Social Capital and the Performance of Water User Associations: Evidence from the Republic of Macedonia

Sozialkapital und die Performanz von Water User Associations: Evidenz aus Mazedonien

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Abstract

The paper assesses the performance of Water User Associations (WUAs) in the Republic of Macedonia. We assess performance in terms of membership rates, the satisfaction of members with their WUA and payment behaviour. Econometric analysis reveals that membership and satisfaction are positively related to farm size. Satisfaction and payment behaviour are strongly linked to structural and relational dimensions of social capital, particularly trust in senior managers of the WUA and the transparency with which resources are utilised. The conclusion highlights the importance of local factors in determining the success of WUAs.

Key words

Water User Association; transition countries; social capital; microeconometrics

Zusammenfassung

Dieser Beitrag fokussiert die Performanz von Water User Associations (WUAs) in Mazedonien. Diese wird bewertet anhand von Mitgliedschaftszahl, der Zufriedenheit der Mitglieder sowie Zahlungsverhalten. Die ökonometrische Analyse ergibt, dass Mitgliedschaft und Zufriedenheit positiv durch die Größe des Betriebes beeinflusst werden. Zufriedenheit und Zahlungsverhalten zeigen sich stark verbunden mit strukturellen und relationalen Charakteristiken von Sozialkapital, hier insbesondere dem Vertrauen in das Seniormanagement der WUA sowie der Transparenz der Ressourcenverwendung. Diese Ergebnisse betonen die Bedeutung lokaler Faktoren im Hinblick auf die Bestimmung des Erfolges von WUA.

Schlüsselwörter

Wassernutzervereinigung; Transformationsländer; Sozialkapital; Mikroökonometrie

1. Introduction

International water policy has witnessed a recent movement away from state based irrigation management towards supporting the development of independent, not-for-profit arrangements, particularly local Water User Associations (WUAs). While WUAs are widely seen to have the potential to be a superior institutional arrangement for local irrigation management, delivering meaningful benefits to farmers and taxpayers, it is nonetheless recognised that the actual performance of WUAs has been patchy (MEINZEN-DICK et al., 1997). It is important therefore to carefully evaluate the performance of WUAs and understand the principles that underpin successful self-government.

This article contributes to this debate by evaluating the performance of Water Communities (WCs), a form of WUA, in the Republic of Macedonia. Water Communities were established in Macedonia from 2002 onwards within a common external environment and institutional framework. In Macedonia, agriculture is the mainstay of rural livelihoods and substantial water deficiencies occur during the summer season, so that irrigation has a major impact on yields and hence incomes. By comparing performance across several water communities, it is possible to identify internal aspects that are critical to success and determine variations in outcomes. The identification of factors that underpin self-sustaining WUAs is particularly pertinent for states in Central and Eastern Europe (CEE), which have undergone a transition from central planning to more market based economies. This transition in agriculture was characterised by substantial falls in agricultural output and decapitalisation (MACOURS and SWINNEN, 2002). Much state owned irrigation fell into disrepair. Many commentators recognise the importance of local self-governance for rebuilding and maintaining irrigation networks in CEE, although some doubt whether this can be currently achieved in the Balkans (THEESFELD, 2004). Through the analysis of the performance of Water Communities in Macedonia we identify factors underpinning successful self-management. Particular attention is given to the role of social capital in determining the performance of WUAs.

The performance of WUAs, has previously been measured in three ways: formation/membership rates (MEINZEN-DICK et al., 1997), technical impact (MEINZEN-DICK et al., 1997; YERCAN, 2003) and cost recovery (YERCAN, 2003; ARARAL, 2009). Technical impact has been assessed in terms of changes in yields/agricultural efficiency, water availability and area irrigated (see ARARAL, 2005). Such assessments are typically based on expert opinion with little recourse to the views of ordinary members. Yet the sustainability of WUAs will depend ultimately on the satisfaction of farmers with the irrigation service. Following empirically validated service quality models (CRONIN and TAYLOR, 1992), one would expect satisfaction to be a significant predictor of purchase/ payment behaviour.

Previous assessments, moreover, typically draw on comparisons of WUAs from different countries and market environments so it has been difficult to identify the relative importance of external factors compared to member/resource characteristics in influencing performance. Our analysis recognises these difficulties and compares the performance of WUAs created in the Bregalnica region of Macedonia under a common legal framework and time period. This allows for a comparison of cases with a similar external environment and therefore a clearer understanding of the role of internal (to the WUA, farm and farmer) factors, including that of social capital. Performance is measured in terms of propensity to become a member, member satisfaction and farmers' payment behaviour.

