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Public Transfers and Communal Cattle Marketing Decisions: Empirical Evidence from Botswana

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A two-step (probit-truncated regression) model is used to examine the influence of public transfers on communal cattle marketing decisions in Botswana. Results show that publicly provided pensions reduce the probability of selling cattle but have no effect on the number of cattle sold. Government food rations and paid employment (which includes employment in a Public Works Program) reduce both the probability of selling cattle and the volume of cattle sold. Thus, public transfers are a disincentive to cattle marketing in Botswana, and they need to be targeted at poor households to minimize their adverse effects on the cattle industry.

Key words: Botswana, cattle marketing, public transfers, social safety nets

Cattle production in Botswana comprises two distinct production systems; communal and commercial. Communal farming is characterized by uncontrolled grazing due to open access to rangeland resources (BIDPA, 2006). Commercial farming, on the other hand, involves production in either freehold or leasehold ranches (Central Statistics Office, 2008a). The communal system is the most prominent. It consistently accounted for over 80% of the country`s cattle population during the period 1979-2004 (TRANSTEC and BIDPA, 2010).

Cattle production is an important livelihood source in Botswana, particularly in the rural economy where income generation opportunities are limited. The industry is also an important source of non mineral foreign exchange for the country.[1] The importance of the cattle industry is also seen in its real value added, which has been the main driver of agricultural GDP (Figure 1).

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[1] During the period 1974-2009, beef and beef by-products accounted for an average of 10% of total export earnings and were the most consistent and leading source of non-mineral foreign exchange from commodity trade (Central Statistics Office, 2010). However, the share of beef and beef by-products exports to total exports declined from 46% in 1974 to 3.5% in 2009. This is a serious concern since the decline was partly due to declining cattle sales for overall slaughter and export slaughter in particular. Notwithstanding this, most of the decline was caused by tremendous growth in mineral exports. Our computations indicate that real mineral exports grew at 8% per year during the period from 1974 to 2009, whereas real beef exports declined by 1.3% per year during the same period.

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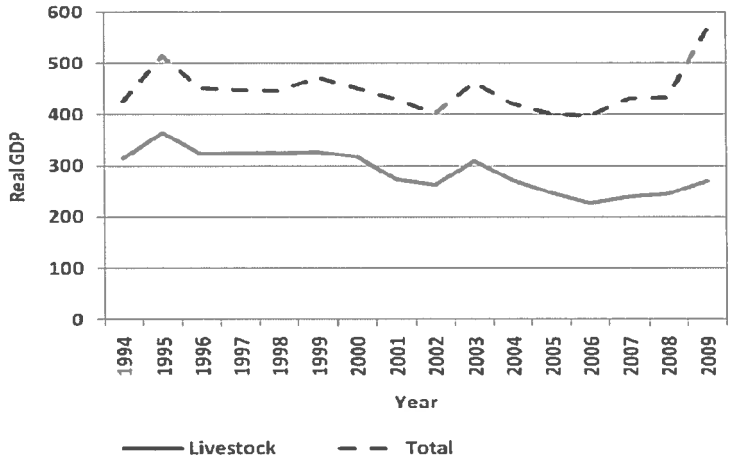
The beef industry in Botswana is currently facing serious challenges. Total cattle sales for slaughter and cattle sales to the Botswana Meat Commission (BMC), a state trading export monopoly, declined significantly since the 1990s (Figures 2 and 3), leading to declining beef exports.[2] This has led analysts to conclude that the beef industry in Botswana may be becoming unsustainable (BIDPA, 2006).



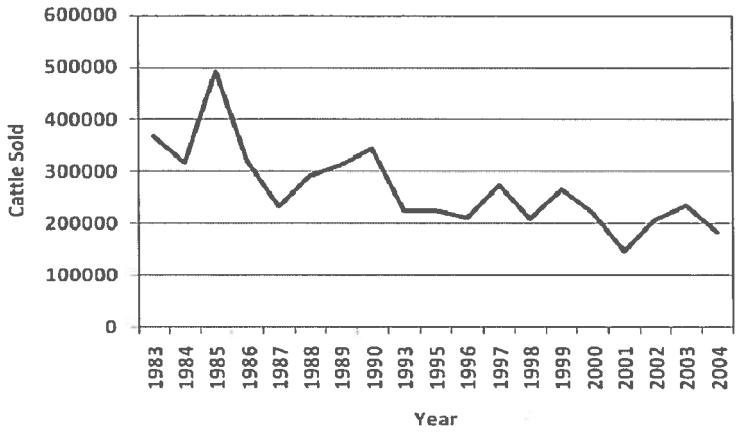
Source: Central Statistics Office (Various[a])

Figure 1: Real Agricultural GDP in Millions of 1993/94 Pula; 1994-2009

There is a paucity of empirical evidence on factors underlying beef cattle marketing in Botswana. Yet, market participation in agriculture is seen as among the most important contributing factors to poverty reduction in developing countries (Delgado, 1995; Ehui, Benin and Paulos, 2009). Only one study has so far modeled cattle marketing decisions in Botswana (Nkhori, 2004). Among other factors, the study found that herd-size and transaction costs (represented by distance to market, market information, and speed of payment) affected the choice of marketing outlets.

