Journal of Agricultural and Applied Economics (2025), 1–13
doi:10.1017/aae.2024.35

CAMBRIDGE UNIVERSITY PRESS

RESEARCH ARTICLE

Determinants of Market Participation among Milk Producers in Kyrgyzstan

Akhmadjon Nurullaev[1], Eunchun Park[2], Bruce Ahrendsen[2], Stijn Speelman[3] and Lawson Connor[2]

[1]International Strategic Center for Agri-Food Development in Tashkent, Uzbekistan, [2]Department of Agricultural Economics and Agribusiness, University of Arkansas, Fayetteville, AR, USA and [3]Department of Agricultural Economics, Ghent University, Ghent, Belgium
Corresponding author: Eunchun Park; Email: park@uark.edu

Abstract
Numerous studies have been conducted to comprehend the economic importance of market participation for producers. However, a significant gap remains, particularly in Central Asia. This study assesses market participation drivers for Kyrgyzstan's milk producers using the Life in Kyrgyzstan dataset, encompassing a comprehensive nationwide farm-level survey. Findings reveal that household assets boost market entry and sales volume, whereas distance from markets discourages participation but can increase sales for active sellers, reflecting transportation cost strategies. The insights inform policy interventions benefiting rural small-scale milk producers in Central Asian countries that share similar cultural backgrounds.

Keywords: Central Asia; Heckman model; Kyrgyzstan; milk market participation

1. Introduction

Market participation by small farmers has been identified as a critical factor for development in developing countries (Barrett, 2008). Braun et al. (1994) also suggested that encouraging subsistence farmers to participate in the market is critical for driving agricultural transformation. However, market participation also presents challenges for farmers, including market risks, access to finance, and inadequate infrastructure (Reyes et al., 2012). Farmers may face price volatility, low product demand, and difficulties accessing markets. Even in some cases, farmers may face high transaction costs, making it difficult to sell their products profitably (Sigei et al., 2014). Previous studies indicated that farmers who own small plots of land in developing countries often do not directly engage in product markets (Reardon et al., 2009; Regasa Megerssa et al., 2020; Sigei et al., 2014). This fact might be attributed to the costly nature of trading between different markets and limited access to better technologies and productive resources for households with lower incomes (Barrett, 2008).

Barrett, 2008) identified that in eastern and southern Africa, one of the primary barriers to market participation exists at the household level. Limited access to productive assets, financial resources, and advanced production technologies prevents households from generating the necessary surplus to engage in markets meaningfully. Similarly, Regasa Megerssa et al. (2020) found that in Ethiopia, various factors significantly influenced market participation among smallholder vegetable producers, such as the age and education of the household head, family size, access to labor markets, availability of market information, and distance to the marketplace. Burke et al. (2015) demonstrated that in Kenya, the market participation of smallholder dairy farmers is

affected by a wide array of socioeconomic, institutional, and market-related factors, as well as external factors like political stability, natural disasters, and other calamities. Additionally, a study by Omiti et al. (2009) in Kenya revealed that while the unit price has a positive but insignificant effect on milk sales, factors like non-farm income, education, gender, and age of the household head do not significantly influence the quantity of milk sold. These studies provide valuable insights into the drivers of market participation among small-scale farmers. However, extrapolating these factors across different regions is complicated by the diverse cultural contexts of producers globally. A notable research gap exists in understanding market participation among agricultural producers in Central Asian countries, posing challenges in applying findings from other regions to inform policy-making in this culturally distinct area.

In this regard, the objective of the paper is to identify the factors influencing dairy market participation for Kyrgyzstan milk producers by analyzing household-level survey data from Kyrgyzstan. Our focus is on milk producers, given the substantial role of milk in satisfying over 50% of Kyrgyz's nutritional requirements and its cultural significance in local cuisine (Smanalieva et al., 2022). The culinary traditions of Kyrgyzstan have been influenced by neighboring cuisines like Uzbek, Uyghur, and Russian (Smanalieva et al., 2022). As a result, the insights derived from this research could potentially be applied for other Central Asian countries that share similar cultural attributes.

Many smallholder and family farmers in Central Asian countries, including Kyrgyzstan, continue to face challenges in maintaining economic viability (FAO, 2016). In Kyrgyzstan, approximately 33% of the population is employed in agriculture, highlighting the sector's importance to the national economy (Dairy Global, 2023). As a largely rural country, agriculture plays a critical role in providing both jobs and income, particularly in dairy and livestock farming.