We organise the remainder of this article as follows: the next section presents an overview of the Macedonian context. This highlights the salience of irrigation for Macedonian agriculture. Section 3 discusses the dataset and econometric analysis and section 4 describes the empirical results. Finally, we drew conclusions regarding factors underpinning successful self-management.

2. The Macedonian Context

Bregalnica is a semi-arid region of the Republic of Macedonia for which water scarcity is significant. Rainfall is approximately 500 mm per annum and occurs principally in Autumn and Spring. Due to dry, hot summers, water deficits of approximately 450 mm for crops are typical (WORLD BANK, 2006). The main crops grown in the Bregalnica region are wheat, maize, barley, alfalfa, rice, peppers, tomatoes, watermelons and grapes. Self-reported non-irrigation wheat and grape yields are 80 and 58% of irrigated levels, respectively. Rice, peppers, tomatoes and watermelon are entirely dependent on irrigation for cultivation. As fruit and vegetables are the main high value added crops produced, agricultural incomes are heavily dependent on irrigation and this is acknowledged by farmers. From the farm survey outlined in section 3,94% of respondents agreed or strongly agreed with the statement that 'irrigation is very important for my livelihood'. Depending on topographical conditions and crop type, the structure of irrigation varies from flood irrigation for rice to, much more commonly, open channels and concrete tubes for arable and horticultural production.

The quality of the irrigation network deteriorated rapidly in the 1990s. In the Bregalnica region, the irrigation area declined from 59% of total utilized agricultural area in 1990 to 26% in 1996 (WORLD BANK, 1997).[1] Many of the concrete channels of the Bregalnica system became cracked and pumping stations moribund. Water can easily be stolen from such a system with it being common for farmers to punch holes in channels to irrigate their land without paying. It has been estimated that at least 20% of irrigation water was lost due to theft and leaks from open channels (PESHEVSKI et al., 2006).

To improve efficiency, in 1998 a new Water Law was introduced, accompanied by a project for the rehabilitation and reconstruction of irrigation. The basis of the latter was an agreement between the Government of Macedonia and the World Bank. The project

[1] The Bregalnica irrigation system consists of a delivery network of 26,008 km.

covered three irrigation networks: Tikves, Bregalnica and Polog. The purpose of the project was to reconstruct irrigation systems, making their use sustainable through introducing better technology and local management. We focus on Bregalnica.

In 2002 a protocol for transferring irrigation management was signed. Water Communities can be formed where the participants in a given area account for more than 50% of agricultural land in the community's territory and wish to manage irrigation and drainage matters collectively. Membership is voluntary. The Water Community sets the prices for irrigation water and drainage to its members, which should reflect the true costs of delivering irrigation water, maintaining the network and ensuring adequate drainage. Water Communities negotiate the supply of water from a Public Water Enterprise. At the time of the establishment of the first Water Communities (May 2002), the average cost recovery rate was only 36%.[2]

3. Data and Econometric Methodology

Data on the performance of the Water Communities was collected via two methods. Firstly, in-depth interviews were conducted with a senior figure for each of the major Water Communities established in the Bregalnica region. The interviews collected information on the geographical area covered by the Water Community, membership, investment, main problems encountered and cost recovery. Data were collected for the first full three years of the existence of each Water Community (years 2002 to 2004). Secondly, to understand the reasons for the variation in Water Community performance in greater depth and to investigate the determinants of member satisfaction, a farm survey was conducted. In total, 249 survey responses were collected through face to face interviews, although, because of missing values, not all observations could be included in the models described below. Data collection occurred in 2005/6. Individual farmers were identified from contacts with local and regional authorities, village mayors, members of Water Community management boards, other farmers, and personal contacts.

The survey responses are divided into two groups: members of a Water Community (n=223) and farmers within the Bregalnica region who operate within a Water Community area but had chosen not to join the association (n=26). Data collection from the latter group allows us to understand why some farmers have not chosen to join their respective Water Community. The distribution of responses by farm size is presented in table 1. Estimates from senior managers of the Water Communities suggest, that on average approximately 87% of farmers in the geographical area covered by the Water Communities have joined. This suggests that the sample is broadly representative in terms of the balance of members and non-members.