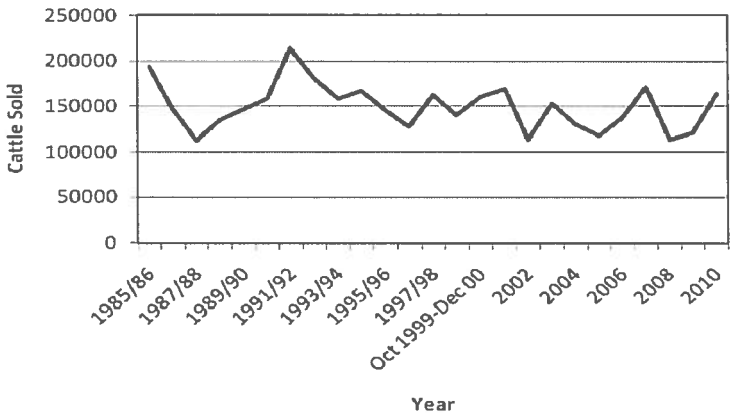
Although not commonly captured in studies on cattle marketing decisions, public transfers (cash and food) and participation in Public Works Programs (PWPs), could be important determinants of cattle marketing decisions in developing countries. Economic theory suggests that cash and food transfers can modify household behavior, especially in

[2] Total cattle sales declined from 368 thousand heads in 1983 to 184 thousand heads in 2004, representing a two-fold decline (Figure 2). BMC cattle throughput declined from 214 thousand heads in 1991/92 to 164 thousand heads in 2010, and was much lower at 113 thousand heads in 2008 (Figure 3).



Source: Central Statistics Office (Various[b])

Figure 2: Number of Cattle Sold to all Outlets; 1983-2004



Source: BMC (Various)

Figure 3: Number of Cattle Sold to Botswana Meat Commission; 1985/86-2010

cases where benefits are regular and consistent (Abdulai, Barrett and Hoddinnot, 2005). The effect can be seen at household, community or national levels (Abdulai, Barrett and Hoddinnot, 2005; RHVP, 2010). At a household level, transfers may lead to changes in economic decisions such as cattle marketing.

This article therefore investigates communal beef cattle marketing decisions in Botswana, with emphasis placed on the role of public transfers, including participation in

a PWP. This is important for public policy in Botswana because such transfers may be amongst the contributing factors to declining cattle sales and beef exports. The rest of the article is organized as follows. First, we provide a brief overview of public transfer programs in Botswana. Second, we discuss empirical models and describe the data for analyzing cattle marketing decisions. Results and policy implications are then discussed, and conclusions presented.

Brief Overview of Public Transfer Programs

Botswana has an extensive set of publicly provided social safety net programs geared at delivering food and cash to beneficiaries based on specified eligibility criteria (Seleka et al., 2007). Food baskets are provided through the Destitute Persons Program (DPP), the Orphan Care Program (OCP), the Community Home Based Care Program (CHBCP), and the Vulnerable Group Feeding Program (VGFP). The DPP (introduced in 1980) provides monthly food rations to individuals whose monthly cash income is below P120 (without dependents) and P150 (with dependents) or who own less than four livestock units (four cattle or 16 goats/sheep).

The food basket for the DPP provides about 1750 calories per beneficiary per day. While eligibility is based on individual, rather than household-wide assessment, the number of monthly food baskets delivered to each beneficiary increases with the number of dependents of the destitute person (see MLG, 2002 for specific criteria). The number of beneficiaries to the DPP rose from 19 thousand in 2004-05 to 45 thousand in 2009-10 (RoB, 2010).

The OCP (launched in 1999) provides food rations and other needs to orphans, to enable them to lead normal lives. Orphans are defined as children under the age of 18 who have lost two parents (for married families) or one parent (for a single-parent family). Each orphan is entitled to a monthly food ration, which is delivered to a foster family (usually a relative of the orphan). The number of orphans enrolled in the program declined from 53 thousand in 2005 to 46 thousand in 2010.

