Trade-offs between international migration and agricultural commercialization: evidence from Kyrgyzstan.

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Abstract

This paper analyzes the relationship between international migration, labor, remittances, and agricultural commercialization in Kyrgyzstan using nationally representative household panel surveys covering eight years from 2013 to 2020. Unlike other studies, we focus on evaluating the impact of international migration on total farm commercialization, including crop, livestock, and live animals. We use quantile regression via moments and a three-stage least squares method to overcome the potential endogeneity of migration, labor, and remittances. Overall results show that sending household members abroad has a significant labor-loss effect on households with a consequent impact on farm commercialization. Remittances only partially compensate for losses for households with the lowest level of commercialization. Furthermore, the quantile regressions show little heterogeneity between the selected quantiles, except for the number of migrants, which is detrimental to the lowest level of commercialization.

Keywords: migration, remittances, agricultural commercialization, Kyrgyzstan

1. Introduction

Agricultural commercialization - a shift from subsistence to more market-oriented farming - can be the main pathway from a semi-subsistence agrarian society to a more diversified and food-secure economy driving the country's inclusive growth (Barrett, 2008; Carletto et al., 2017; von Braun & Kennedy, 1994). Previous studies confirmed that "inclusive agricultural development" through public investment in green revolution Asia was crucial to structural transformation and poverty reduction (Jayne et al., 2019). However, for countries with insufficient agricultural support and in the presence of rural credit constraints, can international migration with remittance inflows be an alternative to public investments to stimulate inclusive development or, conversely, be destructive?

International migration, as a complex economic process with close interrelationships between its determinants and indirect effects on rural economies, mainly focuses on different aspects of the agricultural sector, such as land, income, and productivity (Piras et al., 2018; Taylor & Lopez-Feldman, 2010; Bohme 2015; Liu et al., 2016; Qin & Liao 2016). The findings are mixed depending on the context and other household characteristics. To our knowledge, only Abate et al. (2020) analyzed the implication of intra-rural migration on crop commercialization. We, therefore, contribute to the existing literature by adapting the non-separable farm household model and by providing new empirical evidence on the developmental impact of labor migration and remittances on the commercialization of farm products.

To identify direct and indirect impacts, we use iterative three-stage least squares (3-SLS) with instruments to address potential endogeneity issues. We also estimate quantile regressions via moments to test for potential no-linear relation between migration and commercialization, as certain households can benefit more from international migration with received remittances. In this case, the remitter provides the necessary investment in farming and introduces the family to improved technology.

The empirical analysis builds on nationally representative household panel surveys from Kyrgyzstan. In Kyrgyzstan, as in other formerly centrally-planned economies, international migration is a primary alternative source of livelihood for smallholder farmers, contributing to about one-third of the total gross domestic product, ranking third in the world (World Bank, 2019b). Smallholder farmers account for the lion's share of total agricultural output, falling from 46.3% in

1996 to 12.1% in 2019. Some scholars attributed this trend to labor migration to the service sector or abroad (Mogilevsky et al., 2017). However, the net effect of migration with lifting budget constraints and sharpening time constraints has yet to be evident.

2. Theoretical framework

We employ the classical farm household model to illustrate the impact of migration and remittances on farm households' commercialization. Particularly, we assume that a representative farm household has a labor shortage due to outmigration and off-farm income due to remittances in the production of market and home-consumed agricultural commodities in our model. The analysis is based on a simple static model of a non-separable agricultural household that maximizes utility over the consumption of goods and leisure time. The utility function can then be expressed as:

$$U_{Max} = U(\boldsymbol{c}, T_l; \boldsymbol{z}), \tag{1}$$

where U is the household's utility function; $\mathbf{c} = \{C_a, C_m\} \in \mathbb{R}_+^n$ is the vector of consumption goods consisting of self-produced agricultural goods (C_a) and manufactured luxury food products (C_m); $\boldsymbol{z} \in \mathbb{R}_+^n$ is the vector of the individual and household characteristics such as age, education, and household size; T_l is the time allocated to leisure by the farmer. As usual, the utility function is assumed to be concave in each parameter.

