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Determinants of soybean market participation by smallholder farmers in Zimbabwe

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This article examines the determinants of soybean market participation by smallholder farmers in Zimbabwe, with a view to identifying key policy entry points for increasing farmer incomes. Market linkages have been identified as key to the successful integration of grain legumes into the smallholder farming systems of southern Africa. Data for this article is derived from a baseline household survey in Guruve district of Zimbabwe. Using a sample of 187 smallholder farmers, we employed the Heckman's Probit model with sample selection to firstly, identify the factors affecting a farmer's decision to participate in soybean markets and secondly, evaluate the factors that affect the intensity of a farmer's participation. Study findings show that the use of inoculants and improved soybean seed varieties are significantly correlated with participating in soybean markets. Results also show that ownership of radios has a positive effect on the household's decision to participate in the soybean market. Further results show that male-headed households are less likely than female-headed households to participate in soybean markets because legumes are seen as women's crops in Zimbabwe. We conclude that in order to leverage smallholder farmers' market participation in soybean markets, it is important to improve access to inoculants and improved soybean seed varieties and improving access to market information. We recommend that authorities could improve access to market information to improve farmers' decision making on soybeans market participation.

Key words: Soybean, market participation, determinants, smallholder farmers, Zimbabwe.

INTRODUCTION

Market linkages have been identified as key to the successful integration of grain legumes into the smallholder farming systems of southern Africa (Chianu et al., 2009). Soybean (*Glycine max*) is a commodity with relatively higher prices and that has shown great potential to sustain production in smallholder farming systems due to its multiplicity of use. Soybean can be used as cash crop, as food and also as means of improving soil

fertility through Biological Nitrogen Fixation (BNF). The net income benefits derived from soybean production depend on the extent to which farmers participate in output markets. According to IFAD (2003), market participation can be an effective route for rural smallholder farmers to move out of abject poverty and increase income. Studies show that market participation by smallholder farmers in developing countries is very

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low (Barret, 2008). This scenario has slowed down agriculture driven economic growth and exacerbated poverty levels. As such farmers cannot benefit from the welfare gains and income growth associated with market participation. However, for agriculture to meaningfully contribute to economic growth, smallholder farmers have to commercialize their farming activities to produce marketable surpluses (Jagwe et al., 2010). The issue of why most smallholder farmers who happen to make the larger proportion of the poor in developing countries self select themselves out of the remunerative markets remains largely unanswered. It is therefore necessary to identify the key determinants of soybean market participation by smallholder farmers in order to be able to identify key entry points and interventions that can increase household income.

The trade theory posits that if households participate in markets by selling surplus of what they produce on a comparative advantage, they are set to benefit not only from the direct welfare gains but also from opportunities that emerge from economies of large-scale production (Siziba et al., 2011; Barrett, 2008).

Indeed, they will also benefit from technological change effects from the improved flow of ideas from trade-based interactions (Barrett, 2008). Consequently, there will be improved factor productivity. Despite the stream of benefits that are inherent with market participation, evidence from studies in southern Africa shows that smallholder farmers' participation in agricultural output markets is low due to high market transaction costs, information asymmetries, institutional constraints among other constraints. Barret (2008) argues that inducing market participation through trade and price based market interventions does not provide the sufficient conditions to induce improved participation. In addition to these policies, households need to have access to productive assets, adequate private and public investment, institutional and physical infrastructure to access remunerative markets (Siziba et al., 2011; Barret and Swallow, 2006). As noted by Barret (2008) such smallholder farmers with access to production, private and public sector goods, properly functioning institutions and well developed physical infrastructure actively participate in markets contrary to their counterparts.

However, the general trend in most southern African countries is that most agricultural produce is lost soon after production largely because of poor post harvest handling and failure to access the formal markets (Phiri and Otieno, 2008). This trend is attributed to several factors and barriers in agricultural commodity marketing that discourage smallholder farmers from participating in formal markets. These factors range from household characteristics for instance low education levels, labor shortages, inadequate government services, high transaction costs and lack of physical infrastructure (Siziba et al., 2011, Jagwe et al., 2010; Pingali et al., 2005). In response to these challenges, most

governments in Sub Saharan Africa implemented market liberalization policies in the 1980s and 1990s which sought to open new market led economic growth opportunities (Barrett, 2008). It involved the abolition of commodity boards, introduction of free markets and encouragement of private sector participation. According to Jayne and Jones (1997), although the overall aim of the liberalization was to improve the functioning and effectiveness of markets, it produced mixed results. In some cases, there was actual retreat to subsistence agriculture while in others there was increased market participation in more remunerative markets, technological progress and improvements in institutions and physical infrastructure.