The majority of farms in Kyrgyzstan are small-scale or family-owned. Land reforms during the 1990s resulted in the division of land into small and medium-sized holdings, a structure that remains prevalent today. These smallholder farms dominate dairy production, contributing a significant portion of the country's 160,000 tones of milk annually (Mzyece et al., 2023). However, many of these farmers have limited access to resources and technology, which constrains their productivity

As a result, rural populations in Kyrgyzstan often remain the most impoverished and vulnerable, facing limited access to markets, financing, and technology (Akramov and Omuraliev, 2009). The Kyrgyz government has introduced policies aimed at supporting the dairy sector, such as subsidies for farmers and the development of processing facilities (FAO, 2016). Despite these efforts, the sector continues to face several obstacles, including inadequate infrastructure, low productivity, and limited access to broader markets (FAO, 2020). Data collected further shows regional differences in milk production volumes and market participation, as highlighted in Table 1.

Agriculture plays a crucial role in the economies of Central Asian countries. If smallholder farmers in these countries were able to engage more regularly in market sales, there could be significant advantages for them. These benefits could include increased income, better economic stability, and improved livelihoods. By identifying the key factors that drive milk producers to join in the milk market and understanding how these factors affect the quantities of sold milk, this study can provide insights into the design of development strategies that enhance the participation of smallholder farmers in the market for economically important value chains

We used four years of survey data named the Life in Kyrgyzstan Study (LiK Study) collected from 1905 households across all seven regions of Kyrgyzstan. We estimate Heckman's sample selection model to identify the factors that affect the market participation and magnitude of the sales. We also estimated the double hurdle model to check the robustness of the results.

The paper is structured as follows: In the next section, we provide details about the data. Following this, we discuss the market participation model. After presenting our results, we conclude with a summary of key findings and policy implications.

https://doi.org/10.1017/aae.2024.35 Published online by Cambridge University Press

Table 1. Household milk production and sales by region

Region	Average milk production by a household (in liters)	Average milk sales by a household (in liters)	Percentage sold	Density (km^2/# of population)
Issyk-Kul	1320	1022	77%	80
Djalal Abad	748	193	26%	40
Naryn	1175	116	10%	7
Batken	1030	393	38%	33
Osh	534	93	17%	49
Talas	2053	1906	93%	20
Chui	2168	2085	96%	50

Density information is derived from http://www.stat.kg/ru.

2. Data

This research is based on the LiK Study dataset, which is an open access survey of households and individuals in Kyrgyzstan. The LiK Study was funded by the German Volkswagen Foundation from 2010 to 2012. The project involved various institutions in Central Asia and Europe, and the German Institute for Economic Research is the leading member. Wave 4, which took place from 2013 to 2015, was financed by Department for International Development, UK and Institute of Labor Economics as part of the Growth and Labour Market-Low Income Country Programme, with the Stockholm International Peace Research Institute as the main partner and the University of Central Asia (UCA) as the primary Kyrgyz partner.

Multiple research institutions across Asia, Europe, and North America collaborated on the project. Waves 5 and 6 of the study, conducted from 2015 to 2020, were hosted by the Leibniz Institute of Vegetable and Ornamental Crops (IGZ). Funding for these waves came from the Food and Agriculture Organization of the United Nations, the International Food Policy Research Institute, as well as internal contributions from IGZ and UCA. Data collection for the first five waves of the LiK survey was undertaken by Sotseconik, a reputable company offering services in Kyrgyzstan and other Central Asian countries. SIAR Consult, a survey company, handled the data collection for the sixth wave. Consequently, the LiK Study encompasses six waves from 2010, 2011, 2012, 2013, 2016, and 2019. The LiK Study is survey of households and individuals in Kyrgyzstan. The survey interviews all adult member of the household. In every wave, the survey follows 3,000 households and 8,000 individuals in all regions of Kyrgyzstan, including two major cities, Bishkek and Osh. The data collected is nationally representative and covers various topics such as household demographics, assets, expenditure, migration, employment, agricultural markets, shocks, social networks, and subjective well-being. All members of the households in 2010 are tracked for each wave, and new household members are added and tracked as well. Some topics are covered in each wave, while others are only covered in selected waves. The LiK Study data is accessible to anyone interested in non-profit research, policy analysis, and teaching. The project website (https://lifeinkyrgyzstan.org/) provides the survey questionnaires and interviewer manuals for downloading.