In addition to leisure time, the farm household may spend its time endowment (T) on farm labor (T_f), off-farm labor (T_o), and labor of migrated members (T_m). Hence, the time constraint is:

$$T_f + T_m + T_o + T_l \leq T. \tag{2}$$

Farm labor and hired labor are not perfect substitutes in production, and off-farm work with the labor of migrated members are not perfect substitutes in the utility function (Lopez, 1984, 1986). Labor markets are not perfectly competitive; thus, the farm household model is non-separable.

The farm household also faces the following production technology constraint:

$$\boldsymbol{q} = Q(\boldsymbol{x}, T_f, L; \boldsymbol{f}), \tag{3}$$

where Q is the total farm output, which consists of consumed output (Q_c) and output surplus (Q_s). The farm household is assumed to sell output surplus, which is produced using inputs ($\boldsymbol{x} \in \mathbb{R}_+^n$), labor ($T_f$), and land ($L$) in this model. $\boldsymbol{f} \in \mathbb{R}^n$ is a vector of exogenous factors that shift the production function.

Consumption of self-produced and purchased food products is constrained by household net income received from farming, remittances, off-farm income, and income from other sources such as rents, dividends, interests, and pensions. The resulting budget constraint is:

$$p_a C_a + p_m C_m \leq p_a \boldsymbol{q} - p_x \boldsymbol{x} + W_m T_m + W_o T_o + A, \tag{4}$$

where p_a, p_m, and p_x denote prices for self-produced food products, purchased manufactured food products, and farm inputs, respectively; W_m, W_o, and A represent migrants' wages aka remittances, the off-farm wage paid to the farmer, and other income, respectively.

Setting up the Lagrangian function and taking the first-order conditions of the household's utility maximization problem with respect to farm labor and labor of migrated members yields the following equation of return to labor from farm work and migrant members:

$$W_m \leq P_a \frac{\partial Q}{\partial T_f}, \tag{5}$$

where $P_a \, \partial Q / \partial T_f$ represents the value of the marginal product of farm labor for the farmer. According to Ineq. 5, the household member migrates if his/her anticipated wage (W_m) from migrant labor is higher than the reservation wage for migrant labor, which is $P_a \, \partial Q / \partial T_f \, |_{T_m=0}$.

Using duality theory, we can examine the potential impact of migration decisions on output supply. In particular, the farmer's optimal production can be specified as the farmer's profit maximization problem, such as:

$$\pi = Max(p_a \boldsymbol{q} - p_x \boldsymbol{x} + W_m T_m + W_o T_o + A), \text{ subject to } \boldsymbol{q} = Q(\boldsymbol{x}, T_f, L; \boldsymbol{f}). \tag{6}$$

The solution to the profit maximization problem yields the following reduced-form profit function:

$$\pi = \pi(p_a, p_x, W_m, W_o; \boldsymbol{z}). \tag{7}$$

Applying Hotelling's lemma to Eq. 6, we can get the following reduced-form specification for output supply and input demand functions, which are dependent on output and input prices, remittances, wages from off-farm work, and farm and household characteristics:

$$\frac{d\pi}{dP_a} = \boldsymbol{q} = Q(p_a, p_x, W_m, W_o; \boldsymbol{z}) \tag{8a}$$

$$\frac{d\pi}{dP_x} = -\boldsymbol{x} = X(p_a, p_x, W_m, W_o; \boldsymbol{z}). \tag{8b}$$

As stated earlier, the supply of farmer's output surplus conditional on market participation can be formulated as follows:

$$Q_s = Q(p_a, p_x, W_m, W_o; \boldsymbol{z}); \qquad m_q = \begin{cases} 1 & if \quad Q_s > 0 \\ 0 & otherwise \end{cases}, \tag{9}$$

where m_q is the market participation.