This study sets to establish factors affecting soybean market participation and the level of marketed surplus among smallholder farmers. The results of this study are essential in contributing to the existing body of knowledge on soybean market participation which is scant locally as most previous research concentrated on biophysical aspects of soybean production. Therefore, understanding smallholder marketing of soybean is vital for increased participation which may lead to increased farmer incomes, improved soil fertility and ultimately reduced poverty. Information from this study will be useful to agricultural policy makers to create or amend existing policies in an effort to develop the soybeans production and markets as well as motivate producers to access soybean commodity markets.

Smallholder soybean production in Zimbabwe

Historically, soybean production in Zimbabwe was highly mechanised and carried out by commercial farmers in high rainfall areas (Estehuizen, 2011). The commercial farmers had easy access to inputs, financial capital, irrigation services and well developed marketing channels (Madanzi et al., 2012). The output from commercial farmers accounted for 95% while smallholder farmers contributed only 5% of national soybean output (Estehuizen, 2011). Smallholder farmers used unimproved retained seeds and did not have access to *Bradyrhizobium* inoculant and this contributed to yields as low as 0.6 t ha⁻¹ compared to 3 to 4 t ha⁻¹ in the commercial sector (Mabika and Mariga, 1996). The smallholder farmers lacked general knowledge on good agronomic practices. Shumba-Munyulwa (1996) noted that agronomic research on soybean production was confined to the commercial sector and extension in smallholder farming sectors was limited. This implies that the recommendations from such agronomic studies could not be applied to smallholder farming.

In 1996, the government formed the National Soybean Task Force (NSTF) whose mandate was to help increase the participation of smallholder farmers in soybean production and marketing (Madanzi et al., 2012). In

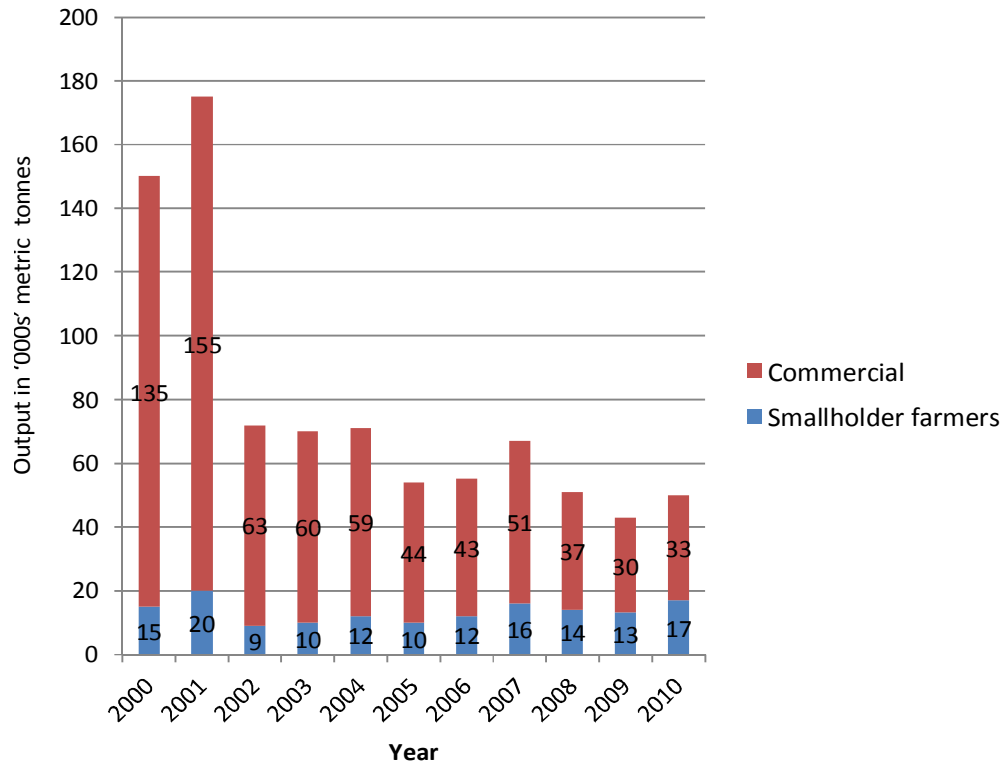


Figure 1. Soybean production in Zimbabwe in "000' metric tonnes. Source: Technoserve, 2011.

