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Analyzing Factors Influencing Secondary Agricultural Education Teachers' Skill Level in Welding

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ABSTRACT

The effects of secondary agricultural education teachers' demographic characteristics on their propensity to become more skilled in welding were examined by estimating an ordered logit model for teachers in Northeast Texas. The sample of teachers was derived from the Agricultural Mechanic Competency Development survey for 2015. According to the estimation results, relative to female, being male was positively associated with being more skilled in welding. Compared to having a Master's degree, having only a Bachelor's degree was negatively associated with being more skilled in welding. Having five or less years of teaching positively affected becoming more skilled in welding compared to having 16 or more years of teaching. Also, relative to having taken no agricultural mechanic courses in college, having taken three or four, and five or more agricultural mechanic courses in college were positively related to becoming more skilled in welding.

KEYWORDS: agricultural mechanical competency; welding; ordered logit model

INTRODUCTION

The objective of the present analysis is to empirically determine the demographic factors impacting in-service secondary agricultural education teachers' skill level in welding in Northeast Texas. To that end, an ordered logit model was estimated employing data compiled within the framework of the Agricultural Mechanic Competency Development survey for 2015. The choice of the welding competency as the focus of this study is explained by its importance (LaVergne and Williams 2016) and the frequency with which welding classes are taught in agricultural education programs across the country (Blackburn et al. 2015; Leiby et al. 2013; Shultz et al. 2014).

The potential beneficiaries of the findings of this study include all of those interested parties that aim to promote the competency of welding among agricultural education teachers. In particular, the empirical results emerging from this study will enable the interested parties to target specific demographic groups among agricultural education teachers when developing and designing different programs directed at the improvement of welding classes in the country.

MATERIALS AND METHODS

Methodology. Secondary agricultural education teachers' skill level in welding may be

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impacted by their demographic characteristics. An ordered logit model was used to empirically investigate the effects of teachers' demographic characteristics on their skill level in welding in Northeast Texas.

The probability of observing response category *i* corresponds to the probability that the estimated linear function, plus stochastic error u_j, is within the range of the cut points estimated for that response. Mathematically, we have:

$$Pr(\text{response category for the } j^{th} \text{ outcome} = i) = \Pr(k_{i-1} < \alpha_1 X_{1j} + \alpha_2 X_{2j} + \ldots + \alpha_k X_{kj} + u_j \leq k_i), \quad (1)$$

where *Pr* denotes probability, $k_{i-1} \ldots k_i$ are the cut points to be estimated along with α_1, $\alpha_2, \ldots \alpha_k$ parameters, *i* is the number of possible response categories of the dependent variable (skill level in welding). The possible responses for the dependent variable are: 1 = "No skills," 2 = "Minimal skills," 3 = "Basic skills," and 4 = "Advanced skills." In the present study, the four ordinal categories of the dependent variable reflect an underlying measure of the teacher's propensity to become more skilled in welding (i.e., the latent variable concept). The demographic independent variables ($X_{1j}, X_{2j}, \ldots, X_{kj}$) entering the model are:

male is a dummy variable taking on one if the respondent was a male and zero otherwise (the base category is female);

age_20_35 is a dummy variable taking on one if the respondent was between 20 and 35 years of age and zero otherwise (the base category is age 51 years and above);

age_36_50 is a dummy variable taking on one if the respondent was between 36 and 50 years of age and zero otherwise (the base category is age 51 years and above);

bachelors_educ is a dummy variable taking on one if the respondent had a Bachelor's degree and zero otherwise (the base category is having a Master's degree);

Texas_ffa_area_teach_5 is a dummy variable taking on one if the respondent had taught in Texas FFA Area 5 and zero otherwise (the base category is Texas FFA area eight);