Table 1 highlights that the majority of farmers sampled farm less than 2 hectares. This is in line with other estimates for Macedonia as a whole (WORLD BANK, 2006). However, a detailed analysis of the representativeness of the sample is impossible because the last population census for the country was conducted in 1981 and no agricultural census has been administered since 1964. Non-members operate significantly smaller farm areas.

Using these cross-sectional survey data we estimate, as a first step, a Heckman selection probit model to identify causal factors related to a farmer's decision to join a Water Community. Based on these estimates we calculate the inverse Mill's ratio to account for possible selection bias with respect to the estimation of the outcome equation modelled as an ordered probit model. Secondly, we investigate determinants of farmers' satisfaction with their membership of Water Communities including, beside other explanatory variables, the inverse Mill's ratio from the Heckman selection model. In a third modelling step we then

Table 1. Classification of Members and Non-Members of Water Communities by Farm Size (%)

Farm size	Member of a WC (n=223)	Non-WC member (n=26)	Total (n=249)
Less than 1 ha	37.2	61.5	26.5
1 to 1.99 ha	26.0	7.7	22.5
2 to 2.99 ha	9.9	3.8	15.3
3 to 3.99 ha	5.4	7.7	9.6
4 to 4.99 ha	4.9	3.8	5.2
5 to 9.9 ha	6.3	11.5	11.2
10 to 19.99	5.4	3.8	5.2
20 ha+	4.9	0.0	4.4

Source: survey data

[2] Measured as the percentage of billed amounts for a given territory which was actually paid by farmers.

explore significant factors for changes in farmers' water payment behaviour by estimating a censored least absolute deviations (CLAD) model based on a non-parametric estimator. Here the estimates for Water Community membership satisfaction gained from our second model are used as an explanatory variable beside other characteristics. From this procedure we try to reveal, following service quality models, if farmers' satisfaction with water services can explain some of the variation in their payment behaviour.

Model 1. It is expected that a farmer's decision to join a water community is influenced by a multitude of factors: socioeconomic characteristics at the household/farm level, production and irrigation technology characteristics, as well as personal attitudes towards and experiences with irrigation in general as well as with respect to their specific, local Water Community. It is likely that, in these regards, the characteristics of Water Community members will differ from non-members. Unobservable characteristics affecting the decision to become a member will be correlated with the unobservable characteristics affecting a farmer's level of satisfaction with his/her Water Community membership. Selectivity bias would be present, therefore, if we were to draw inferences about the determinants of membership satisfaction for all farmers based on the observed level of satisfaction of the subset which is actually a Water Community member. Heckman's two-stage sample selection model copes with such a selection problem by assuming that the farmers make two judgements with regard to membership and membership satisfaction, each of which is determined by a different set of explanatory variables (see HECKMAN, 1979). Hence, it is based on two latent dependent variables models, where the decision to become a member is modelled as a selection equation specified as:

$$(1)\quad P_i = \begin{Bmatrix} 1 \text{ if } \alpha + \sum_j \beta_j hh_{ij} + \sum_k \gamma_k att_{ik} + \sum_l \delta_l irr_{il} + u > 0 \\ 0 \text{ otherwise} \end{Bmatrix}$$

where P_i is a binary variable which takes the value one if the farmer is a member of the local Water Community and zero if the farmer decided not to become a member, hh denotes the vector of socioeconomic characteristics of the household/farm, *att* stands for the personal attitudes of the farmer toward the structure (as an organisational entity) and conduct of the Water Community, and *irr* for the irrigation technology related variables. In capturing attitudes, particular attention is given to social capital: the connections within and between social networks and individuals. NAHAPIET and GHOSHAL'S (1998) distinguish between the structural and relational dimensions of social capital. Structural dimensions of social capital refer to the impersonal configuration of linkages between people and units (TICHY et al., 1979). Relational social capital refers to the bonds between actors (HAKANSSON and SNEHOTA, 1995), particularly regarding obligations and trust. α, β, γ & δ are the vectors of parameters to estimate, and u is the error term (the corresponding log-likelihood function for (1)is given in MADDALA, 1998). The membership satisfaction equation is given by:

$$(2)\quad \text{satis}_i = \mu + \sum_m \kappa_m hh_{im} + \sum_n \kappa_n att_{in} + \sum_r \omega_r irr_{ir} + \sum_s \psi_s comm_{is} + v$$

where *satis* takes the values

$$\begin{Bmatrix} 1: \text{'very dissatisfied'}, 2: \text{'dissatisfied'}, \\ 3: \text{' indifferent'}, 4: \text{'satisfied'}, 5: \text{'very satisfied'} \end{Bmatrix}$$

respectively, and $comm$ denotes water community cost related characteristics. $\mu, \kappa, \tau, \omega$ & ψ are the vectors of parameters to estimate, and v is the error term. Given the distribution of the dependent variable, we estimate (2) as an ordered probit model.