particular the programme provided agricultural extension, access to cheap inputs and linkages to markets to smallholder farmers. When the programme started, it enrolled 55 smallholder farmers but by end of 2006 the programme had reached a total of 55,000 smallholder farmers who produced 40,000 t per annum (Chianu et al., 2009). Complimentary efforts have been done by Africare and the N2Africa Project in Zimbabwe who are assisting the smallholder farmers with agronomic knowledge on soybean production in addition to market linkages. Despite these efforts, soybean producing smallholder farmers face challenges such as access to cheap inputs and rhizobium (Madanzi et al., 2012). Although the Rhizobium is produced by Zimbabwe's Soil Productivity and Research Laboratory (SPRL) at a break-even price of \$3.20 and distributed through Agricultural Technical and Extension services (AGRITEX) at a retail price of \$5.00, some farmers claim that they access the inoculant at more than double the cost (Woomer et al., 2013). The seed houses are not producing sufficient quantities of soybean seed for the market as the smallholder farmers do not purchase the improved seed.

Despite the government's efforts in distributing land from the commercial farmers to landless peasants, Zimbabwe is still facing huge deficits in soybean production with demand far outstripping current production levels. Zimbabwe's annual demand for soybean is 125,000 metric tonnes while production has

been fluctuating far below the equilibrium quantity (Varia, 2011). At present, the demand deficits have been filled by imported soybeans from South Africa, Zambia and Malawi. Zimbabwe is only producing 30% of its national demand of 125,000 metric tonnes and capacity utilization at the major soybean processors is only 16% (Technoserve, 2011). The huge demand deficit in soybean production offers an opportunity for smallholder farmers to produce large quantities of soybeans, participate in markets and improve household income. Since soybean is renowned for its high propensity to fix nitrogen, intensive market participation by smallholder farmers would also improve soil fertility and yields for subsequent crops such as maize if farmed on the same land in rotation. However, despite this market opportunity particularly from the booming livestock and poultry industries where soybean is used to produce animal feed, smallholder farmers are producing very low quantities of soybean for sale and market participation is very low as shown in Figure 1.

Figure 1 shows the contribution of smallholder farmers to national output has remained very low between 2002 and 2010. The observed trends in soybean production, presents an opportunity for smallholder farmers to exploit the market by increasing production of soybeans, as well as participating in its supply chain for income generation. However despite the income generation potential of soybean for smallholder farmers and the huge supply

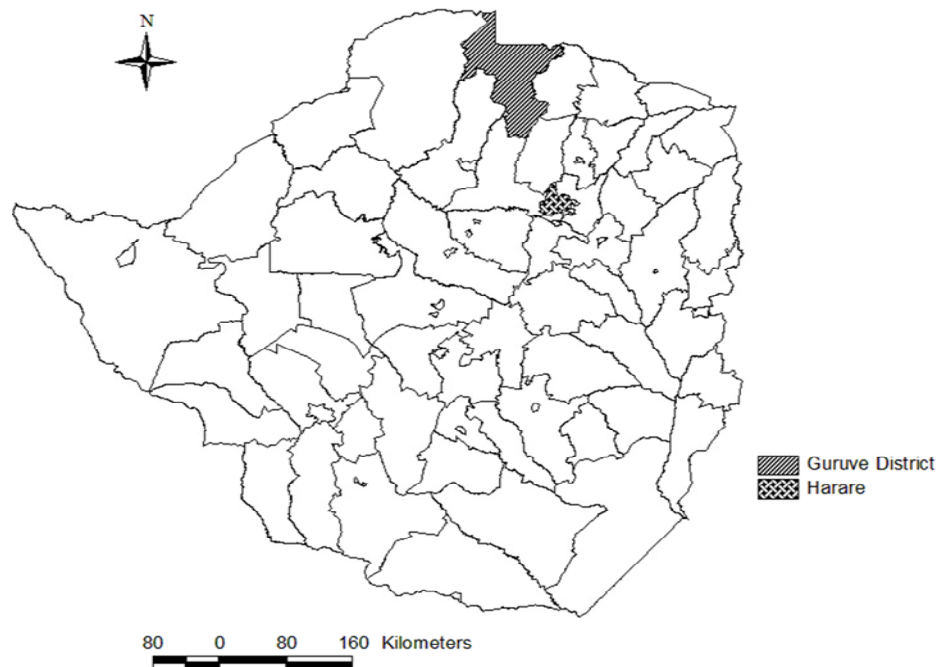


Figure 2. Map of study site: Zimbabwe's Gurube district.