The survey conducted during the third wave in 2012 provided data on both milk production and sales. Consequently, we utilized survey data spanning four years: 2012, 2013, 2016, and 2019. At first, we selected a sample of 2,023 observations that households in the sample data were milk producers in at least one of the four waves of the survey. 118 households were dropped from the

https://doi.org/10.1017/aae.2024.35 Published online by Cambridge University Press

first selected data because there were some missing values in some key explanatory variables. Our analysis focused on a specific subset of the data, comprising 1,905 records related to milk production from 1,062 households involved in milk production during at least one of the four survey waves (843 households involved in milk production more than once in all waves). Among the observation, 942 households participated market at least once (Table A3). As a result, the dataset compiled is characterized as unbalanced panel data.

The explanatory variables in the data generating process are divided into four categories of household characteristics, private assets, public assets, and marketing-related variables. These variables were chosen based on theoretical expectations of their impact on marketing decisions. In total, one dependent and 34 independent variables were utilized to run models (Table 2).

To obtain descriptive statistics and better understand the sample, various tests were conducted based on the type of variable. Chi-square tests were employed for categorical variables, whereas t-tests were used for continuous variables (Tables A2–A19).

3. Modeling market participation

The conceptual framework of the study is based on Barrett, 2008), which assumes that households aim to maximize their utility and that their participation in the market is non-separable, which means that the decision to participate in a market and the decision on how much to sell within that market are interrelated and should be jointly modeled. This framework has been widely adapted in previous studies (Burke et al., 2015).

Under the conceptual framework, this study aims to analyze the determinants of marketing decisions made by households that engage in milk production in seven regions of Kyrgyzstan. The household's decision to participate in markets has a two-step process under the framework. In the first stage, milk-producing households must decide whether to participate in market activities, in the second stage, given the decision to participate, households decide on the quantity of the good to sell (Bellemare and Barrett, 2006). In the previous literature, two alternative econometric models have been employed to estimate the factors of market participation.

The Heckman model (Heckman, 1979) and the double hurdle model (Cragg, 1971) are two primarily used econometric models for modeling the two-step decision-making process. However, they differ in their underlying assumptions. The Heckman model assumes that the sample selection is possibly influenced by a selection process, which determines the inclusion of individuals in the sample. This process can be influenced by observable factors, such as age, gender, and ethnicity, as well as unobservable factors, such as motivation and ability to participate in the survey. The model also assumes that there is a relationship or dependency between the probability of the dependent variable being observed (zero or positive) and modeling the value of the dependent variable in the second stage. The model estimates the probability of selection in the first stage and adjusts for selection bias in the second stage using the inverse Mills ratio.

On the other hand, the double hurdle model posits the existence of two distinct and independent decision points within the analyzed process: the initial decision to enter the market and the subsequent decision regarding the quantity to be sold. This model calculates the likelihood of market entry in the first hurdle and the quantity traded given entry in the second hurdle. Unlike the Heckman model, the double hurdle model does not directly address selection bias and instead assumes the independence of these two decision stages. Thus, while the Heckman model primarily focuses on correcting selection bias within a single decision process, the double hurdle model assumes two separate, independent decision processes and does not explicitly account for selection bias.

As outlined in the data section, our selection process involved households with milk production records in at least one of the four survey waves. It's important to acknowledge the potential presence of sample selection issues, as there could be factors influencing milk-producing decisions

https://doi.org/10.1017/aae.2024.35 Published online by Cambridge University Press