The decision to send family members abroad along with remittances can increase the amount of output supply depending on the consumption of self-produced and the income elasticity of purchased goods. On the other hand, migrant labor can either create labor shortages or higher consumption of leisure, leading to decreased productivity, commercialization, and withdrawal from the agricultural market. Thus, the net effect can only be assessed in an empirical way.

3. Data and measurement of key variables

We use data from the Kyrgyz Integrated Household Survey (KIHS), conducted quarterly by the National Statistical Committee (NSC) of the Kyrgyz Republic. The KIHS is a rotating panel[1] covering a nationally representative sample of nearly 5000 households at each point in time since its inception in 2003. The sampling procedure is stratified into urban and rural for seven provinces and the capital city Bishkek, resulting in 15 sampling strata. The complete survey contains 18,784 households with information on education, health, migration, employment, housing conditions, assets, income, expenditures, and sociodemographic characteristics. The analysis of this study is limited to agricultural production, income, migration, and remittances, covering waves from 2013 to 2020 and 8,418 households.

[1] KIHS sample was fully renewed in 2013.

Our study's variables include agricultural commercialization, number of migrants, working hours, remittance inflows, and other household and household head characteristics. Household characteristics include household size, the share of male adults, the share of children in the household, the share of adults with higher education, land per capita, income from social transfers and employment, income from other employment, agricultural assets, and distance to the nearest bus stop. Similarly, household head characteristics include age and gender.

Key variables such as the commercialization of agriculture, the number of migrants, working hours, and remittance inflows are constructed as follows.

- We measure commercialization based on farmers' agricultural production and sales over the 12 months before the survey. We consider all crops, livestock products, and live-animal enterprises of the farm household. Measuring commercialization with a simple dummy variable would be inappropriate, as most households in the sample sold at least a small proportion of their crops on the market. Thus, we calculate the commercialization rate, ranging between zero and one, as the proportion of total farm output sold during the 12 months covered by the survey (von Braun & Kennedy, 1994; Carletto et al., 2017; Ogutu et al., 2019). We collect sales prices from each farmer to calculate a commercialization index. However, there are missing values, as some farmers only produce certain goods for personal consumption. For missing prices, we use the regional median prices for each commodity to determine the value of products sold and unsold for all farms.
- We consider people as migrants who were members of the household before going abroad and who would have been household members at the time of the interview if they had stayed in the country. Furthermore, we do not distinguish between permanent and seasonal migrants.
- We counted the on-farm working hours of farm household members during the week the interview was conducted. We exclude hours when the person worked elsewhere than on the farm.
- We calculate remittance inflow as the sum of cash remittances in 1000 KGS[2] per household in a year.

[2] Kyrgyz som (KGS) is the national currency of the Kyrgyz Republic. The average exchange rate between January 2012 and December 2013 was 1 USD = 48,4 KGS.

4. Estimation strategy

4.1 Three-stage least squares regressions

It will be impossible to assume that households' past migration decisions will be independent of the current degree of commercialization which depends on the available labor force and income. Thus, relations are likely to be endogenous. There is likely a cross-correlation between migration, labor, remittances, and commercialization equations since all these activities may be subject to the same stochastic shocks. We apply an iterative 3-SLS method with exogenous control variables to solve the endogeneity problem as follows:

$$M_{it} = \alpha_0 + \alpha_1 Z_{Mit} + \alpha_2 I_{Mit} + \alpha_3 D_t + \varepsilon_{Mit}, \quad (10)$$

$$W_{it} = \delta_0 + \delta_1 \widehat{M_{it}} + \delta_2 Z_{Wit} + \delta_3 I_{Wit} + \delta_4 D_t + \varepsilon_{Wit}, \quad (11)$$

$$R_{it} = \gamma_0 + \gamma_1 \widehat{M_{it}} + \gamma_2 \widehat{W_{it}} + \gamma_3 Z_{rit} + \gamma_4 I_{rit} + \gamma_5 D_t + \varepsilon_{rit}, \quad (12)$$