deficit in Zimbabwe, research on soybean has largely focused on biophysical aspects such as yield enhancement, production practices and nutrient use efficiency. There is a lack of information on soybean market participation by smallholder farmers and in particular the factors that influence the level of marketable surplus. Smallholder farmers' market participation is equally important if the full benefits from soybean production are to be realized. The studies on factors affecting smallholder market participation have not been fully exploited especially for soybeans. Most studies (Siziba et al., 2011; Okoyo et al., 2010; Jagwe et al., 2010) conducted on factors influencing smallholder market participation have concentrated on staple crops, that is, maize, cassava and bananas.

Since staple crop markets are very different from soybean markets, recommendations from such studies may not be applicable to soybean markets. Thus this study is an attempt to fill the knowledge gap on soybean market participation by smallholder farmers. To the best of our knowledge, this is the first such study in Zimbabwe, which seeks to identify factors influencing soybean market participation and the intensity of market participation by smallholder farmers.

THE STUDY APPROACH

Study site

This study was conducted in Gurube district, which is linked to

Mashonaland west province of Zimbabwe (Figure 2). The district is linked to the main legume market, Harare, by a 151km tarred road. Although most of Gurube district lies in natural farming region IV, which is a semi-arid and marginal zone, the study sites lie in natural farming region II. The annual average rainfall is 600 mm while the annual average temperature is 26.5°C. This natural farming region is an agro-ecologically high potential zone suitable for growing soybeans, maize and common beans. The altitude range is 800 to 1500 m above sea level. The main livelihood activity is farming with maize being the dominant cereal crop while soybeans and common beans constitute the main legume cash crops.

Sampling and data analysis

This study uses cross sectional household data from the baseline survey collected using a questionnaire with semi structured and structured questions. A sample of 187 of actual greater than 128, an a priori power analysis computed using G Power. It therefore means that the sample provides acceptable statistical power (that is 0.80) for moderate correlation $r = 0.30$, at two tailed 0.05 level of significant (Franzel et al., 2007). Random sampling was used to select the wards and the households for interviewing from the lists that were provided by resident agricultural extension officers. In the first place, 10 households per ward were randomly selected from six wards where the project is being implemented while the 127 all came from a counterfactual site.

A counterfactual site is a site similar to the intervention (treatment) in agroecological and market conditions but did not receive a treatment (Binam et al., 2011). The 127 sampled households in the counterfactual site were randomly sampled from 6 wards that did not participate in the project. The sampling approach followed by the project was meant to allow the use of propensity score matching approach in impact assessment. Data collection for this study was done in October 2011 through face-to-

face administration of questionnaires. The survey collected information on household composition and characteristics, crop production, household market participation, access to infrastructure, household incomes, ownership of land and non land assets, livestock ownership and access to agricultural inputs on credit.

The analytical approaches

The data was entered, cleaned and then analyzed using STATA Version 11.2. The study uses the Heckman's model with sample selection to identify the factors that affect smallholder farmers' decision to participate in soybean markets and then to evaluate the factors that affect intensity of soybean market participation. This model is adopted on the basis that it models the market participation decision as a two step process that involves (1) the household deciding on whether or not to participate in the soybean market (2) the level of market participation. The factors influencing the farmers' decision to participate are estimated using the Probit model (selection equation) while the level of participation is estimated using the Ordinary Least Squares approach (Outcome equation). Goetz (1992) and Huang et al. (1991) noted that the use of Heckman's model with sample selection allows the interpretation of results by distinguishing between factors that affect the farmer's decision to participate in the market and those that affect the level of market participation.