Table 2. Variable information used in the research

	Variable name in the dataset	Label
Dependent variable		
1	Amount of sold milk	Milk sold, liters
Independent variables		
Household characteristics		
1	Gender	= 1 if household head is male
2	Age	Age of household head
3	Kyrgyz	= 1 if household head is Kyrgyz
4	Uzbek	= 1 if household head is Uzbek
5	Russian	= 1 if household head is Russian
6	Other nation	= 1 if household head is other nationality
7	Marital status	= 1 if household head is married
8	Secondary education	= 1 if household head has secondary education
9	Risk-taking level of household head	Risk level of household member (0~10) Head of the household choose willingness to take risks from 0 (completely unwilling) to 10 (completely willing to take risks)
10	Size of the household	Size of the household, number of people
11	Share of male labor	Share of male labor (0~1) Share of the males in labor market in the household
12	Dependency ratio	Share of members over 65 or younger than 15 in household (0~1)
13	Share of members with higher education	Share of members with higher education (0~1)
14	Ratio of off-farm income	Ratio of off-farm income (0~1) (income from agriculture is divided to total income of the household)
Private assets		
15	Total assets value	Total value of all assets, 1000 KGS
16	Bicycle ownership	= 1 if household owns bicycle
17	Motorcycle ownership	= 1 if household owns motorcycle or scooter
18	Car ownership	= 1 if household owns car, pick-up, or van
19	Tractor ownership	= 1 if household owns tractor, truck, or agricultural machines
20	Cell phone ownership	= 1 if household owns mobile phone
21	Land size	household total land size in ha
Public assets		
22	Distance to agro market	Distance from home to agricultural market, km
23	Issyk-Kul	= 1 if household is located in Issyk-Kul
24	Djalal Abad	= 1 if household is located in Djalal Abad
25	Naryn	= 1 if household is located in Naryn
26	Batken	= 1 if household is located in Batken
27	Osh	= 1 if household is located in Osh

(*Continued*)

https://doi.org/10.1017/aae.2024.35 Published online by Cambridge University Press

Table 2. (*Continued*)

	Variable name in the dataset	Label
28	Talas	= 1 if household is located in Talas
29	Chui	= 1 if household is located in Chui
30	Urban	= 1 if household is located in urban area
Marketing-related variables		
31	Milk price	Price per liter of milk, KGS (individual milk price per household is calculated based on survey data: total income from milk sales is divided by quantity of sold milk)
32	Internet access	= 1 if household has internet connection
33	Environmental affect	= 1 if household has been affected by environmental and climate shocks (drought, flooding and etc.)
34	Family shock	= 1 if household has been affected by family shocks (divorce, death and etc.)

that were not captured in the survey. Despite the well-designed random sampling approach employed in the LiK study data collection, these unaccounted variables may introduce biases in our analysis. Therefore, we estimated the panel random effects Heckman model for empirical analysis to check whether there would be potential concerns regarding the sample selection bias. The estimation results also showed the statistical significance of the inverse mills ratio, which implies the existence of potential selection bias. Therefore, we used the Heckman model as the primary model.[1]

The first stage of the Heckman model can be expressed as,

$$\varphi = X\beta + e \tag{1}$$

where φ is a vector of latent variable shows the choice of the household to sell the product or not, X is a matrix of explanatory variables (described in Table 2) that affects the participation decision, β is a vector of coefficients, e is a vector of identically independently distributed (i.i.d) error term.

The second stage is expressed as,

$$y = Z\gamma + \delta IMR + u \tag{2}$$

where y is the milk sales volume, Z is a matrix of explanatory variables that affects the sales volume, γ is a vector of coefficients, IMR is the inverse Mills ratio, $IMR = \frac{\boldsymbol{\phi}(Z\gamma)}{\boldsymbol{\Phi}(Z\gamma)}$, where $\boldsymbol{\phi}$ and $\boldsymbol{\Phi}$ are the standard normal probability density function and cumulative density distribution, respectively, and u is the i.i.d error term. Note that y is the observed dependent variable describes the amount of milk sold that is censored at zero: $y = \begin{cases} y_i & if\ y_i > 0 \\ 0 & if\ y_i \leq 0 \end{cases}$.

In practical data analysis, IMR is calculated based on the predicted values from the selection equation lambda (λ), which uses the error term σ, and the correlation coefficient ρ from the

[1]We also estimated the double hurdle model to check the robustness of the results. The results are presented in the appendix.

https://doi.org/10.1017/aae.2024.35 Published online by Cambridge University Press

selection equation, based on the following formula, $\lambda = \rho \cdot \sigma \cdot IMR$. We use Heckman function in Stata to estimate the model.

4. Results

Tables 3 and 4 display the estimated marginal effects on the likelihood of market participation (Table 3) and sales volume (Table 4) for various independent factors derived from the Heckman model. Note that we include year dummy variable in addition to four sets of explanatory variables to account for unobserved yearly specific differences affecting both the selection process and the sales volume within the Heckman model.