$$C_{it} = \beta_0 + \beta_1 \widehat{M_{it}} + \beta_2 \widehat{W_{it}} + \beta_3 \widehat{R_{it}} + \beta_4 Z_{cit} + \beta_5 D_t + \varepsilon_{cit}. \quad (13)$$

where M_{it}, W_{it}, R_{it}, and C_{it} are the number of international migrants, the total working hours, received remittances, and the agricultural commercialization index for the farm household i in the year t, respectively. Z_{it} represent human and physical capital that affect each equation according to the theoretical discussion/ conceptual reflections above. Similarly, D_t represent year dummies, and ε_{it} are the error terms.

I_{Mit}, I_{Wit}, and I_{rit} are instrumental variables that have been identified following the approach by Taylor et al. (2003). A migration network (I_{Mit}) is used to instrument migration, as migrating village members help to reduce the high cost of migration and share information to increase opportunities for migration. However, the village migration network should not affect the working hours of household members and the amount of received remittances, which depend upon the household's migration decisions, nor should village networks affect household agricultural commercialization from sources within the village. The norm to remit as an average level of cash and in-kind remittances per migrant among households in the community (I_{rit}) is used to instrument received remittances because it affects each household's remittance level but has no independent effect on household agricultural commercialization. The dependency ratio (I_{Wit}) is used to instrument working hours because children and elderly members of the household may

limit total working time in agriculture, but the decision to have children was made in the past and did not coincide with recent decisions.

4.2 Quantile regressions

The impact of international migration on the commercialization of agriculture might differ, conditional upon the degree of commercialization. We are particularly interested to understand whether migration and remittances are differently correlated with commercialization in semi-subsistence households as compared to highly commercialized households. The 3-SLS model estimates the average treatment effect but cannot estimate the heterogeneity of the effect. Since we have panel data and want to include individual effects that affect the entire distribution, we use quantile regression via the method of moments by Machado & Silva (2019). The current approach is based not on the estimation of conditional means but on moment conditions that, under exogenous conditions, identify conditional means. Thus, the quantile fixed effects approach is given by the following equation:

$$Q_{C_{it}}\left(\tau\middle|\widehat{M_{it}},\widehat{W_{it}},\widehat{R_{it}},Z_{it}\right)=\beta_0(\tau)+\beta_1\widehat{M_{it}}+\beta_2\widehat{W_{it}}+\beta_3\widehat{R_{it}}+\beta_Z(\tau)Z'_{it}+\varphi_i(\tau)+\mu_t(\tau),\ (14)$$

where φ_i and μ_t are unobserved households and year-fixed effects in the quantile $\tau \in (0,1)$ to eliminate potential endogeneity (Baryshnikova and Pham, 2019).

5. Results

5.1 Descriptive statistics

Table 1 presents summary statistics by quartile according to the household's commercialization level. On average, sample households sell 17% of their farm output, while the most commercialized quartile (IV) sells 79%, and the least commercialized quartile (I) produces only for self-subsistence. As one would expect, more commercialized households tend to have more land per capita, a higher level of education, and a higher proportion of men in the household. However, the third and fourth quartiles are quite similar, and households in the third quartile have even more land per capita than households in the highest quartile.

