"The Effect of Gender on Productivity Status in U.S. Agriculture"

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The effect of gender on productivity status in U.S. agriculture

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The role of gender in agriculture has gained considerable attention among policymakers and researchers. According to the 2013 Agricultural Resource Management Survey (ARMS) women served as the principal operator on almost 11 percent of U.S. farms and as a second or third operator on more than 40 percent of farms. Comparatively, the 2012 Agricultural Census indicates the share of farms and ranches operated by women has grown to 14 percent. Given the importance of women operators in productive agriculture the objective of this report will be to assess the impact of gender on net farm income, total farm output, farming efficiency, production costs, and total household income in the United States. We apply the average treatment approach (ATE) to analyze the impact of operator gender on the income and performance of U.S. farms.

Profile of Farms with Female Principal Operators

Female farm operators make up 10.8 percent of farms and 2.3 percent of the value of production according to the 2013 Agricultural Resource Management Survey (ARMS), table1. The majority of farms with either male or female principal operators have only one operator. Fewer female principal operators reported being married (ARMS data show they are older as well) than their male counterparts while the percentage of female principal operators above age 65 and the percentage that reported having college education were higher. Few women operated commercial farm operations and those that did were comparatively smaller commercial operations that male operated counterparts. Farms with female principal operators accounted for roughly $9.3 billion in value of agricultural production in 2013 and an average of $5300 per farm of net farm income.

Methodology

Average treatment effect and matching estimators

Rosenbaum and Rubin (1983) proposed propensity score matching as a method to reduce the bias in estimating treatment effects with observational datasets. These average treatment effects methodologies have become increasingly popular in the evaluation of economic policy interventions (Becker et al., 2002).

Since in observational studies assignment of subjects to the treatment and control groups is not random, the estimation of the effect of treatment may be biased by the existence of confounding factors. Propensity score matching is a way to “correct” the estimation of treatment effects controlling for the existence of these confounding factors based on the idea that the bias is reduced when the comparison of outcomes is performed using treated and control subjects who are as similar as possible. Since matching subjects on an n-dimensional vector of characteristics is typically infeasible for large n, this method proposes to summarize pre-treatment characteristics of each subject into a single-index variable (the propensity score) that makes the matching feasible.

The degree that bias is reduced depends on the richness of the matching performed. In other words the bias generated is eliminated if exposure to treatment can be considered to be random among individuals who have the same value of propensity score. Scores are defined by Rosenbaum and Rubin (1983) as the conditional probability of receiving a treatment given pretreatment characteristic.

Matching estimator

An estimate of the propensity score is not enough to estimate the ATT of interest. The reason is that the probability of observing two units with exactly the same value of the propensity score is in principle zero, since p(X) is a continuous variable. Various methods have been proposed in the literature to overcome this problem, and one of the most widely used is Nearest-Neighbor Matching.

We apply the average treatment approach (ATE) to Agricultural Resource Management Data (ARMS) to analyze the impact of operator gender on the income and performance of U.S. farms (Uematsu and Mishra, 2012 or Tauer, 2009). In this study we use the nearest neighbor matching estimator following the paper by Abadie and Imbens (2011).

Summary statistics are shown in table 2 using the mean characteristics of the unmatched and matched sets of farms used in the model. Performance is mixed with no significant difference between most covariates.

Findings

- Net farm income, total household income, and value of production are all lower for female operators than for male operators. The difference suggests that female principal operators seem to be smaller operations that rely less on farm income for household support.
- Female operators have lower total expenses than male operators. Lower expenses are largely driven by lower variable costs rather than fixed costs. Here again, this finding is largely driven by the type and size of female operated farms.
- Farming efficiency (defined as the ratio of cash income to variable cost of production) was measured for female versus male operated farms and found to be a positive ratio but not statistically significant.
- Farms with female principal operators appear to have productive advantages as suggested by higher average efficiency ratios in some cases. ARMS data shows that small crop farms (rural residence typology) operated by female principal operators have farming efficiency ratios of 3.14 compared to 1.40 for male principal operators. The high ratios seem to be driven by a notable group of female operated farms that produce mostly native hay for custom cash sale and are able to keep variable costs low, resulting in a higher farming efficiency ratio (figure 1).
- For this analysis, we based the treatment effect on women principal operators. In some cases, multiple farm operators existed, either a spouse or other operators. Further work will focus upon female owned and operated farms versus female operated farms with multiple operators.

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Table 1. Characteristics of farm operations by principal operator gender, 2013.