The results in Table 3 indicate the presence of sample selection issues. The value of rho ρ is −0.269, which shows a moderate inverse correlation between the selection equation and the milk sale volume equation. This could signify that factors determining participation in milk sales have a negative relationship to the actual volume of milk sold. For example, certain factors might increase the likelihood of participating in milk sales, yet decrease the volume of milk sold. Furthermore, the estimated lambda λ value is −517.0562, indicating that selection bias significantly affects the estimation of milk sales volume. This suggests inherent differences between the non-selected samples (households not selling milk) and selected samples (households that do sell milk), and that these differences influence the results. Therefore, the model represents an attempt to provide more accurate estimates by accounting for sample selection bias.

Among household characteristics, the ethnicity of the household (Uzbek and Russian), is notably significant factor. On average, the probability of milk sales participation is reduced by 16% for Uzbek households and increased by 23% for Russian households compared to Kyrgyz households. However, these ethnicity factors do not influence the quantity of milk sales once households decide to participate in the market. The role of household ethnicity has not been extensively analyzed in previous literature, highlighting the contribution of this paper. These findings suggest the presence of underlying socioeconomic or cultural factors that influence market behavior, such as network effects, where certain ethnic groups may have better access to market information or trade networks, or differences in producing practices and traditions that affect market engagement.

The proportion of male labor and the household's dependency ratio are important factors. Having relatively more male labor or dependents in the household decreases the probability of milk market participation by milk producers. This finding is somewhat counterintuitive, as one might expect that more labor resources would lead to increased production and greater market engagement. However, if male labor is diverted to more profitable or essential activities outside of dairy farming, this could explain the reduction in market participation. These results are consistent with Burke et al. (2015), who found similar patterns in dairy market participation in Kenya, but they contrast with Bellemare and Barrett (2006), who showed that female-headed households are more likely to be autarkic rather than participate in the market. Similarly, a higher number of dependents could strain household resources, thereby reducing the ability to engage in the market. This factor was not found to be significant in the study by Bellemare and Barrett (2006) for the cases of Kenya and Ethiopia. While the number of dependents significantly affects the decision to participate in the market, it does not impact the sales volume once producers decide to engage in the market.

The head of household's willingness to take risks—measured on an index from 0 to 10—corresponds to an increase in milk sales by 78 L annually, which is a unique feature of this study, as it has not been included in previous research. According to the milk sales estimations presented in Table 4, the risk measure does not affect the decision to participate in the market but significantly impacts the sales volume once producers engage in the market. This factor represents a unique contribution of this research, as it has not been previously analyzed in similar studies.

https://doi.org/10.1017/aae.2024.35 Published online by Cambridge University Press

Table 3. Estimation of factors influencing market participation decision

	Variable name in the dataset	Marginal effect
Household characteristics		
1	Gender	0.065
2	Age	−0.001
3	Uzbek	−0.159***
4	Russian	0.230**
5	Other nation	−0.006
6	Marital status	−0.057
7	Secondary education	−0.003
8	Risk-taking level of household head	−0.003
9	Size of the household	−0.001
10	Ratio of male labor	−0.106*
11	Dependency ratio	−0.107**
12	Ratio of members with higher education	−0.078
13	Ratio of off-farm income	−0.008
Private assets		
14	Total assets value	0.001***
15	Bicycle ownership	−0.032
16	Motorcycle ownership	−0.038
17	Car ownership	−0.058***
18	Tractor ownership	0.022
19	Cell phone ownership	0.025
20	Land size	−0.002
Public assets		
21	Distance to agro market	−0.002***
22	Djalal Abad	−0.033
23	Naryn	−0.370***
24	Batken	−0.084*
25	Osh	−0.131***
26	Talas	0.393***
27	Chui	0.363***
28	Urban	0.050
Marketing-related variables		
29	Milk price	−0.273***
30	Internet access	−0.014
31	Environmental affect	0.022*
32	Family shock	−0.083***

(*Continued*)

https://doi.org/10.1017/aae.2024.35 Published online by Cambridge University Press

Table 3. (*Continued*)

	Variable name in the dataset	Marginal effect
Year dummy variables		
33	2013	−0.020
34	2016	0.048*
35	2019	−0.079**
36	Rho ρ	−0.269***
37	Sigma σ	7.559***
	Number of observations	1,905

Note: *, **, *** indicates the corresponding coefficients are significant at the 10, 5, and 1% levels, respectively.