Texas_ffa_area_teach_6 is a dummy variable taking on one if the respondent had taught in Texas FFA Area 6 and zero otherwise (the base category is Texas FFA area eight);

years_teach_5_or_less is a dummy variable taking on one if the respondent had been teaching for five years or less and zero otherwise (the base category is 16 or more years of teaching);

years_teach_6_15 is a dummy variable taking on one if the respondent had been teaching for more than six and less than 15 years and zero otherwise (the base category is 16 or more years of teaching);

school_dist_rural is a dummy variable taking on one if the respondent's school district would be best described as rural and zero otherwise (the base category is suburban or urban school district);

agmech_course_highsch_1_2 is a dummy variable taking on one if the respondent had taken one or two agricultural mechanic courses in high school and zero otherwise (the base category is no agricultural mechanic courses taken in high school);

agmech_course_highsch_3_4 is a dummy variable taking on one if the respondent had taken three or four agricultural mechanic courses in high school and zero otherwise (the base category is no agricultural mechanic courses taken in high school);

agmech_course_highsch_5_more is a dummy variable taking on one if the respondent had taken five or more agricultural mechanic courses in high school and zero otherwise (the base category is no agricultural mechanic courses taken in high school);

agmech_course_college_1_2 is a dummy variable taking on one if the respondent had taken one or two agricultural mechanic courses in college and zero otherwise (the base category is no agricultural mechanic courses taken in college); *agmech_course_college_3_4* is a dummy variable taking on one if the respondent had taken three or four agricultural mechanic courses in college and zero otherwise (the base category is no agricultural mechanic courses taken in college); *agmech_course_college_5_more* is a dummy variable taking on one if the respondent had taken five or more agricultural mechanic courses in college and zero otherwise (the base category is no agricultural mechanic courses taken in college); *agmech_projectshow_1_2* is a dummy variable taking on one if the respondent had participated in one or two agricultural mechanic projects shows on a yearly basis and zero otherwise (the base category is no participation in agricultural mechanic projects shows on a yearly basis); *agmech_projectshow_3_more* is a dummy variable taking on one if the respondent had participated in three or more agricultural mechanic projects shows on a yearly basis and zero otherwise (the base category is no participation in agricultural mechanic projects shows on a yearly basis); and *agmech_cde_part_1_more* is a dummy variable taking on one if the respondent had participated in one or more agricultural mechanic Career Development Events on a yearly basis and zero otherwise (the base category is no participation in agricultural mechanic Career Development Events on a yearly basis).

The model parameters and the cut points were estimated using the maximum likelihood method. The interpretation of the ordered logit coefficients is conducted using percent change in odds ratios. Odd ratios were calculated by exponentiating the ordered logit coefficients (i.e., $e^{\alpha i}$) and the percent change in the odds ratios were calculated as ($e^{\alpha i}$-1)*100.

Age, highest level of education completed, years of teaching, the description of school district as rural, number of agricultural mechanic courses taken in high school or college, and participation in agricultural mechanic project shows or Career Development Events were anticipated to be positively related with the teachers' propensity to become more skilled in welding. No prior expectations were formed regarding the influence of gender and teaching in a specific Texas FFA area on the propensity to become more skilled in welding.

Data. Cross-sectional data on a set of demographic variables employed in this study were collected within the scope of the Agricultural Mechanic Competency Development survey for 2015 that was conducted in an attempt to analyze high school agricultural education teachers' agricultural mechanical competency development starting from high school through their college completion. The final sample size of 95 observations included information on in-service agricultural education teachers in Northeast Texas from areas Five, Six, and Eight as identified by the Texas FFA Organization during the 2015-2016 school year (N = 700). A random sample of 150 teachers was identified using a sampling formula suggested by Bartlett et al. (2001), questions borrowed from a questionnaire developed by Rice et al. (2011), and survey implementation and data collection methods by Dillman et al. (2009). There were no statistically significant differences when comparing early respondents with late respondents in explaining the non-response error. The final sample used in the model estimation reflected a response rate of 63%, resulting in a total number of observations of 95.