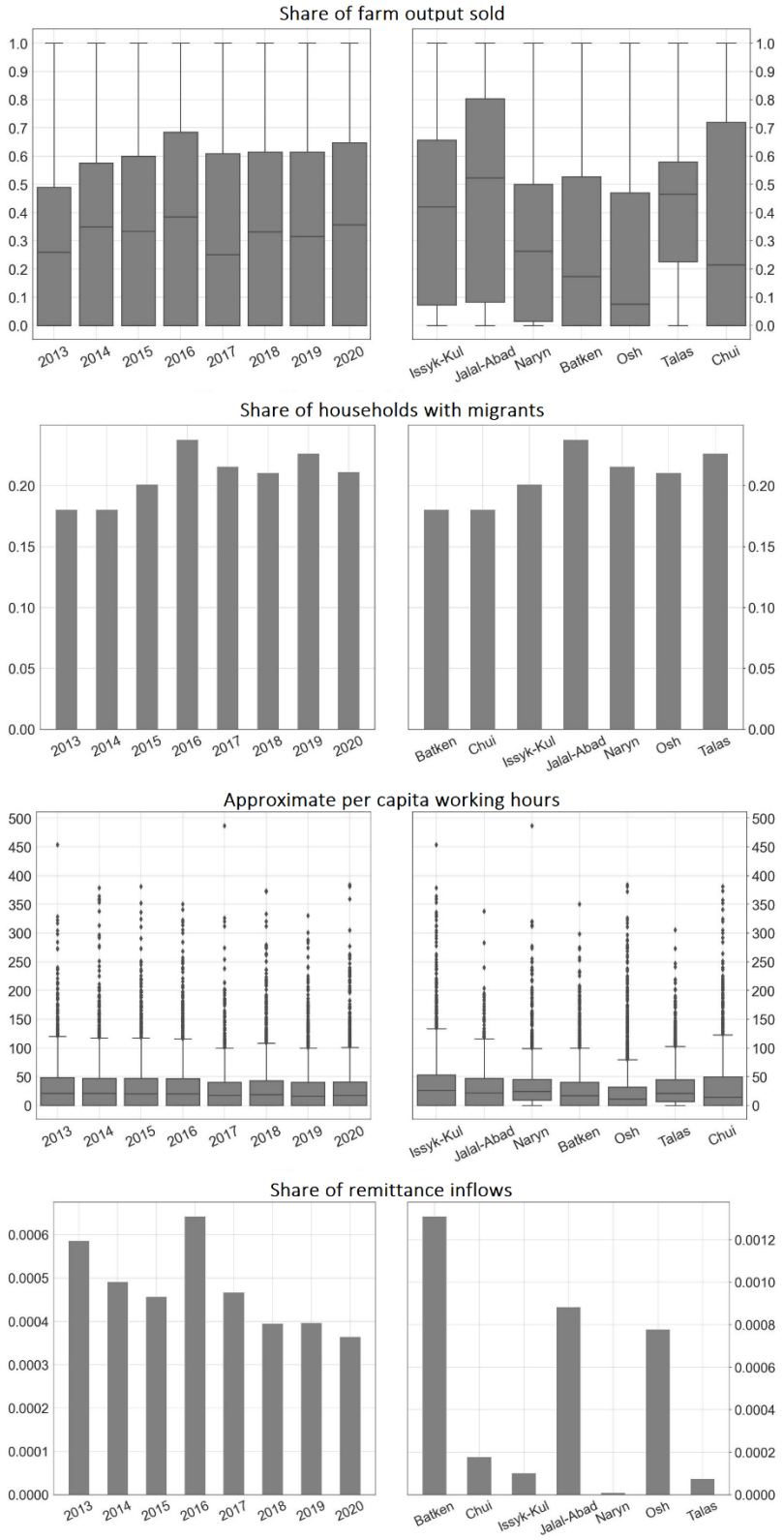
In our sample, the least commercialized households send more migrants and consequently receive more remittances. On average, they are less engaged in fieldwork and have higher incomes from other employment. In this quartile, the fact that more women are serving as household heads than

in other quartiles may also play a role in the lower involvement in agricultural activities. Figure 1 displays the development of key variables across years and provinces.