Table 4. Estimates of factors influencing milk sales volume

	Variable name in the dataset	Marginal effect
Household characteristics		
1	Gender	86.172
2	Age	8.627
3	Uzbek	150.078
4	Russian	−321.195
5	Other nation	−54.698
6	Marital status	28.662
7	Secondary education	65.803
8	Risk-taking level of household head	78.778***
9	Size of the household	−15.281
10	Ratio of male labor	535.054
11	Dependency ratio	470.952
12	Ratio of members with higher education	1056.179**
13	Ratio of off-farm income	−432.712**
Private assets		
14	Total assets value	0.188***
15	Bicycle ownership	124.657
16	Motorcycle ownership	2087.290***
17	Car ownership	221.479
18	Tractor ownership	386.141*
19	Cell phone ownership	−308.000
20	Land size	65.877***
Public assets		
21	Distance to agro market	23.809***
22	Djalal Abad	−1121.049***

(*Continued*)

https://doi.org/10.1017/aae.2024.35 Published online by Cambridge University Press

Table 4. (*Continued*)

	Variable name in the dataset	Marginal effect
23	Naryn	29.181
24	Batken	285.244
25	Osh	−729.903**
26	Talas	91.150
27	Chui	1314.239***
28	Urban	−650.920**
Marketing-related variables		
29	Milk price	−98.718
30	Internet access	49.367
31	Environmental affect	−10.662
32	Family shock	250.179
Year dummy variables		
33	2013	29.098
34	2016	363.160**
35	2019	683.826***
	Number of observations	1,905

Note: *, **, *** indicates the corresponding coefficients are significant at the 10, 5, and 1% levels, respectively.

Additionally, the ratio of household members with higher education is positively correlated with milk sales. On the other hand, a rise in the proportion of off-farm income relative to total household income is associated with a decrease in milk sales. These findings suggest that risk-taking propensity and educational attainment within a household have a significant positive impact on market activity, whereas reliance on off-farm income can reduce market participation in terms of milk sales.

Among the private asset variables, the positive impact of total asset value on market participation suggests that wealthier households are more likely to engage in the market. Additionally, total asset value is positively related to the volume of milk sales, which may indicate that households with greater financial resources have more capital to invest in production. An increase in the total value of a household's assets is linked to a higher volume of milk sales. Specifically, for every 1,000 Kyrgyz Som (equivalent to about $11 based on the 2024 exchange rate), there is an expected increase of 0.19 liters in annual milk sales. This financial stability enables them to expand their market participation and increase sales volume.

Interestingly, car ownership by a household decreases market participation by nearly 6%, which is not immediately intuitive. This negative association may be partly explained by socioeconomic traits specific to Central Asian countries, where lower taxi fares are more common than in other regions. Additionally, households that own private vehicles might primarily use them for non-agricultural activities, generating income from car-related services rather than investing in dairy market engagement. Owning an additional hectare of land is associated with an increase of 65 L in milk sales over the year. These findings indicate the importance of asset accumulation and the availability of transportation and land resources in enhancing market participation. Overall, the impacts of private asset variables on market participation are generally

https://doi.org/10.1017/aae.2024.35 Published online by Cambridge University Press

consistent with previous literature. For example, total asset value, motorcycle ownership, tractor ownership, and land size all positively influence milk sales volume once a producer participates in the market.

Regarding the influence of public assets on market activities, the findings from the selection equation suggest that greater distance to the agricultural market has a negative effect on the initial decision to participate in the market. This finding aligns with previous literature, such as Burke et al. (2015), who found that distance from a motorable road negatively affected milk sales among Kenyan producers. However, once the decision to engage is made, households located farther away that do participate tend to increase their sales volume. This strategy might be driven by an effort to reduce the per-liter cost of transportation. By selling more milk, households can spread transportation costs over a larger volume, thereby reducing the impact of distance on overall profitability.

The results identify regions like Jalal-Abad, Osh, and Chui as significantly distinct in terms of milk sales. Households in Jalal-Abad and Osh typically sell less milk compared to those in Issyk-Kul. Conversely, a household in Chui outsells one in Issyk-Kul by more than 1,300 L of milk annually. As detailed in Table 1, which presents the average milk production and sales volumes by region, it becomes clear that higher production or population density does not necessarily correlate with increased sales. For example, despite being the most populated, Issyk-Kul does not lead in milk sales. This discrepancy suggests that other regional factors may influence sales volumes. The urban location of a household is not a statistically significant factor when it comes to the decision to participate in the milk market. However, the analysis reveals that once the decision to participate has been made, urban households tend to sell 650 L less milk annually compared to their non-urban counterparts. This disparity could be attributed to the limited capacity for production expansion in urban settings, where space and perhaps regulatory constraints make it more challenging to increase livestock numbers or to grow feed.