The CHBCP was introduced in 1995 to provide food baskets to terminally ill individuals suffering from AIDS. However, it was later modified to also cover individuals with other debilitating chronic illnesses such as diabetes, who cannot provide for themselves. Referral to the CHBCP is made by a medical doctor and means testing is conducted based on the eligibility criteria for the DPP. The program delivers monthly food baskets to each beneficiary, based on the recommendations of a dietician. Enrolment in the CHBCP declined from 14 thousand in 2004-05 to three thousand in 2009-10 (RoB, 2010).

The VGFP has existed since Botswana's independence in 1966 and provides monthly food packages to medically selected pregnant and lactating mothers, TB and leprosy

patients and children under the age of five. Monthly food rations are provided as take home packages and are meant to only meet additional food requirements of the beneficiaries. The number of children aged four to 36 months receiving the soya/sorghum weaning food increased from 64 thousand in 2006 to 91 thousand in 2009 (RoB, 2010). During the same period, the number of children aged 37 to 60 months, medically selected pregnant and lactating mothers and TB patients receiving enriched maize meal dropped from 73 to 62 thousand.

Cash transfers are mainly made through the Old Age Pension (OAP) Program, the World War II (WW II) Veterans Program, and a Public Works Program. However, the DPP also has a small cash transfer of P81 per month, intended to assist the destitute persons to meet personal (nonfood) needs such as toiletry items. The OAP program was introduced in 1996 to provide cash to all citizens aged 65 and older. Each elderly receives P220 per month. The number of the elderly enrolled in the program increased from 65 thousand in 2004-05 to 91 thousand in 2009-10.

The WW II Veterans program was launched in 1998 to provide cash income to individuals who fought in the Second World War, or their surviving spouses or children under the age of 21. Each WW II beneficiary currently receives P339 per month. The number of beneficiaries has remained at about 3000 since 2004-05.

A PWP, Labor Based Drought Relief Program (LBDRP), provided cash benefits to unemployed individuals during 1982-2009, as a temporary relief measure conditional on the declaration of drought by government. The current PWP, Ipelegeng, was introduced in 2009 to provide employment on a continuous basis, with beneficiaries rotated to widen participation and coverage of the unemployed (BIDPA, 2010). Due to the rotational nature of employment in the Ipelegeng program, the number of beneficiaries cannot be accurately determined.

Model, Data and Descriptive Statistics

A two-step model is used to estimate cattle marketing decisions in Botswana's communal system. The model assumes that the farmer first makes a decision on whether or not to sell cattle, and if selling is chosen, the farmer then makes a decision on the number of cattle to sell. The first step involves estimation of a probit model to represent market participation decisions, and the second step, which is conditional on the first, involves estimation of a truncated regression model to represent quantity decisions (Katchova and Miranda, 2004; p.88).

Table 1: Variable Definition

Variable	Description
Participation	Whether farmer sold cattle:1=yes and 0=otherwise
Cattle Sold	Total number of cattle sold
Household Characteristics	
HHSS	Household Size (total number of people in the household)
AGEH	Age of the head of household
Gender	Gender of the household head:1=male and 0 =otherwise
Married	Whether the household head is married or not: 1=married and 0=otherwise
Education	Number of years of schooling for the household head
Full time	Whether the household head is full-time farmer or not: 1=full-time and 0=otherwise
Main Livestock Water Source	
Borehole	Whether main water source is borehole: 1=yes and 0=otherwise
Well	Whether main water source is well: 1=yes and 0=otherwise
Dam	Whether main water source is dam: 1=yes and 0=otherwise
River	Whether main water source is river: 1=yes and 0=otherwise
Pan	Whether main water source is pan: 1=yes and 0=otherwise
Pond	Whether main water source is pond: 1=yes and 0=otherwise
Main Water Source Ownership	
Self	Whether main water source is self-owned : 1=yes and 0=otherwise
Family	Whether main water source is owned by an extended family: 1= yes and 0=otherwise
Syndicate	Whether main water source is owned by a syndicate: 1 = yes and 0=otherwise
Community	Whether main water source is owned by community: 1 =yes and 0=otherwise
Government	Whether main water source is owned by government: 1 =yes and 0=otherwise
Other	Whether main water source is owned by other: 1= yes and 0=otherwise
Herd Dynamics	
Herd Size	Total number of cattle owned
Deaths	Total number of cattle that died during the season
Labour Input	
Hired Farm Labour	Presence of hired farm labour: 1=yes and 0=otherwise
Sources of Cash Income	
Crop Produce†	Whether income was sourced from sales of crop produce: 1=yes and 0=otherwise
Livestock Sales†	Whether income was sourced from livestock sales: 1=yes and 0=otherwise
Paid Employment	Whether income was sourced from paid employment: 1=yes and 0=otherwise
Other Business	Whether income was sourced from other business:1=yes and 0=otherwise
Remittances	Whether income was sourced from remittances:1=yes and 0=otherwise
Pension	Whether income was sourced from pension: 1=yes and 0=otherwise
Sources of Food	
Own Farm Production†	Whether the household sourced food through own production: 1=yes and 0=otherwise
Purchases†	Whether the household sourced food through purchases: 1= yes and 0=otherwise
Government Rations	Whether the household sourced food through government ration: 1=yes and 0=otherwise
Relative and Friends	Whether the household sourced food from relatives and friends: 1=yes and 0=otherwise