Table 1. Summary statistics by the level of commercialization

Variables	Quartiles			
	I	II	III	IV
Commercialization (share of farm output sold)	0.00	0.17	0.47	0.79
Share of farm households with migrants	0.22	0.19	0.20	0.20
Approximate per capita working hours	24.59	36.36	36.33	30.69
Share of remittances on household income	0.09	0.08	0.07	0.08
Household size, including migrants (number of people)	4.44	4.82	4.91	4.71
Share of male adults in the household	0.30	0.32	0.32	0.32
Share of adults with higher education in the household	0.10	0.10	0.10	0.10
Household income from social transfers (1000 KGS)	42.25	50.04	41.81	39.21
Household income from employment (1000 KGS)	118.64	86.02	84.66	99.26
Remittance (1000 KGS)	25.51	20.58	17.15	19.84
Land per capita (ha)	0.11	0.34	0.37	0.32
Time to the nearest bus stop (minutes)	12.60	12.80	14.45	14.03
Rural households (=1 if hh is rural)	0.47	0.79	0.84	0.79
Household head’s age (years)	54.83	55.15	54.26	54.37
Household head’s gender (=1 if male)	0.66	0.75	0.76	0.72
Number of households	2,444	1,799	2,088	2,087
Number of observations	6,427	3,762	5,095	5,094

Figure 1. Dynamics of key variables across years and provinces



5.2 Econometric results

Table 2 presents the results for the impact of international migration and remittances on agricultural commercialization using the 3-SLS approach described in Section 4.1. Each stage of the estimated results is presented in subsequent columns, respectively. For instance, the results of the first stage estimation using Eq. 10 are presented in Table 2, column 2.

The results show that all instruments are statistically significantly different from zero and consistent with the theory. They also pass weak under-identification and weak instrument tests. According to first-stage results, households with more men or located near bus stops, ceteris paribus, are more likely to send their members abroad. However, rural households with more highly educated members and more land per capita are less likely to have migrant members.

Time constraint is an essential issue for farm households with migrants. One migrant costs a farm household 47 working hours per week. Sending migrants is particularly detrimental for a rural household, which works 42 hours more than an urban one. As expected, larger household size and land per capita are positively related to labor, as both are labor-intensive.

As theory predicts, increasing the number of migrants in households significantly reduces labor hours on the farm and increases remittance inflows. In our sample, the labor-loss effect of one migrant is 47 hours per week, and the gain from remittances is 75 soms on average. However, the cumulative effect on agricultural commercialization is negative. One migrant sending one som as a remittance decreases agricultural commercialization by 9.2 percentage points. These results are consistent with a previous study by Atamanov & van den Berg (2012) but refute some findings of Zhunusova & Herrman (2018).

Table 2. Regression results based on 3-SLS model

Variables	(1)	(2)	(3)	(4)
	Number of migrants	Working hours	Remittances inflow	Agricultural commerce
Migration network*	0.972 (0.018)			
Number of migrants in the hh		-47.172 (5.554)	74.982 (1.964)	-0.092 (0.030)
Weekly working hours of farmers			0.050 (0.012)	0.001 (0.000)
Dependency ratio*		-107.596 (5.370)		
Received remittances				0.000 (0.000)
Village norm to remit*			0.402 (0.021)	
Share of males adults in the hh	0.411 (0.019)		4.869 (2.508)	0.030 (0.015)
Share of children in the hh			1.149 (1.841)	
Share of adults with higher education	-0.069 (0.019)	95.983 (6.146)	-1.048 (2.105)	-0.051 (0.015)
Land per capita, ha	-0.018 (0.006)		-0.129 (0.555)	0.015 (0.004)
Income from social transfers		-0.169 (0.021)	-0.023 (0.006)	-0.000 (0.000)
Income from employment		0.273 (0.015)	-0.062 (0.006)	-0.000 (0.000)
Household size		16.543 (0.819)		
Size of land, ha		3.238 (0.556)		
Agricultural assets				0.007 (0.009)
Time to the nearest bus, min	0.001 (0.000)			0.002 (0.000)
Rural households	-0.019 (0.008)	42.346 (2.598)	-6.566 (0.984)	0.109 (0.007)
Household head's age				0.001 (0.000)
Household head's gender				0.014 (0.006)
Number of hh				
Number of observations	20,378	20,378	20,378	20,378
R-squared	0.155	0.112	0.542	-0.109

Notes: Variables marked with * are instruments. Robust weighted standard errors are in parenthesis. