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SCIENTIFIC INFORMATION

Do farmers' old age pension programs affect farm production? Empirical evidence of dairy farms in Taiwan

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Abstract: Although a considerable body of literature has examined the determinants of farm production, little is known about the role of the farmers' pension program. This study contributes to this knowledge gap by assessing the impact of the farmers' pension payments on farm production and the labour allocation using the Old Age Farmers' Pension program in Taiwan as a case study. In particular, this study quantified the effect of pension payments on the labour allocation of the farm operator and other family members, hired labourers, as well as on the farm production. A unique sample of 465 dairy farms was drawn from the Agricultural Census survey in Taiwan in 2010. The data set was compiled using the national administrative profile of the pension program in Taiwan in order to access an objective pension status for all recipients of the payments. By estimating an endogenous treatment effect model, it was found that the pension payments decreased the amount of the on-farm work of the farm operator. In contrast, it increased the on-farm labour use of the family members. Moreover, the availability of the pension program decreased the size of farm operation and the farm productivity.

Key words: farm production, labour allocation, Older Farmers' Pension Program

Economic theory predicts that the non-labour income, including endowments, pensions and government transfers, alters the labour allocation decisions of individuals. The previous evidence has shown that the non-labour income decreased the on-farm labour supply among Canadian farmers. Further, this reduction in the on-farm labour led to a reduction in scale of the farm production (e.g. Lopez 1984). Similar empirical findings have been reported among the U.S. farm households (Dewbre and Mishra 2007; El-Osta et al. 2008). However, the contrary anecdotal evidence shows that the farmers may choose to work as long as they can and that age is not an issue. The previous evidence further points out that as the farmers are aging, they become less efficient in the production of agriculture (Tauer and Mishra 2006; Chang and Mishra 2010). In some countries, the policymakers have designed policies to: (1) encourage farmers to retire through providing financial assistance, or retirement programs, for old-age farmers; and (2) re-structure agriculture through retirement. One example of this is found in Taiwan, where in 1995 the government enacted the Old Age Farmers' Pension (OFP – Regulation 1995).

The Old Age Farmer's Pension (OFP) program[1], a unique social welfare system for farmers in Taiwan, provides financial assistance in the form of a monthly pension for dairy farmers aged 65 years or older,

[1]Farmers, as self-employed, had no access to public pension schemes in Taiwan until the Council of Agriculture enacted the Regulation on the Old Age Farmer's Pension (OFP – Regulation) in 1995. However, OFP recipients can receive the pensions without being required to retire from the farm (Wang and Chang 2010).

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regardless of their production. The OFP was implemented in 1995, and was designed to secure the financial well-being of farmers in later life. Under this program, every farmer aged 65 or above can apply for a pension that is equal to NTD $7000 per month (approximately USD $233). The OFP benefit is a pension payment and it also acts as an income transfer to provide the self-employed farmers with the social pension insurance (OFP – Regulation 1995; Wang and Chang 2010). However, not every farmer aged 65 or above is eligible to receive this pension. Multiple regulations have been set to exclude non-farmers from obtaining a farmer's identity. Specifically, an eligible farmer must satisfy the following criteria: (1) he or she must not be engaged in any full-time employment for the off-farm work; (2) must never have received any retirement pension from other social insurance programs, such as the general labour insurance program or the government sponsored employees' retirement pension; and (3) must work on the farm for at least 90 days per year. These constraints are put in place to ensure that the OFP pension primarily serves the full-time farmers (Bureau of Labour Insurance 2012).

How does the availability of the elderly farmers' pension program affect the production of dairy farms? Theoretically, the old age pension program may provide a direct incentive for elderly farmers to retire and pass the family business on to the younger generation. If this is the case, then the OFP program would likely affect the dairy farm production because of the intra-generational succession within the farm households (Tauer and Mishra 2006). On the other hand, the pension program provides a secure income to elderly dairy farmers; crowding out the private income transfers within the family farms (Cox and Jakubson 1995; Jensen 2003). In this case, young farmers may seek the non-agricultural employment for higher wages and the loss of these young farmers may in turn affect the dairy farm production.