Item	Male principal operators	Female principal operators	All
Farm and Operator Characteristics		*number*	
Number of farms	1,868,925	226,543	2,095,468
Average acres operated	453	231	429
		percent of farms	
Principal Operator conditions:			
Farm had 2 or more operators	38.5	40.7	38.7
Operator married	84.4	50.7	80.8
Education past high school	52.4	64.1	53.7
Owns all acreage operated	62.7	81.2	64.7
65 years or older	32.7	42.3	33.7
Commercial farms	15.1	4.4	14.0
Off-farm income	94.6	96.3	94.8
Retired	12.1	20.6	13.1
Livestock farm	53.3	58.2	53.8
Costs of Production		*$thou*	
Variable Costs	207,228,116	6,822,782	214,050,898
Fixed Costs	48,895,572	1,836,600	50,732,172
Income Indicators			
Total net farm income	96,746,248	1,192,434	97,938,683
Total household income	229,909,982	17,274,992	247,184,975
Production			
Total value of production	401,230,342	9,270,856	410,501,198
Efficiency		*ratio*	
Farm efficiency ratio (GCFI/Variable costs)	1.40	1.66	1.43

Source: 2013 USDA Agricultural Resource Management Survey.

Table 2. Mean characteristics of farms of the propensity score unmatched and matched samples

Variable	sample*	males mean	males std. dev.	females mean	females std. dev.
Operator age	U	58.5	11.96	62.88	13.23
	M	57.08	12.65	60.03	13.14
Land owned/rented (share)	U	0.94	2.84	0.51	3.42
	M	0.91	3.85	0.53	1.36
Works off-farm (share)	U	0.89	0.32	0.93	0.26
	M	0.88	0.32	0.92	0.26
Crop farms (share)	U	0.59	0.49	0.49	0.5
	M	0.59	0.49	0.49	0.5
Operator retired (share)	U	0.08	0.28	0.18	0.39
	M	0.08	0.26	0.18	0.39
Married (share)	U	0.85	0.36	0.53	0.5
	M	0.85	0.36	0.51	0.5

Table 3. Estimates of the average treatment effect for the treated (ATT)

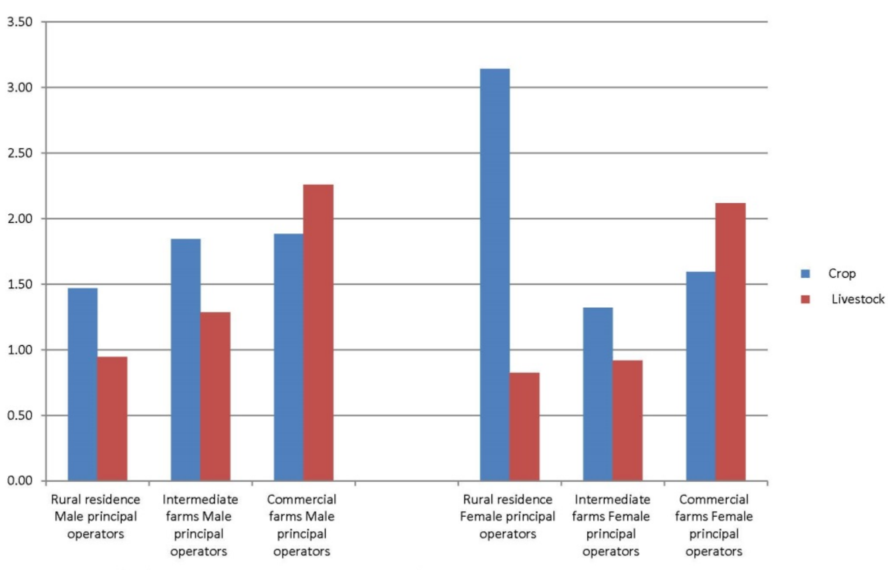
Variable	ATT	Standard error	T-value
Income Variables			
Net farm income ($000)	-49.2	19.5	-2.52**
Total household income ($000)[2]	-26.8	14.5	-1.85*
Production			
Value of production ($000)	-312	54.4	-5.73***
Expense variables			
Total expenses ($000)	-235	45.6	-5.16***
Total fixed cost ($000)	-21.9	4.9	-4.45***
Total variable cost ($000)	-190.0	43.4	-4.38***
Efficiency ratio			
Farming efficiency (farm cash income/total variable cost)	1.66	1.23	1.36

1/ Values show how female principal operators differ from male principal operators, (the treatment effect; being a female

2/ Total household income includes income to the household of the principal operator. It includes farm business income,

*, **, *** indicates statistical significance at the 10% level, 5% level, and 1% level

Figure 1. Female principal operators of rural residence crop farms have highest efficiency ratios.



Source: USDA Agricultural Resource Management Survey, 2013, Version 1 only