The dependent variable concerning teachers' skill level in welding was estimated as a function of demographical variables pertaining to gender, age, highest level of education completed, Texas FFA area, years of teaching, school district description, number of agricultural mechanic courses taken in high school and college, and participation in agricultural mechanic projects shows and Career Development Events. In particular, the dependent variable (i.e., skill level in welding) was developed based on the answers to the question inquiring about the respondent's skill level dealing with welding at the completion of their college career. The set of independent variables was comprised of respondents' demographic characteristics including gender, age, highest level of education completed, years of teaching, school district description, number of agricultural mechanic courses taken in high school and college, and participation in agricultural mechanic projects shows and Career Development events for Texas FFA Areas Five, Six, and Eight (see Figure 1 for Texas FFA Areas). To operationalize these demographic characteristics, they were incorporated as dummy variables in the final estimation of the model.

Table 1 shows the percentages of the respondents for each variable used in this analysis. The results in Table 1 indicate that slightly more than half of respondents (51%) had advanced skills in welding. Slightly more than three-quarters of respondents (76%) were male teachers. Less than half of respondents' (46%) reported age was between 20 and 35 years. Less than two-third of respondents (64%) had a Bachelor's degree. More than half of respondents (52%) were from Texas FFA Area Five. More than one-third of respondents (35%) reported having 16 or more years of teaching experience. Slightly less than two-thirds of respondents (65%) were from a rural school district. Forty-one percent of respondents reported having taken one or two agricultural mechanic courses in high school, while 42% of respondents reported having taken three or four agricultural mechanic courses in college. Thirty-six percent of respondents reported having participated in one or two agricultural mechanic projects shows per year, while 60% of respondents had not taken part in agricultural mechanic Career Development Events on a yearly basis.

Figure 1. Texas FFA areas.

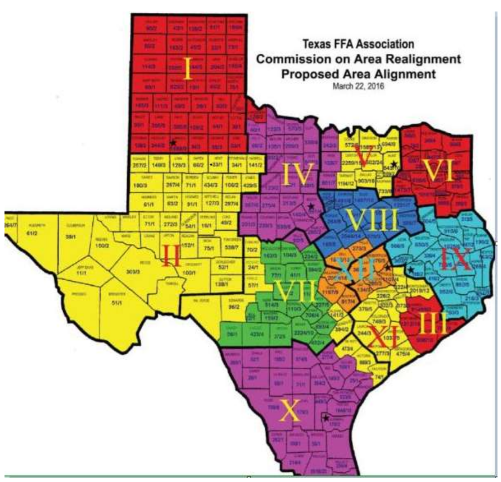

Table 1. Percentages of in-service agricultural education teachers by demographical variables in Northeast Texas, n = 95.

Variable	**%**
Skill level in welding	
No skills	2
Minimal skills	8
Basic skills	39
Advanced skills	51
Gender	
Male	76
Female	24
Age	
20_35	46
36_50	35
51_above	19
Education	
Bachelor’s	64
Master's	36
Texas FFA area	
Area_5	52
Area_6	29
Area_8	19
Years of teaching	
5 or less	34
6_15	31
16 or above	35
School district description	
Rural	65
Suburban or urban	35
Number of ag. mech. courses taken in high school	
None	13
1 or 2	41
3 or 4	34
5 or more	12
Number of ag. mech. courses taken in college	
None	13
1 or 2	27
3 or 4	42
5 or more	18
Ag. mech. projects shows participation per year	
None	33
1 or 2	36
3 or more	31
Ag. mech. Career Development Events	
None	60
1 or more	40

[1] Authors’ own calculations.

In summary, drawing a profile of a typical in-service agricultural education teacher from Northeast Texas would reveal a male respondent between 20 and 35 years of age with advanced skills in welding and a Bachelor's degree teaching in Area 5. As well, this typical teacher had 16 or more years of teaching experience in a rural school district, and had taken between one to two agricultural mechanic courses in high school and three to four agricultural mechanic courses in college. Finally, this typical teacher participated in one to two agricultural mechanic projects shows per year and had no prior experience partaking in agricultural mechanic Career Development Events competitions on a yearly basis.