To address the likely problem of small sample bias as well as heteroscedasticity, we estimate the robust covariance matrix using the Huber-White sandwich estimator (see HUBER, 1967, and WHITE, 1980). To examine the validity of the final model specification, we test for the group wise insignificance of the parameters in (1) and (2) by a common generalized likelihood ratio testing procedure. To test for small-sample bias we further investigate the robustness of our estimates obtained by (1) and (2) by applying a simple stochastic re-sampling procedure based on bootstrapping techniques (EFRON and TIBSHIRANI, 1993).

Model 2. Our second model focuses on explaining the variation in farmers' water payment behaviour. Among other variables, we also use the estimates from model 1 for farmers' satisfaction with their water community membership as an explanatory variable beside other socioeconomic household characteristics. From this procedure we try to reveal if farmers' satisfaction with water services can explain some of the variation in their payment behaviour.

Initial analyses revealed that essential model violations (heteroscedastic error terms and a non-normal error distribution) lead to highly inconsistent parametric estimation results with respect to censored model specifications. Consequently, we adopted a nonparametric censored least absolute deviations estimator

(CLAD), which was developed by POWELL (1984, 1986) as a generalization of the least absolute deviation estimation for non-negative dependent variables. Farmers' payment behaviour with respect to their water bill can be approximated as:

(3) $payincr_i = \max(x_i\beta + \varepsilon_i, L)$

where *payincr* denotes the percentage change in the amount of their total water bill paid by the farmer between the years 2002 to 2004, x_i is the observable explanatory variables for farm i (i.e. socioeconomic characteristics of the household/farm, the personal attitudes of the farmer, the irrigation technology related variables, and water community cost related characteristics), β are the vectors of parameters to estimate, and ε is the error term. L stands for the lower censoring bound with respect to the dependent variable. The CLAD estimator of β minimizes the sum of absolute deviations, $|\varepsilon|$, assuming a conditional median restriction on the error term. The objective function can thus be specified as:

(4) $S_n(\beta) = \min\left\{\frac{1}{n}\sum_{i=1}^{n}\left|payincr_i - \max\{L, \beta x_i\}\right|\right\}$

whereby the estimator uses the observations so that the median is preserved by monotonic functions and n refers to the number of parameters β for which the the sum of the absolute deviations is minimized. Hence, the CLAD estimator involves the minimization of an objective function that is not necessarily convex in β. Thus, obtaining a global minimum of (4) implies the usage of numerical minimization algorithms.[3] The optimization procedure follows JONSTON and DI NARDO (1997) suggesting the following steps: (i) estimating the median regression using the total sample to determine the initial values for β, (ii) calculation of the values for the dependent variable VA'_{it} based on the estimated values for β by neglecting the observations for which VA'_{it} takes a negative value, and (iii) estimating the median regression based on the adjusted sample to obtain new estimates for β. Steps (ii) and (iii) form the iteration process to determine the final values for β. A crucial weakness of the CLAD estimator is its finite sample bias resulting in mean-biased results for relatively small samples (see PAARSCH, 1984). Since finally the estimator's asymptotic variance-covariance matrix involves the estimation of the density function of the error term, we use again bootstrap estimates of the standard errors with about 1 000 draws.

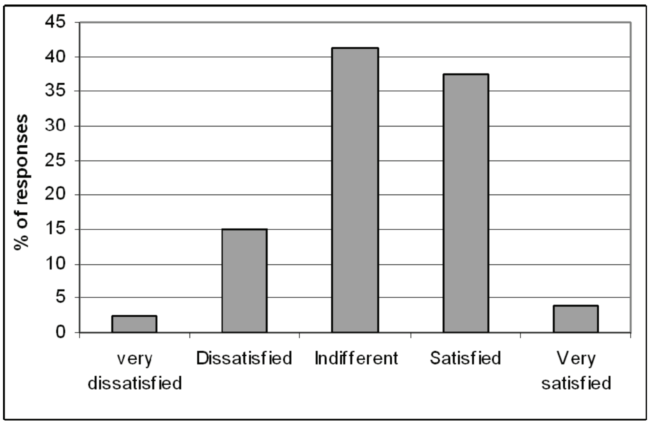
[3] The iterative linear programming algorithm (ILPA) contained in STATA is used here.