† : Not included amongst the explanatory variables (see discussions in the results sections).

We used data from the 2004 Botswana Agricultural Census for communal cattle farmers. Since this article is about cattle marketing, we extracted cattle farmers from the entire sample, resulting in a sample of 12,527 households.[3] Table 1 defines the variables for the models and Table 2 presents descriptive statistics. As evident, the explanatory variables, for probit and truncated regression models, include household characteristics, main water sources, main water source ownership, cattle herd dynamics, hired labor and income sources. We also included 25 district dummies to capture fixed regional effects (there are 26 districts in total).

Table 2 shows that 42% of the sampled farmers sold cattle during 2004. This is comparable to the 46% found by BIDPA (2006). The average number of cattle sold is three, implying low level of sales by communal farmers. Average household size was estimated at four individuals, which is consistent with Central Statistics Office (2008b). The average age of the head of the household is 58 years, signifying predominance of the elderly. About 75% of the households were male-headed, implying predominance of males in cattle farming.

About 60% of the household heads were married. Average years of schooling are estimated at about three, signifying low levels of educational attainment amongst cattle farmers. Similar observations were made by BIDPA (2006), which found that about 43% of communal farmers had attended primary school and that 24% were illiterate. Those who practiced cattle farming on a full-time basis accounted for 74% of cattle producers.

Boreholes were the most common main water source for cattle, having been cited by 45% of the households. This is followed by wells (28%) and dams and rivers with 14% and 11%, respectively. Pans and ponds were cited by negligible proportions of households as main water sources. Thus, groundwater sources (boreholes and wells) are the most predominant water source for cattle. A majority of water sources belonged to syndicates (25%), followed by other (23%), individual households (19%), community (14%) and family (13%). Government owned water sources were used by only 6% of the households.

Average cattle herd-size is estimated at 43 animals, implying the predominance of smallholders. The average number of cattle deaths per year is about four animals. About 32% of the households used hired farm labor. A majority of cattle farmers (40%) sourced cash income from paid employment, followed by remittances (31%) and pensions (30%).[4] Other businesses were a source of income for 15% of the households. About 6% of the households received government rations and only 3% received food from relatives

[3] A few observations were left out due to missing entries for some of the explanatory variables.

[4] This ranking excludes cattle sales (the dependent variable), which were a source of cash income for 42% of the households.

Table 2: Descriptive Statistics

Variable	Mean	Std Deviation	Min	Max
Participation	0.421	0.494	0	1
Cattle Sold	3.248	9.928	0	417
Household Characteristics				
HHSS	3.998	3.009	1	30
AGEH	58.325	14.887	12	99
Gender	0.752	0.432	0	1
Married	0.596	0.491	0	1
Education	3.216	3.984	0	19
Full time	0.735	0.441	0	1
Main Livestock Water Source				
Borehole	0.448	0.497	0	1
Well	0.284	0.451	0	1
Dam	0.140	0.347	0	1
River	0.109	0.312	0	1
Pan	0.005	0.067	0	1
Pond	0.013	0.113	0	1
Main Water Source Ownership				
Self	0.192	0.394	0	1
Family	0.126	0.332	0	1
Syndicate	0.254	0.435	0	1
Community	0.141	0.348	0	1
Government	0.059	0.236	0	1
Other	0.228	0.419	0	1
Herd Dynamics				
Herd Size	43.382	82.095	1	1789
Deaths	4.014	9.737	0	350
Labour Input				
Hired Farm Labour	0.318	0.466	0	1
Sources of Cash Income				
Sale of Crop Produce	0.018	0.133	0	1
Livestock Sales	0.421	0.494	0	1
Paid Employment	0.395	0.489	0	1
Other Business	0.152	0.359	0	1
Remittances	0.307	0.461	0	1
Pension	0.303	0.460	0	1
Other	0.076	0.265	0	1
Sources of Food				
Own Farm Production	0.314	0.464	0	1
Purchases	0.969	0.172	0	1
Government Rations	0.064	0.245	0	1
Relative and Friends	0.031	0.173	0	1
Other	0.003	0.050	0	1

Min: minimum, Max: maximum.

and friends. A negligible proportion of households got food from other sources.[5]

Results and Discussions

Overall Results

Tables 3 and 4 present the results for probit and truncated regression models. The marginal effects of the probit model (Table 3), which measure the change in the probability of selling cattle due to a change in regressors, were computed at mean values of the regressors and the dependent variable. The pseudo R^2 for the probit model is very low. However, this should not be alarming for cross-sectional data.