According to Greene (2003), in instances where observed characteristics only occur in subsets, incidental truncation occurs. As such, this study uses this model as it corrects for sample selection bias and incidental truncation. The selection bias arises due to the observation of sales from a subset of households who participated in the soybean markets. The empirical analysis in this study is premised on three constructs namely household characteristics, information and assets. In this study, the econometric analysis is based on these constructs to reflect the effect of transaction costs on farmer's decision to participate in the market and also the level of market participation. Variables hypothesized to explain smallholder farmers' soybean market participation and level of participation were identified based on theoretical framework and on past empirical work on market participation under transaction costs (Goetz, 1992; Holloway et al., 2000; Key et al., 2000; Alene et al., 2008; Jagwe et al., 2010; Siziba et al., 2011).

This study builds on earlier studies on smallholder market participation under transaction costs by applying this to smallholder market participation in soybean markets. Based on these constructs as in Jagwe et al. (2010), in this study household head's gender, head's age, head's age squared and household size are used as proxies for household characteristics. Livestock wealth or resource endowment is represented by number of cattle owned while information is represented by contact with extension, household head education, distance to nearest market, ownership of radio and ownership of a mobile phone. These constructs are used in the analysis to reflect the influence of transaction costs on the farmer's decision to participate in a soybean market and to estimate the significant factors that influence the level of market participation.

The outcome regression

The outcome model is conditional on market participation and it is estimated using the Ordinary Least Squares (OLS). In the OLS equation, the dependent variable is amount of soybeans sold (continuous variable). In this paper we hypothesized that gender of household head, age of household head, size of the household, farming experience; ownership of cattle and distance to the market

affect the intensity of a household's participation in the soybean market—following Jagwe et al. (2010).

Selection equation

In the selection equation, that is the Probit model, the dependent variable is a dichotomous variable 'participation in soybean market (represented as 1 when a household participates in the market and 0 otherwise)'. The independent variables that condition the participation of smallholder farmers as adapted from literature are gender of household head, age of household head, size of the household, farming experience; ownership of cattle, ownership of radio, ownership of cellphone, access to extension, use of rhizobial inoculants and use of improved soybean seed varieties (Table 1). Age may influence market participation through various channels such as experience, access to resources and risk preferences. The expected direction of the effect of age is thus ambiguous. The gender of a household head is likely to reveal the differences in market orientation between male and female household heads. Cunningham et al. (2008) argues that male household heads sell their produce when prices are high while female household heads keep their produce for household food self sufficiency. We thus expect the sign to be positive meaning that male-headed households are more likely to participate in soybean markets as compared to their female counterparts.

Alene et al. (2008), posit that the household size is an indicator of the amount of family labor that is available for production activities.

It also explains the consumption levels for a household. We thus expect the sign to be positive when a household's labor resources are efficient that is they produce far more output than what they require for household consumption. In such a case, there is high marketable surplus. However, if the sign is negative it is an indicator of household labor inefficiency that is, a larger household produces far less than what it needs for household consumption and thus less marketable surplus. According to Omiti et al. (2009), the distance to the market negatively influences both the household's decision to participate in the market and the amount sold (intensity of participation). The further the distance to the market, the higher the transport costs and the lower the net benefit to the household. Key et al. (2000) note that farmers who stay in remote areas have low input use that is, they normally substitute high value commercial varieties with locally easily obtainable varieties.

Consequently, this input substitution has adverse effects on productivity, market participation and marketable surplus. We thus expect a negative relationship between distance to market and likelihood to participate in marketing. This implies that the higher the distance to the nearest selling points, the lower the likelihood of a household to participate in markets. However, Fafchamps and Hill (2005) observed that wealthy farmers can sell their produce to distant markets as they can afford the high transport costs compared to the poor farmers. This then implies that we expect the resource constrained farmers to participate in local markets while the resource endowed farmers participate in distant markets.

Most economists argue that relative prices form critical incentives to induce market participation and increase the amount of marketable surplus (Alene et al., 2008; Fafchamps and Hill, 2005). Smallholder farmers in Zimbabwe access market information on prices of inputs and output through contact with extension agents, radios and phoning the buyers using cell phones. Knowledge of input prices enables farmers to make informed decisions on input use intensity and also the area to commit to soybeans. We argue that access to price information positively influences the farmers' decision to participate in soybean markets while the lack of it acts as a disincentive. We therefore expect a positive relationship

Table 1. Description of covariates used in the regression models.