4. Results

Before reviewing the econometric models, it is informative to review key descriptive statistics. As part of the farm survey respondents were asked to rate their degree of satisfaction with their Water Community, on a 5-point Likert scale where 1 equals 'very dissatisfied' and 5 equals 'very satisfied' (figure 1). Only 2.5% were 'very dissatisfied' with the majority being either 'indifferent' or 'satisfied'. A mere 3.8% were 'very satisfied'. By this measure, therefore, the introduction of Water Communities has been neither an unqualified success nor failure.

Regarding cost recovery, results are more positive. For the first three years following formation of the Water Communities, average cost recovery rates, measured as the percentage of billed amounts actually paid, were 72, 70.6 and 68%, respectively. While a slight downward trend is apparent, figures for all years compare favourably to the rate prior to formation (36%). However, significant non-payment persists and the data presented in figure 1 mask significant differences between Water Communities. Comparing mean satisfaction scores for the first six Water Communities created, significant differences are apparent (F test = 2.87). Even with a common external framework, therefore, significant variations in the perfor-

Figure 1. Overall Satisfaction with Water Community original six Water Communities



Source: survey data

mance of Water Communities are evident, suggesting the importance of internal characteristics for explaining variations in satisfaction.

Tables 2, 3 and 4 summarize the results for the estimated models. According to the different diagnosis tests performed all estimated model specifications are significant with no severe signs of misspecification. These conclusions are supported by the bootstrapped bias-corrected standard errors as well as the robust estimation technique applied for the Heckman selection specification which confirms the robustness of the various estimates.

The hypotheses tests conducted with respect to the significance of explanatory variables indicate for

Table 2. Stage 1 of Heckman Selection Model – Bootstrapped Binary Probit Estimates

(n=176) **Independents**	**Coefficient[1]**	**Robust z-value**	**Bootstrapped bias-corrected standard error 95% confidence interval[2]**
Stage 1 – selection equation		*dependent 1*: water community membership	
Socio-economic characteristics			
Hectares farmed	0.467**	2.17	[0.210; 0.221]
Proportion of land used for crops	-0.042	-0.62	[0.066; 0.069]
Proportion of household income derived from farming	-0.017	0.48	[-0.035; -0.036]
Proportion of household income derived from crops	-0.001	0.956	[-0.001; -0.001]
Age of farmer	0.204	0.620	[0.321; 0.337]
Level of education	-0.158	0.701	[-0.220; -0.231]
Farmers attitudes towards water community's structure and conduct			
Water communities improve the quality of irrigation	-0.011	0.986	[-0.011; -0.011]
WC guarantees transparent resource use	1.199***	2.54	[0.460; 0.484]
WC covers a clear geographical area	1.201***	2.72	[0.431; 0.453]
Irrigation is very important for livelihood	0.266	0.43	[0.603; 0.634]
Farmers have common view on irrigation management	-0.768***	-2.59	[0.289; 0.304]
Farmers maintain irrigation equipment for long-run use	-0.686*	-1.63	[0.410; 0.431]
Farmers consider only their short-term interest	0.067***	2.70	[0.024; 0.025]
Want to have a say in how irrigation water is delivered	1.515***	3.39	[0.436; 0.458]
Want to have a say in how irrigation equipment is maintained	-0.144	-0.29	[0.484; 0.509]
Trust in the leader of the WC	0.059	0.14	[0.411; 0.432]
Trust in the management board of the WC	1.679***	3.79	[0.432; 0.454]
Experience with involvement in local associations	-1.739***	-3.72	[0.456; 0.479]
Transparent management structure	1.037***	2.89	[0.350; 0.368]
Transparent relations between WC and water authority	-0.012	-0.02	[0.585; 0.615]
Easy to cut access to non-payers	0.779***	3.28	[0.232; 0.243]
Use of irrigation water can be effectively monitored	-0.632**	-2.16	[0.285; 0.300]
Transparent structure for conflict solution	0.343	1.11	[0.301; 0.317]
Irrigation technology related characteristics			
Proportion of total farm area irrigated	2.131***	3.05	[0.681; 0.716]
Proportion of total farm area irrigated by sprinkler technology	1.276	1.37	[0.908; 0.955]
Proportion of total farm area irrigated by flooding technology	1.696***	2.61	[0.634; 0.666]
Constant	-0.654	-0.08	[7.971; 8.379]
log pseudo-LL	*-19.114*		
Wald test of model significance, $chi^2(26)$	*91.00****		
McFadden's R2	*0.671*		
McKelvey/Zavoina's R^2	*0.899*		
Cragg & Uhler's R2	*0.741*		
Count R2 (adj Count R2)	*0.955 (0.556)*		
linear hypotheses tests on model specification ($chi^2(x)$)			
H_0: socio-economic characteristics related variables have no significant effect ($chi^2(6)$)	*46.40*** (rejected)*		
H_0: farmer's attitudes/experiences related variables have no significant effect ($chi^2(17)$)	*46.30*** (rejected)*		
H_0: irrigation technology related variables have no significant effect ($chi^2(3)$)	*19.97*** (rejected)*		