The marginal effects of the truncated regression (Table 4), which were also computed at mean values of the regressors and the dependent variable, represent how the observed variable (i.e number of cattle sold) changes with respect to changes in the regressors. These marginal effects apply for the sub-population (those selling cattle) and are smaller (in absolute terms) than the marginal effects of the whole population (represented by the estimated coefficients) (Bowen and Wiersema, 2004).

Household Characteristics

Household size does not influence the probability of selling cattle but reduces the volume of cattle sold. Thus, for a household selling cattle, an increase in household size by one member would reduce the number of cattle sold by 0.1 heads. Education of the head of household is highly significant in influencing both the probability of selling cattle and the number of cattle sold. An increase in years of schooling by one would increase the probability of selling cattle by 0.5 percentage points. For a participating household, an increase in years of schooling by one would increase the number of cattle sold by 0.05 heads. This was expected as education improves farmers' access to market information as well as its utilization. Even though some argue that increased level of education may result in a lower probability of selling cattle, arising from the opportunity costs of education (Kan, Kimhi and Lerman, 2006; Ehui, Benin and Paulos, 2009), such argument is not supported by the current findings for Botswana.

[5] A majority of households (97%) sourced food through purchases while 31% of households sourced food through own farm production (Table 2). However, the two sources of food have not been included in the models for reasons stated in the results section.

Table 3: Probit Model Results for the Likelihood to Sell

Variables	Coefficient	P>Z	Marginal Effects
Household Characteristics			
HHSS	-0.002	0.953	-0.001
AGEH	0.004	0.000***	0.001
Gender	0.009	0.796	0.003
Married	0.178	0.000***	0.070
Education	0.013	0.000***	0.005
Full time	0.078	0.021**	0.031
Main Livestock Water Source			
Well	-0.090	0.006***	-0.035
Dam	-0.047	0.347	-0.018
River	-0.119	0.011**	-0.046
Pan	0.151	0.391	0.060
Pond	-0.109	0.323	-0.042
Main Water Source Ownership			
Family	0.055	0.206	0.022
Syndicate	-0.101	0.014**	0.039
Community	-0.219	0.000***	-0.084
Government	-0.290	0.000***	-0.110
Other	-0.204	0.000***	-0.079
Herd Dynamics			
Herd size	0.005	0.000***	0.002
Deaths	0.005	0.001***	0.002
Labor Input			
Hired Labor	0.100	0.001***	0.039
Sources of Cash Income			
Paid Employment	-0.369	0.000***	-0.142
Other Business	-0.142	0.000***	-0.055
Remittances	-0.247	0.000***	-0.096
Pension	-0.152	0.000***	-0.059
Other	-0.310	0.000***	-0.117
Sources of Food			
Government Rations	-0.254	0.000***	-0.096
Relative and Friends	-0.157	0.029**	-0.060
Constant	-0.698	0.000***	
No. of observations	12527.000		
LR chi2 (51)	1930.760		
Prob>chi2	0.000		
Pseudo R^2	0.113		
Log likelihood	-7564.497		

***=Significant at 1%, **=Significant at 5%, *=Significant at 10%

Estimates for 25 district dummies are not presented

Table 4: Truncated Model Results for the Number of Cattle Sold

Variables	Coefficient	P>Z	Marginal Effects
Household Characteristics			
HHSS	-4.264	0.000***	-0.079
AGEH	0.246	0.246	0.005
Gender	47.195	0.000***	0.802
Married	15.602	0.031**	0.284
Education	2.499	0.000***	0.046
Full time	8.582	0.200	0.157
Main Livestock Water Source			
Well	-40.576	0.000***	-0.710
Dam	-123.547	0.000***	-1.735
River	-80.573	0.000***	-1.220
Pan	63.000	0.148	1.478
Pond	-211.844	0.005***	-2.294
Main Water Source Ownership			
Family	-42.748	0.005***	-0.718
Syndicate	-36.049	0.000***	-0.635
Community	-73.539	0.000***	-1.144
Government	-126.491	0.000***	-1.685
Other	-62.408	0.000***	-1.031
Herd Dynamics			
Herd Size	0.217	0.000***	0.004
Deaths	0.414	0.000***	0.008
Labour Input			
Hired farm Labour	99.002	0.000***	2.043
Sources of Cash Income			
Paid Employment	-20.976	0.000***	-0.381
Other Business	23.716	0.002***	0.465
Remittances	-2.471	0.723	-0.046
Pension	7.264	0.284	0.136
Other	-89.081	0.000***	-1.304
Sources of Food			
Government Rations	-108.266	0.000***	-1.505
Relatives and Friends	-29.205	0.130	-0.494
Constant	-279.815	0.000***	
Sigma	38.043		
No. of observations	5288.000		
Wald chi2 (51)	230.310		
Prob>chi2	0.000		
Log likelihood	-14702.967		