When examining market-related factors, the logarithm of the milk price is a statistically significant predictor, yet it exhibits a negative influence on market participation. This finding is not intuitively straightforward, as we anticipate a positive correlation between prices and market participation. Nevertheless, it is important to clarify that the milk price in the model is the average per liter at local markets where the household is located rather than the actual price farmers received. The LiK dataset does not provide the farm-received prices; hence, the local market price was utilized in the analysis to mitigate the risk of omitting a significant variable. We could not clearly interpret the result since a complex vertical marketing structure could exist.

The variable representing family shock—indicating whether a family experienced issues such as divorce or deaths within a year of the survey—negatively impacts milk market participation, reducing the likelihood by 8.3%. In contrast, Bellemare and Barrett (2006) and Burke et al. (2015) included family member deaths as a measure of shock but found it to be insignificant. Conversely, environmental shocks experienced by a family within the same time frame seem to increase market participation by 2%. These results suggest that personal challenges within a household can significantly deter market activity, whereas environmental factors might encourage market engagement, potentially as a coping mechanism or due to changes in market dynamics. Notably, previous studies (Bellemare and Barrett, 2006; Burke et al., 2015) did not find any significant impacts from environmental factors, such as weather shocks.

Overall, the estimated results highlight distinct cultural and socioeconomic dynamics in Kyrgyzstan that differ significantly from those observed in previous studies focusing on African contexts, such as Bellemare and Barrett (2006) and Burke et al. (2015). While the studies in Kenya and Ethiopia found limited or no significant effects of household shocks, dependency ratios, or gender-based labor dynamics on market participation, our results reveal that such factors play a critical role in Kyrgyzstan. The negative impact of family shocks and the contrasting effects of ethnicity on market engagement highlight unique cultural, social, and economic characteristics in the region. These differences suggest that the context-specific factors—including cultural traits,

https://doi.org/10.1017/aae.2024.35 Published online by Cambridge University Press

market access, and social networks—significantly shape market behavior in Central Asia, emphasizing the importance of regional studies when examining agricultural market participation.

This study explores impact of different exploratory variables like the ethnicity of the household, the proportion of male in labor force, risk-taking willingness of the household and others on market participation. These type of factors have never been considered in literature before. However, we were not able to capture all relevant variables, such as credit availability for the household or the quality of roads or electricity access for the household. As milk is a perishable product, storing milk requires technology based on electricity and perhaps credit to have sufficient funds to purchase the technology. Therefore, future research could include variables on household access to electricity or if credit is easily accessible to purchase new assets. Additionally, in the dataset, there is a lack of information regarding whether households rent any land for agricultural purposes. This may be a potential limitation of the data because there could be households that engage in nomadic practices, utilizing public or government lands through leasing arrangements.

5. Conclusions

This research examines the factors influencing market participation among milk producers in Kyrgyzstan, utilizing the LiK dataset and addressing a critical research void in Central Asia. Our study reveals that household assets significantly boost market entry, emphasizing the role of economic stability. Also, distance from markets deters participation but may encourage larger sales volumes to compensate for unit transport costs once they participate.

Policy recommendations for Kyrgyzstan include enhancing infrastructure to lower transaction costs and improve market access, as well as fostering asset accumulation to stimulate market engagement. The study also underscores the intricate relationship between cultural aspects and traditional economic factors in market dynamics, suggesting a rich area for further study to craft culturally sensitive policies.

The insights have broad implications, are relevant for empowering Kyrgyzstan's rural smallholders, and are applicable to Central Asia's socioeconomic framework. This investigation into market participation in Kyrgyzstan contributes to the broader conversation on rural development and market integration in emerging regions, offering insights into strategies that promote market inclusion and improve rural livelihoods.

Supplementary material. The supplementary material for this article can be found at https://doi.org/10.1017/aae.2024.35.

Data availability statement. The data that support the findings of this study are available on request.

Author contribution. Conceptualization, A. Nurullaev, E. Park; Methodology, A. Nurullaev, E. Park, L. Connor; Formal Analysis, A. Nurullaev, E. Park; Data Curation, R.B.; Writing—Original Draft, A. Nurullaev; Writing—Review and Editing, A. Nurullaev, E. Park, B. Ahrendsen, and S. Speelman; Supervision, E. Park, B. Ahrendsen, and S. Speelman.