Consequently, the impact of the availability of the old farmers' pension on the dairy farm production is unclear and remains an unanswered empirical question. The objective of this study is to investigate the impact of the old age pension payments on the farm production performance and the labour allocation on dairy farms using the OFP program in Taiwan as a case study. Specifically, this study attempts to quantify the effect of the OFP payments on the labour allocation of the farm operator and other family members, hired labourers, as well as on the farm production. A unique sample of 465 dairy farms was drawn from the Agricultural Census survey in Taiwan in 2010. The data set was compiled using the national administrative profile of the OFP program in Taiwan in order to access an objective OFP status for all recipients of the OFP payments. By estimating an endogenous treatment effect model, it is evident that the OFP payments decreased the amount of the on-farm work of the farm operator. On the other hand, it increased the on-farm labour use of family members. Moreover, the availability of the OFP program decreased the size of farm operations and the farm productivity.

MATERIAL AND METHODS

Data

The primary data for dairy farms were drawn from the 2010 Census of Agriculture in Taiwan, conducted by the Directorate-General of Budget, Accounting and Statistics, Executive Yuan, Republic of China, Taiwan (DGBAS 2012). The Census of Agriculture survey has been conducted every 5 years since 1976 and has become the government's most important data source for monitoring the farm production and the farm household situations in Taiwan. Specific aspects of the farm production and family characteristics were collected during face-to-face interviews (DGBAS 2012). In this data, only one principal farm operator was identified for each dairy farm and the information about the socio-demographic characteristics of this principal farm operator was collected. In total, 502 dairy farms were surveyed in the 2010 census. After deleting the observations of farms without any cows, our final sample consisted of 462 dairy farms.

Although the information on the dairy farm operators' socio-demographic and farming characteristics was collected in the census survey, no information on the OFP status of the principle farm operator was recorded. To overcome this drawback, we merged all of the 462 dairy farm operators' names and the unique Social Security identification numbers with the national administrative government profiles, which record all of the OFP recipients in Taiwan in 2010. The national OFP profiles are maintained by the Bureau of Labour Insurance (BLI) of the Council of Labour Affairs in Taiwan. Since only one principle operator is identified for each dairy farm in the census data set, we could only access the OFP status for each principle dairy farm operator from the OFP profile. Therefore, whether the principal farm operator of the dairy farm

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received the OFP payments was identified. It should be noted that the OFP status of each principle farm operator was drawn from the administrative profile and so it is free from any self-report bias.

Measures of the variables

Building on the findings of previous studies on the dairy farm production (e.g. Tauer and Knoblauch 1997; Bijl et al. 2007), several variables reflecting the socio-demographic characteristics of the principle farm operator, the family structure, the farm production, and the regional heterogeneity were specified. Consistent with the information contained in the OFP profile, a dummy variable was identified for whether he/she received the OFP pension in 2010. With respect to the socio-demographic characteristics of the farm operator, the age of the farm operators was defined in years. In addition, we defined a dummy variable to indicate whether the farm operator was 65 years or above in 2010. The specification of this age dummy variable was crucial in our analysis insofar as the farm operator, in order to be eligible to receive the OFP payments, must be 65. Methodologically speaking, this age cut-off is useful for model identification purposes (more discussion on this below). A dummy variable was also defined for the gender of the principal farm operator. The education level of the farm operator was defined by four dummy variables: elementary school or less, finished junior high school, finished senior high school, and college education or higher level. We also defined a dummy variable to indicate whether the farm operator worked off the farm in 2010.