Variable	Description	Measurement	Expected sign
Household characteristics			
Age	Age of household head	Number of years	+
Age squared	Age of household squared		+
Gender	Gender of household head	0=female; 1=male	
Household size	Number of people in a household	Number	+
Farming experience	Number of years household head has been farming as a household	Number of years	+
Information			
Distance to market	Average distance from household's home to nearest point of sale	Km	-
Household education	head's Education level of household head	0=no secondary education 1=has secondary education	+/-
Access to extension	Access to agricultural extension for crop production advice	0=no access	+/-
Own cellphone	Ownership of a cellphone	0=does not own 1=owns a cellphone	+/-
Own radio	ownership of radio	0=does not own 1=owns a radio	+/-
Assets			
Number of Cattle Owned	Number of cattle owned	Ratio	+

between a household's decision to participate in the soybean market and its access to market information, ownership of a radio and or cellphone. By accessing extension agents, farmers get advice on good agronomic practices, improved technologies and market prices. We therefore expect the sign to be positive when farmers have access to extension agents and negative otherwise. According to Zingore et al. (2007), ownership of cattle is a major determinant of the timeliness of agronomic operations. We assume that the resource-endowed farmers may use their livestock for traction to till larger pieces of land and for transportation to the market. According to Alene et al. (2008) and Zingore et al. (2007) cattle ownership has a wealth effect, in that those households who own animals are more likely to use fertilizers than those without. The resource endowed households are also more likely to have cash resources to finance basal fertilizer purchases, inoculants and improved soybeans germplasm (Zingore et al., 2007). Varia (2011), notes that resource constrained smallholder farmers lack access to finance, give less priority to their non staple crops and use poor agronomic practices. The combined effect of these factors is very low yields and low market participation compared to the commercial farmers who have higher use of herbicides and fertilizers. We thus expect a positive relationship between wealth (resource endowment) and intensity of market participation as such households are more likely to have higher marketable surplus. According to Alene et al. (2008), access to agricultural extension services enhances market participation and marketable surplus as agents provide technical assistance and information on improved varieties and technologies.

Extension agents are the information exchange platform between research and farmers; they decode information from researchers into a format understandable by farmers and also provide feedback to the researchers. These results were also observed by Siziba et al. (2011), who noted that access to extension services reduces farmers risk perceptions and thus improve market participation. We thus expect a positive relationship between access to extension services and market participation in soybean markets.

RESULTS AND DISCUSSION

Sample characterization

The household survey results in Table 2 show that only 28.88% (54 out of 187 farmers) of the sampled households participated in the soybean market. The average marketable surplus for households that participated in the soybean market is 211.26 kg. These results are consistent with findings by Ojiem et al. (2007) and Giller et al. (2006) who note that soybean output is very low in smallholder farming communities largely because farmers apportion at most 5% of their land to legumes and do not fertilize them leading to low yields. The low levels of marketable surplus could also be a

Table 2. Description of sample household and socioeconomic characteristics.

Parameter	Market participants	Non market participants	p-values
Sample n (prop)	54 (28.88)	133 (71.12)	
Head age (years)	43.76(12.96)	50.43(16.60)	0.0089
Household size	5.33(3.16)	5.18(2.77)	0.7433
Head education (% prop with secondary)	59.26(0.50)	46.62(0.50)	0.1184
Farming experience (no. of years)	15.13(11.94)	20.42(15.51)	0.0257
Gender (%prop of male)	75.93(0.43)	79.7(0.40)	0.5709
Own mobile phone (%prop)	68.52(0.47)	63.91(0.48)	0.5511
Own Radio (% prop)	68.52(0.47)	52.63(0.50)	0.0469
Number of cattle owned	2.35(3.46)	2.35(3.61)	0.0027

result of low input usage and the substitution of commercial high value varieties with low yielding locally available varieties. The results show that the average household head for market participating households (43.76) is significantly lower with a standard deviation of 12.96 than that of non-participating households (50.43) that has a standard deviation of 16.60 and this is significant at 1% level of significance. The probability of younger farmers to participate in soybean market is higher than that of older farmers. The results from the survey show that amongst the market participating households, 75.93% are male headed while 79.70% of the non-market participating households are male headed. Since the p-value is 0.5709, there is thus no statistically significant difference between the two groups of soybean farmers.