Funding statement. None.

Competing interests. None.

References

Akramov, K.T., and N. Omuraliev. "Institutional Change, Rural Services, and Agricultural Performance in Kyrgyzstan." *International Food Policy Research Institute (IFPRI) Discussion Paper 00904*, 2009.

Barrett, C.B. "Smallholder market participation: Concepts and evidence from eastern and southern Africa." *Food Policy* **33**,4(2008):299–317.

Bellemare, M.F., and C.B. Barrett. "An ordered Tobit model of market participation: Evidence from Kenya and Ethiopia." *American Journal of Agricultural Economics* **88**,2(2006):324–37.

Braun, J.von, H. Bouis, and E. Kennedy. "Conceptual Framework." *Agricultural Commercialization, Economic Development, and Nutrition*, 1994, pp. 11–33.

Burke, W.J., R.J. Myers, and T.S. Jayne. "A triple-hurdle model of production and market participation in Kenya's dairy market." *American Journal of Agricultural Economics* **97**,4(2015):1227–46.

Cragg, J.G. "Some statistical models for limited dependent variables with application to the demand for durable goods." *Econometrica: Journal of the Econometric Society* **39**,5(1971):829–44.

Dairy Global. (2023). Russia bans Kyrgyzstan dairy products. Internet site: https://www.dairyglobal.net/industry-and-markets/market-trends/russia-bans-kyrgyzstan-dairy-products/ (accessed on 31 August 2024).

Food and Agriculture Organisation of the United Nations. *National Gender Profile of Agricultural and Rural Livelihoods—Kyrgyz Republic: Country Gender Assessment Series*, Ankara (Turkey), 2016.

Food and Agriculture Organisation of the United Nations. Smallholders and Family Farms in Kyrgyzstan." *Smallholders and Family Farms in Kyrgyzstan*, 2020. https://doi.org/10.4060/ca9826en.

Heckman, J.J. "Sample selection bias as a specification error." *Econometrica: Journal of the Econometric Society* **47**,1(1979):153–61.

Mzyece, A., A. Shanoyan, V. Amanor-Boadu, Y. A. Zereyesus, K. Ross, and J. N. Ng'ombe. "How does who-you-sell-to affect your extent of market participation? evidence from smallholder maize farmers in Northern Ghana." *Cogent Economics & Finance* **11**,1(2023). https://doi.org/10.1080/23322039.2023.2184062.

National Statistical Committee of the Kyrgyz Republic Production of Main Livestock Products. Internet site: http://www.stat.kg/en/opendata/category/90/ (accessed on 31 August 2024).

Omiti, J.M., D.J. Otieno, T.O. Nyanamba, and E.B. McCullough. "Factors influencing the intensity of market participation by smallholder farmers: A case study of rural and periurba areas of Kenya." *African Journal of Agricultural and Resource Economics* **3**,311-2016-5509(2009):57–82.

Reardon, T., C.B. Barrett, J.A. Berdegué, and J.F.M. Swinnen. "Agrifood industry transformation and small farmers in developing countries." *World Development* **37**,11(2009):1717–27.

Regasa Megerssa, G., R. Negash, A.E. Bekele, and D.B. Nemera. "Smallholder market participation and its associated factors: Evidence from Ethiopian vegetable producers." *Cogent Food & Agriculture* **6**,1(2020):1783173.

Reyes, B., C. Donovan, R.H. Bernsten, and M.K. Maredia. *Market Participation and Sale of Potatoes by Smallholder Farmers in the Central Highlands of Angola: A Double Hurdle Approach* (2012).

Sigei, G., H. Bett, and L. Kibet. *Determinants of Market Participation among Small-scale Pineapple Farmers in Kericho County, Kenya*, 2014.

Smanalieva, J., J. Iskakova, and M. Musulmanova. "Milk-and cereal-based Kyrgyz ethnic foods." *International Journal of Gastronomy and Food Science* **29**(2022):100507.

The Life in Kyrgyzstan Study. (n.d.). About – The 'Life in Kyrgyzstan' study. https://lifeinkyrgyzstan.org/about/.

Cite this article: Nurullaev, A., E. Park, B. Ahrendsen, S. Speelman, and L. Connor (2025). "Determinants of Market Participation among Milk Producers in Kyrgyzstan." *Journal of Agricultural and Applied Economics*. https://doi.org/10.1017/aae.2024.35