Table 1. Sample statistics

Variable	Definition	Full sample		OFP recipients		OFP non-recipients	
		Mean	S.D	Mean	S.D	Mean	S.D
OFP_OP	If the operator received old farm pension (= 1)	0.20	0.40	1.00	0.00	0.00	0.00
Production	Production value per cow (NTD $10 000)	6.63	4.31	6.60	4.09	6.64	4.37
Cow	Number of cows	174.82	124.50	167.51	98.11	176.60	130.17
Hired labour	Hired labour (person)	1.21	1.71	0.96	1.50	1.27	1.75
On farm days_OP	On-farm days of the operator (days)	189.48	72.93	158.46	88.01	197.03	66.75
On farm days_ others	On-farm days of other family members (days)	314.38	273.45	378.02	324.27	298.89	257.72
Age65_OP	If the operator is aged ≥ 65 (= 1)	0.24	0.43	0.79	0.41	0.10	0.30
Age_OP	Operator age (years)	56.28	11.15	66.32	11.11	53.83	9.71
Primary_OP	If the operator has less than a junior high school education (= 1)	0.33	0.47	0.64	0.48	0.25	0.44
Junior_OP	If the operator finished junior high school (= 1)	0.22	0.42	0.19	0.39	0.23	0.42
Senior_OP	If the operator finished senior high school (= 1)	0.35	0.48	0.16	0.37	0.39	0.49
College_OP	If the operator has a college degree or higher education (= 1)	0.10	0.30	0.01	0.10	0.13	0.33
Male_OP	If the operator is male (= 1)	0.89	0.32	0.87	0.34	0.89	0.31
Off farm work_OP	If the operator worked off the farm (= 1)	0.02	0.12	0.01	0.10	0.02	0.13
Household size	Number of family members (persons)	5.07	2.48	6.08	3.00	4.83	2.27
Land	Farm land area (hectare)	0.85	1.21	0.99	1.18	0.82	1.22
Ownership	Land ownership (0–1)	0.63	0.48	0.75	0.44	0.60	0.49
North	If located in the northern region (= 1)	0.09	0.29	0.13	0.34	0.08	0.27
Center	If located in central region (= 1)	0.41	0.49	0.49	0.50	0.39	0.49
South	If located in southern region (= 1)	0.48	0.50	0.36	0.48	0.51	0.50
East	If located in the eastern region (= 1).	0.02	0.15	0.01	0.10	0.02	0.15
Sample (%)		465 (100%)		91 (20%)		374 (80%)	

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With respect to the family structure and farm production, we defined a continuous variable to measure the number of household members living on the farm. The total amount of land in hectares, and the share of land ownership were also defined. A continuous variable for the total on-farm days of other family members (excluding the farm operator) was included. In addition, the total number of hired labourers was specified. In order to capture the scale of the farm operation, the total number of cows was defined. Moreover, the production value per cow was defined to measure the productivity of the dairy farm. Finally, four dummy variables for different regions were defined to capture the geographical heterogeneity on the farm production. Detailed definitions and sample statistics for the selected variables are defined in Table 1.

Statistical analysis

The primary focus of the empirical analysis is to quantify the effect of the OFP payments on the labour allocation of the farm operator and other family members, and farm production. To assess the causal effects of the OFP payments correctly, an important econometric issue has to be addressed. Since participation in the OFP program is voluntary, the endogeneity issue related to the OFP participation decision by the farmer has to be considered. Without controlling for this issue, a self-selection bias would result in inconsistent estimates.

To control for the self-selection bias related to the OFP payments, we applied the *control function* or the so- called *general residual* method proposed by Vella (1998: 136). This model is estimated on a two-stage framework. In the first stage, the OFP participation decision of the farm operator is specified as a binary probit model. With consistent estimates from the first stage, the general residual (Generalized Inverse Mills Ratios, GIMR) is calculated to account for the potential self-selection bias. In the second stage, this GIMR variable, along with the binary indicator of the farm operator's OFP participation and other explanatory variables are then included in each outcome equation. A detailed discussion of our econometric strategy in each stage is introduced below.

First stage estimation

Following the conventional binary choice framework, receipts of the OFP payments by the farm operator can be regarded as the result of the farmer comparing the benefits and costs of the participation in this program. Following the random utility framework proposed by McFadden (1981), the specification of the probit model describing the farm operator's OFP participation can be shown as:

$$I_i^* = X_i^{'}\beta + \gamma \times Z_i + \varepsilon_i$$

$$I_i = 1 \text{ iff } I_i^* > 0,\ I_i = 0 \text{ iff } I_i^* \leq 0 \quad (1)$$

where I_i^* is the latent variable which represents the propensity of the farm operator to receive the OFP payments. This variable is not observed in the data. Instead, only the binary indicator that specifies whether the farm operator received the payments can be observed (I_i). X_i is a vector of covariates associated with the receipts of the OFP payments, and the variable Z_i is the instrumental variable (more are discussed below). β is the vector of parameters of interest. The error term (ε_i) follows a standard normal distribution with zero mean and unity variance. The consistent estimates of Equation (1) can be obtained by applying a maximum likelihood method to the following log-likelihood function (Greene 2008):

$$\log L = \sum_{i=1}^{n} I_i \times \log\Phi(X_i^{'}\beta) + (1 - I_i) \times \log[1 - \Phi(X_i^{'}\beta)] \quad (2)$$

where Φ(.) is the cumulative density function of the standard normal distribution.