1: * - 10%-, ** - 5%-, *** - 1%-level of significance; 2: 1000 replications.
Note: none of the variables were deflated as for the years studied inflation was very low in Macedonia. According to National Bank of Macedonia data, inflation in the years 2002 to 2004 was 1.1, 2.6, -1.9%, respectively.
Source: own calculations

model 1 the relevance of socioeconomic characteristics, farmers' attitudes towards their Water Community's structure and conduct, utilised irrigation technology, and for model 2, in addition, Water Community cost related characteristics. Considering the specific variables included in model 1, it is apparent regarding the impact of household characteristics on propensity to join a Water Community, only size of farm is significant (table 2). Membership is not biased to a particular demographic group or related to years in education. Farmers' attitudes regarding the structure and conduct of their Water Community were measured using the same Likert scales as mentioned above. Scale items were designed to measure farmers' trust in the Water Community and its senior managers, the level of farmers' previous experience with local associations, degree of free riding, effective sanctions for opportunistic behaviour and commitment to the Water

Table 3. Stage 2 of Heckman Selection Model – Bootstrapped ordered Probit Estimates

(n=176) Independents	Coefficient[1]	Robust z-value	Bootstrapped bias-corrected standard error 95% confidence interval[2]
Stage 2 – outcome equation	*dependent 2*: farmer's satisfaction with water community membership		
Socio-economic characteristics			
Hectares farmed	0.946**	2.15	[0.113; 0.120]
Proportion of land used for crops	-0.003	-0.19	[0.013; 0.021]
Proportion of household income derived from farming	-0.001	-0.15	[0.011; 0.009]
Proportion of household income derived from crops	-0.013***	-2.70	[0.005; 0.006]
Age of farmer	-0.273**	-2.04	[0.129; 0.130]
Level of education	0.360***	2.79	[0.124; 0.128]
Farmers' attitudes towards water community's structure and conduct			
WC guarantees transparent resource use	0.019	0.11	[0.164; 0.178]
Irrigation is very important for livelihood	-0.489***	-3.16	[0.183; 0.223]
Want to have a say in how irrigation water is delivered	-0.249	-1.09	[0.218; 0.221]
Want to have a say in how irrigation equipment is maintained	0.091	0.51	[0.169; 0.174]
Trust in the leader of the WC	0.478***	2.71	[0.171; 0.175]
Trust in the management board of the WC	1.089***	5.07	[0.207; 0.208]
Experience with involvement in local associations	0.363***	2.09	[0.159; 0.167]
Transparent management structure	0.885***	4.49	[0.181; 0.182]
Transparent relations between WC and water authority	0.118	0.65	[0.159; 0.164]
Transparent structure for conflict solution	0.269***	11.24	[0.216; 0.236]
Irrigation technology related characteristics			
Proportion of total farm area irrigated	-0.165	-0.43	[0.399; 0.413]
Proportion of total farm area irrigated by furrow technology	0.123	0.27	[0.376; 0.446]
Proportion of total farm area irrigated by sprinkler technology	0.059	0.18	[0.313; 0.322]
Proportion of total farm area irrigated by flooding technology	-0.828***	-2.27	[0.429; 0.448]
Water community cost related characteristics			
Cost recovery of WC	0.297***	11.17	[0.023; 0.027]
Costs per hectare of land irrigated	0.002***	2.15	[7.88e-05; 8.78e-05]
Increase in water bill 2002 to 2004	0.001***	2.08	[5.46E-05; 6.91E-05]
Inverse mill's ratio	-2.123***	-2.51	[0.698; 0.881]
log pseudo-LL	*-97.911*		
Wald test of model significance, $chi^2(24)$	*96.78****		
McFadden's R2	*0.620*		
McKelvey/Zavoina's R^2	*0.537*		
Cragg & Uhler's R2	*0.503*		
Count R2 (adj Count R2)	*0.946 (0.640)*		
linear hypotheses tests on model specification ($chi^2(x)$)			
H_0: socio-economic characteristic related variables have no significant effect ($chi^2(6)$)	*18.12*** (rejected)*		
H_0: farmer's attitudes/experiences related variables have no significant effect ($chi^2(9)$)	*29.48*** (rejected)*		
H_0: irrigation technology related variables have no significant effect ($chi^2(4)$)	*53.60*** (rejected)*		
H_0: water community cost related variables have no significant effect ($chi^2(3)$)	*12.20*** (rejected)*		