***=Significant at 1%; **=Significant at 5%; and *=Significant at 10%.

Estimates for 25 district dummies are not presented.

An increase in the household head's age by one year would increase the probability of selling cattle by 0.1 percentage points and would have no influence on the number of cattle sold by participating households. The effect of age on the likelihood to sell cattle confirms results for Namibia (De Bruyn et al., 2001). Since older farmers are relatively more experienced, they are more likely to have established contacts with buyers, increasing the probability of market participation. The probability of selling cattle is not influenced by gender. However, a participating male-headed household sells 0.8 heads more than a participating female headed-household. A married household head is 7 percentage points more likely to sell cattle than an unmarried household head. For participating households, a married household head sells 0.3 heads of cattle more than an unmarried household head. This may result from increased cash needs associated with marital responsibilities (Nnadi and Akwiwu, 2008).

Households engaged in full-time farming are 3.1 percentage points more likely to sell cattle than those practicing part-time farming. However, for participating households, there is no difference between full-time and part-time farmers with respect to the volume of cattle sold. The positive effect of full-time farming on the probability of selling cattle may in part be that full-time farmers depend more on cattle farming as a source of income, increasing the need to sell to finance household consumption and reinvestment in cattle production. Thus, the less likelihood to sell by part-time farmers could be due to the possibility of them having alternative income sources to meet consumption needs and to finance cattle farming operations.

Main Water Sources for Livestock

Water sources include boreholes, wells, dams, rivers, pans and ponds. These appear as binary variables in the data set with a value of one assigned to indicate that the water source was identified as being the main source of water for livestock and a value of zero assigned if the water source is not the main source of water for livestock. The variable borehole was excluded from the model and serves as a reference variable against which the differential impacts of other water sources are measured. Results show that households watering livestock from wells (rivers) are 3.5 (4.6) percentage points less likely to sell cattle than those using boreholes. Moreover, a participating household using a well (a river) sells 0.7 (1.2) less heads than a participating household which uses a borehole.

Sourcing water from dams rather than boreholes, has no significant effect on the probability to sell cattle. However, a participating household which uses a dam sells 1.7 heads of cattle less than a participating household which waters livestock from a borehole. Similarly, sourcing water from ponds rather than boreholes, has no effect on the probability to sell cattle, but a participating household which uses a pond sells 2.3 heads

less than a participating household which uses a borehole. Using pans rather than boreholes has no impact on both the probability to sell cattle and the number of cattle sold by a participating household.

Generally, the above sources of water for cattle are likely to have lower user fees than boreholes; they are associated with lower production costs than boreholes. A farmer who owns a borehole (base variable) is expected to sell more cattle to finance the costs associated with running and maintaining it. In cases where a farmer does not own a borehole but uses one to water cattle, we expect him/her to contribute user fees to the owner. Hence, generally, all borehole users (both owners and non-owners) are likely to have a higher probability to sell cattle, or/and higher cattle sales volumes, than users of other water sources. Moreover, the use of boreholes, rather than rivers or dams, reduces the chances of cattle straying, leading to an increased likelihood of selling cattle and/or the number of cattle sold.

Main Water Source Ownership

Main water source ownership variables included self, family, syndicate, community, government and other. These are categorical variables with a value of one assigned for households identifying a variable as affirming ownership and a value of zero otherwise. The variable self was excluded from the model and serves as a reference point against which the impacts of other variables are measured. Compared with self ownership (the base variable), family ownership of the main water source has no effect on the probability of selling cattle. However, a participating household which uses a family-owned water source is likely to sell 0.7 heads less than a participating household which uses a self-owned water source.

Households that use syndicates are 3.9 percentage points less likely to sell cattle than those that use self-owned water sources. Moreover, a participating household which uses a syndicate sells 0.6 heads of cattle less than a participating household that uses a self-owned water source. These results are expected since self- ownership implies that the household bears the full cost of borehole maintenance leading to the need to participate and/or sell more cattle, while family or syndicate ownership imply cost sharing amongst members; hence the need to reduce market participation and/or sell fewer cattle.