Second stage estimation

The second stage of our analysis examined the extent to which the OFP payments may affect the labour allocation and farm production. The OFP decision can be viewed as a special treatment and we can estimate each outcome equation for the entire sample by incorporating the endogenous treatment effect. By taking into consideration the endogenous treatment effect (Barnow et al. 1996), this model accounts for the fact that unobservable variables might be correlated with both the farm operator's OFP decision and the level of the labour allocation and farm production. To correct for self-selection bias, it is necessary to construct a generalized residual (GIMR) for the OFP receipts in the entire sample. The GIMRs can be derived as follows (Vella 1998):

$$GIMR_i = I_i \times \frac{\varphi(X_i^{'}\beta)}{\Phi(X_i^{'}\beta)} + (1 - I_i) \times \frac{-\varphi(X_i^{'}\beta)}{1 - \Phi(X_i^{'}\beta)} \quad (3)$$

where $GIMR_i$ is the general residual of each recipient and non-recipient of the OFP payments for the farm operator; and ϕ(.) is the probability density function of the standard normal distribution. After correcting

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for the self-selection decisions of the farm operator in terms of the OFP payments, the estimated farm production equation is specified as follows:

$$Y_i = X_i^{'}\alpha + d \times I_i + k \times GIMR_i + e_i \quad (4)$$

where Y_i is the level of outcome variables. Several variables related to the farm production are specified as the outcome variables in the empirical analysis, including *On farm days_OP*, *On farm days_others*, *Hired labour*, *Number of Cows (herd size)*, and *Production* (all of these variables are defined in Table 1). a is the vector of parameters to be estimated, and X_i contains the exogenous variables defined in Equation (1). The estimated parameter d then captures the effects of the farm operator's OFP payments on the farm production variables. The scalar e_t is the random error. Consistent estimates can be obtained by using the Ordinary Least Square method (OLS) on Equation (4). In the empirical analysis, estimates of the parameters were calculated using the bootstrap method with 500 replications.[2]

One issue related to the model identification should also be discussed. Equation (4) can be theoretically identified through the non-linear functional form of the variable GIMR. However, this identification strategy has empirically shown a poor performance. To increase the statistical power, then, it usually requires an exclusion condition. That is, some of the explanatory variables specified in the choice equation (i.e. Equation (1)) have to be excluded from the outcome equation (i.e. Equation (4)). These variables are sometimes called the instrumental variable (i.e. the variable Z_i defined in Equation (1)). In this study, we used the variable *Age65_OP* as the instrument. The idea of this strategy is that one of the critical criteria required to receive the OFP payments is the operator's age. Operators have to be aged ≥ 65 to be eligible to receive the payments. Therefore, this age cut-off has a direct effect on the likelihood of the farm operator to receive the OFP payments. In contrast, the operator age is exogenously determined, so this variable is unlikely to directly affect the farm production. Using the cut-off of the applicant's age as the instrumental variable has been done in many studies in order to evaluate the effect of the program participation.[3]

RESULTS AND DISCUSSION

Sample distribution of selected variables

Sample statistics of the selected variables are presented in Table 1. In addition to the full sample, we also report sample statistics for the selected variables by the OFP status to underscore differences in the farm production, socio-demographic characteristics of the farm operator, the family, and the farm structure between these two groups of respondents. As exhibited in Table 1, 20% of farm operators receive the OFP payments. The farm production performance differs by the OFP status of the farm operator. For instance, dairy farms whose farm operators receive the OFP payments have a lower productivity: the average farm production value per cow for the farms of the OFP recipients and non-recipients are NTD $6600 vs. NTD $6640, respectively. Moreover, farms whose operators received the OFP payments have smaller herd sizes (168 vs. 177), as measured by the number of cows. In terms of labour uses, it appears that the number of hired labourers and the total number of the on-farm days of the farm operators are lower for the farms whose operators receive the OFP payments. In contrast, the total on-farm days for family members other than the farm operator are larger among the dairy farms whose operators receive the OFP payments.