1: * - 10%-, ** - 5%-, *** - 1%-level of significance; 2: 1 000 replications
Source: own calculations

Community. This draws on verified scale items developed in the social capital/marketing literature.

The majority of the scale items are significant; propensity to join a Water Community is positively related to the Water Community having transparent resource use, clear geographical area, trust in the management board, effective systems of payment and transparent management structure. Good governance and accountability are thus vital. Considering irrigation technology, farmers for whom a higher proportion of their total farm is irrigated and those using flooding technology (for rice) are more likely to join a Water Community. This suggests that commitment to Water Communities is higher where irrigation is more critical for livelihoods and echoes previous work highlighting the importance of salience (ARARAL, 2009).

Table 3 presents the second stage of the Heckman selection model concerning farmers' satisfaction with their membership. The analysis reveals that membership satisfaction is related to household characteristics, the Water Community's conduct and performance and the technology employed in the case of flood irrigation. Regarding household characteristics, satisfaction is positively related to size of farm and level of education. Better educated people appear to more readily perceive the potential benefits of Water Community membership and more importantly appreciate that benefits accrue over time.

Significant, negative correlations between satisfaction and age, and proportion of household income derived from crops are evident. The latter may reflect that those who are more dependent on crops have higher requirements and demands for the Water Community. This may also explain the significant, negative coefficient for "irrigation is very important for my livelihood". Regarding Likert scale items capturing the structural and relational dimensions of social capital, members' satisfaction is positively related to trust in both the leader and management board of the Water Community, presence of a transparent management structure and structure for conflict solution. These relationships again highlight the importance of good governance much of which rests with trust of the senior managers of each Water Community. For

Table 4. Non-parametric Cumulative Least Absolute Deviation Model – Bbootstrapped Estimates

(n=176)	coefficient[1]	t-value	bootstrapped bias-corrected standard error 95% confidence interval[2]
Dependent: proportional change in farms' water bill payment 2002 – 2004			
Independents			
Socio-economic characteristics			
Hectares farmed	-0.908	-0.94	[0.942; 0.990]
Proportion of land used for crops	0.437***	5.44	[0.078; 0.082]
Proportion of household income derived from farming	-0.447***	-8.28	[0.053; 0.055]
Proportion of household income derived from crops	0.433***	9.55	[0.044; 0.046]
Age of farmer	-0.608***	-0.56	[1.059; 1.113]
Level of education	0.938	0.88	[1.039; 1.093]
Farmers attitudes towards water community's structure and conduct			
Farmer's satisfaction with water community membership *(y_hat model 2)*	3.571***	3.25	[1.098; 1.071]
Easy to cut access to non-payers	4.147**	2.02	[2.053; 2.002]
Water community cost related characteristics			
Membership	-3.908	-0.85	[4.597; 4.483]
Costs per hectare of land irrigated	-0.003***	-6.02	[4.98E-04; 4.86E-04]
Increase in water bill 2002 to 2004	0.004***	13.71	[2.92E-04; 2.84E-04]
Irrigation technology related characteristics			
Proportion of total farm area irrigated	-2.776	-0.78	[3.559; 3.470]
Constant	-17.411	-1.44	[12.091; 11.789]
Minimum sum of deviations	2966.997		
Adj. McFadden's R2	*0.878*		
linear hypotheses tests on model specification ($chi^2(x)$)			
H_0: socio-economic characteristics related variables have no significant effect ($chi^2(6)$)	*20.96*** (rejected)*		
H_0: farmer's attitudes/experiences related variables have no significant effect ($chi^2(3)$)	*4.76*** (rejected)*		
H_0: water community cost related variables have no significant effect ($chi^2(3)$)	*84.05*** (rejected)*		

Source: own calculations

instance, the satisfaction of members in one Water Community plummeted after the community's president damaged an irrigation channel and refused to pay for repairs.