RESULTS

Ordered Logit Model. The estimated percent change in odds ratios from the ordered logit model are shown in Table 2. The significance level chosen for this analysis is 5%, and the interpretation of the estimation results is conducted in terms of only statistically significant percent change in odds ratios. Recall that in the present analysis, the concept of a latent variable was adopted where the latent variable can be thought of as the secondary agricultural education teachers' propensity to become more skilled in welding. The p-value of the likelihood ratio $\chi 2$ statistic of 0.0003 implies that all the parameter estimates are jointly statistically significant. The estimated pseudo R^2 statistic is 0.2421.

Male teachers had odds of becoming more skilled in welding that were 1,889.2% greater, compared to female teachers, everything else held constant. As expected, compared with teachers that had a Master's degree, teachers with a Bachelor's degree had odds of becoming more skilled in welding that were 78.9% lower, everything else held constant. The odds of becoming more skilled in welding were 910.9% greater for teachers with five or less years of teaching, compared to teachers with 16 or more years of teaching, everything else held constant. Consistent with our expectation, the odds of becoming more skilled in welding increased by 467.5% and 1,572.9% for teachers who had taken three or four, and five or more agricultural mechanic courses in college, respectively, compared to teachers with no agricultural mechanic courses taken in college, everything else held constant. The effects of the rest of the variables on the propensity to become more skilled in welding were not statistically significant at the 5% level.

Table 2. Percentage change in the odds ratios from the ordered logit model for welding, *n* = 95.

Variables	% change in the odds ratios
Gender (base: Female)	
Male	1,889.2*
Age (base: 51 and above)	
20-35	17.0
36-50	209.2
Education (base: Master's)	
Bachelor's	-78.9*
Texas FFA area (base: Area_8)	
Area 5	-9.7
Area 6	-55.6
Years of teaching (base: 16 or more)	
5 or less	910.9*
6_15	216.0
School district description (base: Suburban or urban)	
Rural	-23.5
Number of ag. mech. courses taken in high school (base: none)	
1 or 2	91.1
3 or 4	203.6
5 or more	-45.3
Number of ag. mech. courses taken in college (base: none)	
1 or 2	183.5
3 or 4	467.5*
5 or more	1,572.9*
Ag. mech. projects shows participation per year (base: none)	
1 or 2	21.7
3 or more	61.3
Ag. mech. Career Development Events (base: none)	
1 or more	-38.0

1 Authors' own calculations.
2 Likelihood ratio $\chi 2$ was 46.08 with the p-value of 0.0003, and pseudo R^2 was 0.2421.
3 Asterisk indicates statistical significance at the 5% significance level ($p < .05$).

CONCLUSION AND DISCUSSION

Using data from the Agricultural Mechanic Competency Development survey for 2015, an ordered logit model was estimated for teachers in Northeast Texas to empirically examine the influence of secondary agricultural education teachers' demographic characteristics on their propensity to become more skilled in welding. The estimation results revealed that a set of demographic characteristics were important factors impacting secondary agricultural education teachers' propensity to become more skilled in welding.

According to the estimation results, gender was found to be statistically significantly affecting teachers' propensity to become more skilled in welding. In particular, relative to female, being male was positively associated with being more skilled in welding.

Education emerged as a statistically significant determinant of teachers' propensity to become more skilled in welding. Compared to having a Master's degree, having only a Bachelor's degree was negatively associated with being more skilled in welding. Per estimation results, having five or less years of teaching positively affected becoming more skilled in welding, compared to having 16 or more years of teaching. Taking agricultural mechanical courses in college was also found to be a statistically significant determinant of teachers' propensity to become more skilled in welding. In particular, relative to having taken no agricultural mechanic courses in college, having taken three or four, and five or more agricultural mechanic courses in college were positively related to becoming more skilled in welding.

A couple of recommendations for future research need to be mentioned. First, it needs to be noted that the empirical findings emerging from this analysis must be interpreted with caution due to the fact that the present study did not incorporate information on non-participant teachers. Future research should focus on including this information in an attempt to produce more generalizable results. Second, future research would benefit by replicating this study for other agricultural mechanical competencies (agricultural buildings and structure, concrete and masonry, hydraulics).

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