The socio-demographic characteristics and the family and farm structure attributes are also different among the two groups of farms. As expected, the OFP recipients are older and less educated than their non-recipient counterparts. The average age of farm operators receiving the OFP payments was 66, while the average age for non-recipients was 54. Differences in family structure were also found be-

[2]As stated in Maddala (1983), the standard errors of the estimates in the second stage equation have to be corrected. Two different ways have been proposed to derive the correct standard errors. The first way relies on the asymptotic theory to derive asymptotic standard errors, and the second way is to use the empirical bootstrapping method. Since it has been shown that asymptotic standard errors may result in a small sample bias (Efron 1987), we used the bootstrap method to calculate the correct standard errors of the estimates in the second stage analysis.

[3]For example, Maynard and Qiu (2009) examined the effect of the Medicaid program in the United States on household savings across different wealth groups using the instrumental variable method. Since adults who are older than 65 are eligible to participate in the program, the cutoff point at age 65 was used as the valid instrument.

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tween the farms whose operators received the OFP pensions and their non-recipient counterparts. For instance, farms whose operators did not receive the OFP payments have larger families. In addition, the pension recipients also have a higher share of the land ownership (75% vs. 60%). The differences in the socio-demographic characteristics of the dairy operators, the family and farm structure indicates the importance of controlling for the observed differences in these factors in order to assess the effect of the OFP program on farm production.

Determinants of the old age farmer pension program

The estimation results of the OFP equation using the probit model are presented in Table 2. In addition to the estimated coefficients, the marginal effects that measure the magnitude of the changes in the explanatory variables on the probability of receiving the OFP payments are also reported. As expected, the socio-demographic characteristics of the farm operator, the family and farm factors are significantly associated with the likelihood of the farm operator to receive the pension. The importance of human capital of the farm operator, such as the age and the educational attainment, was found to significantly affect the likelihood of the farm operators receiving the OFP payments. Since one of the critical eligibility criterion in receiving the OFP payments is the age of the operator (age 65 or older), it is not surprising to see that the farm operators older than 65 have a higher probability (76%) of receiving the OFP payments compared to their non-recipient counterparts. The education level of the farm operator also plays an important role in terms of receiving the OFP payments. Compared to the operators who have college degrees or a higher education (the reference group), those who have the primary education, have finished the junior high school, or have finished the senior high school have a higher probability of receiving the pension by 13.8%, 11.3%, and 11.6%, respectively. The negative association between the operator education and the pension receipt may reflect the fact that educated operators have a higher chance to engage in the off-farm labour market, which is in accordance with the predictions of the human capital theory.

Table 2. Estimation of the OFP equation

	Coefficient	S.E	Mar. Effect
Age_OP	−0.036	0.044	−0.006
Age65_OP	2.727***	0.346	0.765
Primary_OP	0.669*	0.513	0.138
Junior_OP	0.528***	0.212	0.113
Senior_OP	0.577***	0.183	0.116
Male_OP	−0.180	0.285	−0.035
Off farm work_OP	0.087	0.645	0.016
Household size	0.056**	0.035	0.010
Land	−0.046	0.094	−0.008
Ownership	0.149*	0.110	0.027
Center	−0.458**	0.279	−0.078
South	−0.918***	0.291	−0.163
East	−0.299	0.616	−0.044
Constant	0.002	0.870	–
Log-likelihood		−132.578	
LR test#		74.12 (*p-value* < 0.001)	

***, **, * indicates the significance at the 1%, 5% and 10% level; # H^0: the coefficient of the variable Age65_OP = 0

The farm and family structure attributes also affect the likelihood of the farm operators receiving the OFP payments. Our results show that the farm operators who have a higher land ownership are more likely to receive the pension. The family structure is also important in terms of the receipt of the OFP payments. Our results show that an additional family member decreases the likelihood of receiving the OFP payments by approximately 1.0%. Finally, the regional heterogeneity is also evident from our analysis. Compared to the farm operators located in the Northern part of Taiwan, the farm operators who live in the Central and Southern parts of Taiwan are less likely to receive the OFP pension by 7.8% and 16.3%, respectively.