Households that use community-owned water sources are 8.4 percentage points less likely to sell cattle than households that use self-owned water sources. A participating household that uses a community-owned water source sells 1.1 heads of cattle less than a participating household that uses a self-owned water source. Households that use government-owned water sources are 11 percentage points less likely to sell cattle than those using self-owned water sources. Once participation decision has been made, a

household that uses a government-owned water source sells 1.7 less cattle than that which uses a self-owned water source. Using a water source owned by 'other' rather than a self-owned water source also reduces the probability of selling cattle (by 7.9 percentage points), and the number of cattle sold by a participating household (by one head). The negative coefficients are attributed to the lower costs of utilizing (running and maintaining) a community, 'other' or government-owned water source, compared to a self-owned water source, which may necessitate increased likelihood of market participation and/or number of cattle sold by participating households.

Herd Dynamics

Cattle herd-size increases the probability of selling cattle and the number of cattle sold. An increase in herd-size by one animal increases the probability of selling cattle by 0.2 percentage points and for a participating household it increases the volume of cattle sold by 0.004 heads. Cattle deaths also have a positive influence on the likelihood to sell cattle as well as on the number of cattle sold. An increase in the number of deaths by one animal would increase the probability of selling cattle by 0.2 percentage points and the number of cattle sold by a participating household by 0.01 heads. This may imply that farmers sell more cattle as a risk aversion strategy, to guard against the likelihood of the occurrence of further deaths. Montshwe (2006) also observed a similar pattern in South Africa.

Hired Labor Input

Having hired farm labor increases both the likelihood to sell cattle and the number of cattle sold, as this is a form of cost that needs financing. Households that use hired labor are 3.9 percentage points more likely to sell cattle than those without hired labor. For a participating household, the use of hired labor increases the number of cattle sold by two heads.

Sources of Income

The different sources of cash income identified in the data set include sale of livestock, sale of crop produce, paid employment, other business income, remittances, pensions and other. These are all binary variables and each household may have more than one source of cash income. We excluded sale of livestock from the model since it is the dependent variable and sale of crop produce because it is endogenous; as there may be a two-way causality between sale of livestock and sale of crop produce. The results indicate that paid employment reduces the probability of selling cattle by 14.2 percentage

points and the number of cattle sold by participating household by 0.4 animals. This is because the availability of an alternative income source yields reduced pressure on farmers to sell cattle. The results confirm the findings obtained in Kenya (Baldwin et al., 2008; Vincent et al., 2010). It can therefore be inferred that a public works program, such as Ipelegeng, would reduce both market participation and cattle sales volume since beneficiaries of this program are remunerated in cash.

Sourcing income from other businesses reduces the probability of selling cattle by 5.5 percentage points and for a participating household it increases the number of cattle sold by 0.5 heads. The positive coefficient for the number of cattle sold implies that proceeds from cattle sales are used to finance other businesses. Remittances reduce the probability of selling cattle by 9.6 percentage points and have no effect on the volume of cattle sold by a participating household. Similarly, pensions reduce the probability of selling cattle (by 5.9 percentage points) but have no influence on the number of cattle sold by a participating household. Income from other sources reduces the probability of selling cattle by 11.7 percentage points and the number of cattle sold by a participating household by 1.3 heads. In sum, and consistent with findings elsewhere (Makhura, 2001; Baldwin et al., 2008; Uchezuba, Moshabele and Digopo, 2009; Ehui, Benin and Paulos, 2009), alternative income sources discourage participation in cattle marketing.

Sources of food identified in the dataset include own farm production, purchases, government rations, relatives and friends and other. Each household may have more than one source of food. We included government rations and relatives and friends in the model.[6] The results indicate that households receiving government food rations are 9.6 percentage points less likely to participate in cattle marketing than those who do not. Moreover, a participating household that receives government rations sells 1.5 less heads than a participating household without government rations. This reflects the reduced need to sell cattle to finance food purchases. Similarly, households receiving food from relatives and friends are six percentage points less likely to sell cattle than those who do not. However, once a participation decision has been made, receiving food from relatives and friends has no influence on the volume of cattle sold.

There could be a concern that as government food rations are likely to be given to poor households, the negative coefficients for the government food rations dummy may be simply capturing the fact that poor households do not have many cattle to market.

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[6] A specification which included own farm production produced a coefficient carrying a positive sign for the probit model, which was not consistent with a priori expectation. This variable was therefore excluded from the model. The estimated coefficients for the remaining variables did not change much as a result of excluding the variable, and qualitative conclusions remained the same.

