910
	(1.731)	(2.030)
CUSTIN	0.346	0.194
	(0.589)	(0.589)
N = 71	$R^2 = 0.184$	$R^2 = 0.178$

* Denotes statistical significance at 0.05 level.

isting firms, and help the government to anticipate future market or industry issues/changes due to HACCP and other similar regulations.

Although this paper helps improve understanding of the impact of HACCP on costs and product exit, the results are subject to the limitations of the data used. For instance, the data for the very small plants and those choosing to become custom exempt are based on firm projections since the survey was conducted in the spring of 1999 which is prior to the full implementation of HACCP plans for such processors (*ex ante*). In addition, due to the smallness of the sample and the limited area of the survey (just one state), care must be taken when generalizing results of this study to regional or national levels since state-specific results may not contribute to broad regional or national inferences. Clearly, more research is needed to fully understand the impact of HACCP on small firms. For instance, it would be interesting to re-survey the very small firms analyzed in the present study *ex post* and compare their realized costs, changes to facilities, employment, and product lines. In a similar vein, it would also be beneficial to have *ex ante* information from the small plants examined in this study. Similar research that would have both *ex ante* and *ex post* information should also be conducted in other states so that findings could be compared and the robustness of the findings can be tested or confirmed.

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