The effects of the pension program on labour allocation and farm production

The estimation results of the labour allocation and farm production equations are presented in Tables 3 and 4, respectively. As discussed earlier, the standard errors of the estimates are calculated based on the bootstrapping method with 500 replications. Perhaps the most interesting finding of this study is the effect of the OFP pensions on the farm production and the labour use. We begin our discussion of the results in Table 3 on the effect of the OFP program on labour use. It is evident that the OFP program is negatively associated with the total on-farm days supplied by the farm operators. Compared to farm operators who did not receive an OFP pension, the farm operators who have received the pension worked on the farm less, by approximately 7.715 days. Comparing this

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Table 3. Estimation of the labour allocations

Variable	Operator's on farm days		Number of hired labour		On farm days of other family member	
	coefficients	S.E	coefficients	S.E	coefficients	S.E
OFP_OP	−7.715*	6.009	−0.157	0.437	38.565***	11.940
Age_OP	−2.189***	0.440	−0.014	0.012	2.902***	1.177
Primary_OP	16.790*	12.260	−1.132***	0.377	53.174	39.578
Junior_OP	15.591**	9.859	−0.953***	0.346	66.335**	32.349
Senior_OP	7.918	9.575	−0.843**	0.356	15.991	28.146
Male_OP	22.399**	11.650	−0.034***	0.011	58.590**	30.371
Off farm days_OP	−160.114***	15.017	−0.158	0.617	−129.201***	36.661
Household size	−1.725	1.357	−0.014*	0.009	66.529***	5.122
Land	6.729**	2.976	0.096	0.118	22.517*	14.505
Ownership	−6.987	7.861	0.014	0.208	−32.617	25.599
Center	9.547	12.922	0.351	0.280	122.906***	26.391
South	15.571	12.790	0.315	0.301	166.441***	25.956
East	48.514***	15.378	2.095***	0.705	5.519	73.111
IMR	−3.881***	1.318	−0.096***	0.026	−2.911	32.443
Constant	279.983***	27.484	2.359	0.738	−395.362***	66.069
Adjusted R^2	0.207		0.083		0.483	

***, **, * indicates the significance at the 1%, 5% and 10% level. Standard errors are calculated using the bootstrap method with 500 replications

IMR is the Inverse Mills Ratio, calculated from the OFP equation

reduction with the average on-farm days by farm operators (189.48), our findings show that receiving the OFP payments decreases the on-farm days of farm operators by 4% (i.e. 7.715/189.48 = 0.04). A negative effect of the OFP program on the hired labour by dairy farms is also revealed. The farms whose operators receive the OFP payments hire less labour by 0.157 persons. However, this result is not significant.

The results in Table 3 show a positive effect of the OFP program on the total on-farm days of family members (excluding the farm operator). Our results show that the farms whose operator receives the OFP payments tend to recruit more family members to work on the farm, by about 38.565 on-farm days. When we compare this value to the average on-farm days by family members (314.38), the magnitude is approximately 12% (i.e. 38.565/314.38 = 0.12). This result is interesting and may reflect the possibility that the OFP program provides an incentive to the old-age farm operators to plan for retirement by reducing their on-farm work. At the same time, it is also plausible that the OFP recipients are more likely to pass the farm business on to the younger generation by recruiting them on the farm. This finding is in accordance with those of the previous studies on the farm succession behaviour. For example, Pietola et al. (2003) looked at the early retirement program in Finland, and found that the availability of a pension program is positively associated with the farm operator's decision to exit farming and transfer the farm business to the younger generation.

The effect of the OFP program on farm production is presented in Table 4. We specifically study the impact of the receipt of the OFP payments on the herd size (farm size) and the value of production per cow. The negative effect of the OFP program on the total number of cows and the value of production per cow are evident. Our results show that the farms whose operators are the OFP recipients tend to have a smaller herd size, by an average of 47 cows. If we compare this value to the sample average of the cow (174.82), this value reveals that the magnitude of the OFP payments on the number of cows is approximately 27% reduction in the herd size. A negative effect of the OFP payments on the farm productivity is also observed. Dairy farms whose operators are the OFP recipients tend to have a lower production value per cow, by approximately NTD $18,100 (approximately 27% of the sample mean value).