Results for the average household sizes show that the mean household size for market participants is 5.33 with a standard deviation of 3.16 while that for non-market participants is 5.18 with a standard deviation of 2.77. Although the household sizes were slightly lower than the national average household size of six, the p-value of 0.7433 indicates that there were no significant differences in household sizes between the market participating and non-market participating farmers. In terms of farming experience, there were statistically significant differences observed between soybean market participating households and the non-market participants at 5% level of significance. Households that participated in the soybean market on average had 15 years of farming experience compared to their counterparts with over 20 years. The 2 sided t test results show that the difference in farming experience is statistically significant at 5% level of significance. This implies that the probability of less experienced to market soybean is very high.

The results also show that 68.51% (standard deviation 0.47) households who participated in the soybean market owned radios while 52.63% (standard deviation 0.50) amongst non-market participants owned radios. Since the p-value is 0.0469, we observed significant differences between the two groups at 5% level of significance. This

means that ownership of radios is common among market participating households than non-market participating households. As such, owning a radio increases the probability of marketing soybeans.

Although, we estimated that 68.5% of the soybean market participating households owned cellphones with a standard deviation of 0.47 compared to 65% with a standard deviation of 0.48 for non-participating households; the p-value of 0.5511 shows that there were no statistically significant differences in the proportions. This suggests that cellphone ownership is not a determinant of soybean market participation among the smallholder farmers.

Econometric results

The results from the econometric analysis for the market participation (Probit Model results) and intensity of market participation (OLS regression model) are presented here. Intensity of market participation is estimated conditional on the smallholder farmers' market participation decision.

Factors affecting soybean market participation

Table 3 presents the OLS results for intensity of market participation and the Probit model results for smallholder farmers' decision to participate in the soybean market. The OLS regression model estimates the factors affecting the intensity of participation in a soybean market while the Probit model estimates the determinants of the dichotomous soybean market participation variable.

Selection model results (Probit model results)

The results in Table 3 show that for the Probit model, gender of household head, ownership of a radio, access to agricultural extension services, use of inoculants and use of improved soybean seeds affect the farmers

Table 3. OLS and Probit Estimates for soybean market participation and intensity of participation.

Dependent variable	Probit (selection model)		OLS (outcome)	
	(soybean bean market participation)		(Amount of soybean sold)	
	β	p-value	β	p-value
Gender	-0.847	0.004***	6.249	0.345
Head age	-0.063	0.172	0.210	0.536
Head age squared	0.000	0.488	0.004	0.490
Household size	0.045	0.511	-0.403	0.256
Farming experience	-0.001	0.939	-0.367	0.183
Ownership of cattle	0.003	0.283	0.023	0.094*
Distance to market	-	-	3.921	0.014**
Own radio	0.672	0.0060***		
Own cellphone	0.003	0.992		
Access to extension	0.4185	0.086*		
Used Inoculants	0.894	0.016**		
Use improved seed varieties	0.684	0.041**		

*** Significant at 1% level; ** significant at 5% level; * significant at 10% level.

decision to participate in the soybean market as a seller. The gender of the household head negatively influences the likelihood of smallholder farmers' participation in the soybean output market, that is male headed households are less likely to participate in soybean markets than female headed households. The probable explanation is that in Guruve district as in other parts of Zimbabwe, most legumes are culturally viewed as women's crops. These results are consistent with the findings of Alene et al. (2008) for Kenya but contrary to the findings of Cunningham et al. (2008) in a study on gender differences in marketing styles in western Oklahoma. Ownership of a radio, which represents access to a communication asset positively and significantly, influences a smallholder farmer's likelihood of participating in the soybean market. It represents access to formal sources of market information that increases the likelihood of market participation. In Zimbabwe, radio stations frequently air broadcasts on rainfall patterns, crop varieties and input and out prices. Access to this information lowers the transaction costs and road accessibility to the market. According to Siziba et al. (2011) access to such information reduces smallholder farmers risk perceptions and improves the likelihood of participating in the soybean market. These results are consistent with the findings of Siziba et al. (2011) on cereal market participation in southern Africa. Access to agricultural extension agents positively influences the likelihood of participating in soybean markets. The results demonstrate the importance of improved technology and support services in promoting soybean market participation. The likely explanation for this is that agricultural extension workers are the bridge between research programmes and farmers. They

provide information on good agronomic practices, production technologies, soybean varieties and market information. This interaction is likely to improve productivity, marketable surplus and enhance a smallholder farmer's likelihood of participating in a market. These results are consistent with the findings of Alene et al. (2008).