The only significant relationship identified between irrigation type and members' satisfaction is a negative one for flood technology. Implementing effective sanctions to punish non-payers is more difficult in the case of flood irrigation in Macedonia as water typically flows freely between the plots of paying and non-paying farmers. Cutting supplies of water to non-payers would negatively impact on farmers who have paid their bills. Flood irrigation, because it demands greater quantities of water, is also more costly per hectare.

A positive correlation is apparent between membership satisfaction and increases in a farmer's water bills between the years 2002 and 2004. The latter variable can be considered a proxy, in the Macedonian context, for a growth in the size of land under Water Community irrigation. Individuals who are expanding their irrigated activities are thus more satisfied, suggesting that structural change is likely to help reinforce the Water Communities. Those farmers who are seeking to expand their farming operation are more likely to be younger and better educated. The inverse mill's ratio is significant.

Table 4 presents the results of model 2, concerning relationships with the changes in farmers' payment behaviour. This analysis is critical for assessing the viability of Water Communities, given historically very low levels of cost recovery and the objective of Water Communities becoming financially sustainable local institutions. Significant relationships are uncovered between household characteristics, farmers' attitudes, Water Community characteristics and payment behaviour. Improvements in payment behaviour are associated with a higher dependence on crops. Those less dependent on irrigation have been less responsive to the Water Communities in terms of improving their payment behaviour and this may reflect that the sanction of withholding water is less severe to those not engaged in crop production. Consistent with service quality models, improvements in payment behaviour are positively related to members' satisfaction (2nd stage of model 1) and the presence of effective sanctions for non-paying farmers. Improvements in payment behaviour thus depend on the presence of both a *carrot* (better service delivering higher satisfaction) and *stick* against opportunistic behaviour.

A positive correlation is apparent for the relationship between the expansion of irrigated farm area, proxied by the variable 'increase in water bill 2002 to 2004' and improvements in payment behaviour. This again suggests that structural change is broadly positive for establishing Water Communities. The coefficient for costs per hectare of land irrigated is significant and negative, indicating that lower fees are associated with improvements in payment behaviour. Older farmers have been significantly less responsive.

5. Conclusion

As noted by ARARAL (2005) those advocating WUAs place the greatest emphasis on structural factors, for instance establishing clear property rights, management structures and markets for crops. However, the Macedonian case illustrates that even when Water Communities share these characteristics, performance is variable. This highlights the importance of internal factors in determining the success of self-management. The analysis identifies the importance of the structural and relational dimensions of social capital regarding all three measures of performance considered. For instance, the presence of good governance and accountability contribute significantly to the decision to join a Water Community, membership satisfaction and changes in payment rates. Good governance requires effective leadership, transparency in resource allocation and trust in senior managers. While the constitutions of each Water Community can detail responsibilities and procedures to help maximise transparency and promote accountability, much will rest on local factors.

Cost recovery improved substantially after the introduction of the Water Communities. Model 2 reveals that improved payment behaviour depends on, amongst other variables, both the positive satisfaction of members and effective sanctions against non-payers. Previous irrigation studies have rarely paid attention to membership satisfaction, yet our analysis indicates that it is a critical determinant of payment behaviour and hence the long-run viability of WUAs.

In assessing whether WUAs can be usefully introduced, policy makers therefore have to consider if they can deliver both the *carrot* of a reliable service and *stick* of sanctions against opportunistic behaviour. Local, internal factors are significant in determining the actual size of carrots and sticks faced by farmers. Consequently, even if WUAs have been successfully introduced in one location, it does not follow that the same rules and procedures transferred to another location will generate comparable results. Much depends on the presence of trusted, community minded individuals at the local level and, therefore, the proponents of Water Communities cannot guarantee that sustainable communities will always emerge.

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