Table 5: Households Receiving Government Rations by Herd-Size

Number of Cattle Owned	Number of Households Receiving Government Rations	Total Number of Households	Share of Households Receiving Government Rations (%)
1-10	433	4,153	10.4
11-20	173	2,700	6.4
21-30	78	1,841	5.3
31-40	44	916	4.8
41-50	21	605	3.5
51-60	8	430	1.9
61-70	10	306	3.3
71-80	5	246	2.0
81-90	6	183	3.3
91-100	5	189	2.7
101-150	12	623	1.9
151-200	3	269	1.1
201-300	1	220	0.5
301-400	2	83	2.4
>400	1	123	0.8
Total	802	12,157	6.4

However, as not all food transfer programs are means tested, a cross-tabulation of the government food rations variable and herd-size revealed that program beneficiaries are found across the herd-size distribution (Table 5). Moreover, the inclusion of herd-size as one of the explanatory variables should control for the possibility that beneficiaries market less cattle simply because they have fewer cattle. Therefore, the estimated coefficient for the government food rations dummy captures the impact of public food transfers on cattle marketing.

Summary and Conclusions

This paper examined factors underlying communal beef cattle marketing decisions in Botswana. Results show that market participation is significantly influenced by household characteristics such as age, marital status, gender, education of the head of household and household size. Age of the household head has a positive impact on the probability of selling cattle and has no influence on the number of cattle sold by a

participating household. Gender has no impact on the probability of selling cattle. However, a participating male headed household sells more cattle than a participating female headed household. Households with married heads are more likely to sell cattle than those headed by unmarried individuals, and a participating household headed by a married person markets more cattle than a participating household headed by an unmarried person. This might be due to marital responsibilities.

Household size does not have a significant effect on the probability of selling cattle but reduces the volume of cattle sold by a participating household. Education level of the head of household positively influences both the probability of selling cattle and the volume of cattle sold by a participating household. This suggests that education is used as an input in utilizing market information, which enhances market participation.

Full-time farmers are more likely to sell cattle than part-time farmers. This might be due to limited alternative income sources to finance consumption and cattle farming operations. Put differently, part-time farmers are more likely to finance consumption and farming operations from income earned elsewhere, while full-time farmers may be forced to sell cattle to finance consumption and farming operations.

When measured against using boreholes, sourcing water from wells and rivers reduces both the likelihood of selling cattle and the number of cattle sold by a participating household, while sourcing water from dams and ponds only reduces the number of cattle sold by a participating household. This is because boreholes have higher operation and maintenance costs than these other water sources, which may need financing through cattle sales. When measured against self-ownership, community-, other- and government-ownership of a main water source reduce both the probability of selling cattle and the number of cattle sold by a participating household. This is attributed to the fact that operating a self-owned water source may be more costly than using community- or government-owned main water sources, and would require selling cattle to finance operation and maintenance costs.

The key finding of this study is that nonfarm income sources (pensions, remittances, paid employment, other businesses, government food rations, and food supplies from relatives and friends) affect marketing decisions. Paid employment and government food rations reduce both the probability of selling cattle and the volume of cattle sold by a participating household, while pensions, remittances and food from relatives and friends only reduce the probability of selling cattle and have no impact on cattle sales volume of a participating household. Households that source cash income from other businesses are less likely to sell cattle but once they have decided to participate, they sell more cattle than those without other businesses. The positive influence on the number of cattle sold implies that cattle sales are used to finance other businesses.

Generally, these results were expected for a communal production system where the general motive is to accumulate cattle inventory as a store of wealth (BIDPA, 2006). In such a production system, cows and bulls are treated as the current breeding stock while heifers and female calves are the future breeding stock. Oxen are usually the candidates for marketing, while steers will be marketed in the near future after reaching marketable age. Cows and bulls are marketed only for culling purposes or when there are emergency cash needs that need financing and there are not enough oxen to sell. Steers and heifers may be sold for the same reason. Under the production system, having alternative sources of income reduces emergency cash and food needs, leading to reduced market participation and cattle inventory accumulation (to store wealth).

The question is whether the results present a policy dilemma as alternative income (cash and food) sources include publicly provided programs meant to reduce poverty. Thus, while these programs increase household food security and welfare, they also discourage farmers from marketing cattle and hence may contribute to poor beef export performance, and lower foreign exchange. Cattle inventory accumulation may also lead to environment degradation from overstocking and overgrazing. There is need, therefore, to ensure that such programs are targeted at the poor to minimize their adverse impacts on beef industry performance.

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