The use of rhizobial inoculants in the production of soybeans by smallholder farmers in Guruve district is significantly positive and increases likelihood of participating in the soybean market. The likely explanation for this is that rhizobial inoculants increase average yield and total soybean production with lower costs than using inorganic fertilizers (Chanaseni and Kongngoen, 1992). Thus the results show that smallholder farmers who used rhizobial inoculants for soybeans had a higher likelihood of participating in soybean markets than their counterparts. Similarly, the use of improved soybean seed varieties has a significantly positive influence on soybean market participation by smallholder farmers. The likely explanation is that improved seed varieties (germplasm) have high yield potential and are disease and pest resistant thus improve productivity and marketable surplus (Technoserve, 2011).

OLS regression model results

The results for the OLS regression model are shown in Table 3. Livestock wealth (cattle owned) and average distance to the market explained the intensity (amount of soybean sold) of smallholder farmers' participation in soybean market. Number of cattle owned had a positive

and significant influence on the intensity of market participation conditional on market participation. The probable explanation is that resource endowed households have more cattle which they can use for traction and transportation, a development which reduces production and market related transaction costs. The resource endowed households are likely to have finances from which they are able to hire labor, purchase inoculants, buy improved soybean germplasm and thus can grow soybeans on bigger pieces of land compared to the resource constrained smallholder farmers. Furthermore, households who own cattle are more likely to use good agronomic practices to produce their soybean. Resultantly, this will increase yield and marketable surplus. These results are consistent with the results of Alene et al. (2008). Zingore et al. (2007) noted that resource endowed farmers had higher yields in their fields compared to resource constrained farmers.

Distance to the market positively and significantly influences the intensity of soybean market participation by smallholder farmers. This means that as distance to the market increases, the amount of soybean sold by smallholder farmers also increases. These results are in contrast to findings from studies on staple crops in which distance negatively influences smallholder farmers' intensity of market participation (Siziba et al., 2011; Alene et al., 2008, Makhura et al., 2001; Key et al., 2000). A common finding in all these studies is that as distance from the market increases, variable transport costs increase and this discourages resource constrained smallholder farmers from selling high volumes. However, a possible explanation for the Zimbabwean case is that, local buyers offer very low prices compared to well established distant buyers. This is so because established soybean buyers are based in Harare, which lies over 151 km from the study sites. As such most farmers are set to benefit from price differentials between local prices and prices in distant markets.

Conclusion

This article did set out to identify through empirical evidence the determinants of soybean market participation and further evaluate the factors that affect intensity of market participation by smallholder farmers in Guruve district of Zimbabwe. This study used cross sectional household data of 187 randomly selected smallholder farmers in Guruve district in Zimbabwe. Econometric analysis was done using the Heckman model with sample selection, which corrects for selection bias at market participation decision by smallholder farmers. Choice of covariates for the OLS and Probit was guided by economic theory, literature and in some cases intuition. Descriptive results from the survey show that only 28.88% of the survey households participate in soybean market. The market participating households

averagely sold 211.26 kg of soybean. Most of the market participating households owned communication equipment such as radios (68.52%) and had bigger land sizes (3.52 ha) compared to the non-participating households. The econometric analysis results from this study show that for the OLS model, livestock wealth or resource endowment and distance to the market have positive influence on marketed surplus. However, for the Probit model, only gender negatively influences the smallholder farmers' decision to participate in soybean market while household ownership of a radio, access to agricultural extension, use of rhizobial inoculants and use of improved soybean varieties have a positive influence on household's likelihood to participate in the soybean market.

Based on these findings from the analysis of the factors affecting soybean market participation by smallholder farmers in Guruve district, we recommend that policy makers can improve farmer to extension worker ratio as this will improve access to technical information and support services on improved technologies such as use of inoculants, biological nitrogen fixation and knowledge on improved soybean seed varieties. Furthermore, policy makers could improve the dissemination of market information as it is currently available through radio broadcasts. Access to market information would improve farmers' knowledge of markets and aid in decision making on market participation as well as the level of marketed surplus. This will lead to increased productivity, high marketable surplus and enhances the likelihood of participating in the soybean market.

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