The negative effect of the OFP program on the farm production may shed some light on the adjustment for the aged dairy farm structure in Taiwan. Our analysis points to an interesting trade-off between the social

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Table 4. Estimation of the production equations

Variable	Number of cows		Production value per cow	
	coefficients	S.E	coefficients	S.E
OFP_OP	–47.046**	29.860	–1.810**	0.943
Age_OP	0.098	0.568	–0.051**	0.023
Primary_OP	–7.549	25.174	0.589	0.817
Junior_OP	–12.691	17.289	1.246	0.848
Senior_OP	–8.695	15.115	0.459	0.717
Male_OP	10.573	14.361	0.545	0.593
Off farm days_OP	–102.261***	26.877	–0.534	2.103
Household size	11.047***	3.612	0.150*	0.080
Land	18.598*	11.249	0.017	0.187
Ownership	–23.507	14.301	0.181	0.469
Center	47.874***	14.509	2.751***	0.557
South	41.354***	15.014	5.214***	0.565
East	19.917	33.302	–0.436	0.907
IMR	24.643***	11.294	–1.042*	0.604
Constant	82.033**	39.769	3.571***	1.319
Adjusted R^2	0.107		0.152	

***, **, * indicates the significance at the 1%, 5% and 10% level. Standard errors are calculated using the bootstrap method with 500 replications
IMR is the Inverse Mills Ratio, calculated from the OFP equation

welfare program for elderly dairy farmers and the farm production. On the one hand, the policy goal of the OFP program is to provide a safety net for the self-employed elderly farmers with cash transfers. On the other hand, as our study reveals, the OFP program may also negatively influence the dairy farm production, particularly with respect to the herd size and the value of production per cow. If the policy goal of the government is to secure the old-age farmers' welfare and to adjust the aged farm structure, our findings demonstrate that using a public pension program, such as the OFP, as a policy instrument is not a good idea and is in fact counter-productive.

Validation of the model specification

Before we conclude the paper, we also provide some evidence of the model validation in our empirical analysis. As indicated earlier, our empirical analysis works according to a two-stage estimation process. Although the econometric model is theoretically identified, it is always helpful to enter some exclusion conditions in the empirical analysis. Recall that we chose the variable *Age65_OP* to be our instrumental variable. The rationale behind this strategy is that the eligibility rule of the age cut-off at 65 provides an ideal candidate for an exclusion condition. In order to provide some formal evidence of the model validation, we conducted a weak instrument statistical test to see whether the variable *Age65_OP* was statistically weak. The results of the Likelihood Ratio test were encouraging. The test result was 74.12 with a corresponding *p-value* of less than 0.001. Therefore, the null hypothesis that the variable *Age65_OP* is statistically weak was rejected. This result provides some confidence in our empirical specification of the selected instrument.

CONCLUSIONS

In 1995 the government of Taiwan enacted the Old Age Farmer's Pension Program (OFP – Regulation 1995). This program entitled farmers over the age of 65 to receive a monthly retirement income/pension from the government until they died. The intention behind providing this non-labour income was to reduce the work load of old age famers until they retired from farming and let a new generation of farmers enter farming. This study investigated the availability of the OFP payments on the labour allocations of the farm operator, the hired labour, other family members and the farm production performance (such as the herd size and the value of production per cow). Using 2010 data from 462 Taiwanese dairy farms and controlling for self- the selection bias we found that the government pension payments, like the OFP, reduce the on-farm labour supply of the farm operator and increase the on-farm labour supply of family members. However, we also found that farmers receiving the OFP payments decreased their herd size and the production value per cow.

Findings from this study thereby suggest that the social retirement programs like the OFP, especially designed so that old farmers can continue to work without restriction, can be counter-productive. This piece of legislation did not produce the intended results. We found that the farmers who receive pensions from the government reduced their on-farm labour supply and the farm size and became less productive. However, the silver lining of this legislation may be that, in the future, the retiring farmers may be willing to bequeath their farms to their family members.

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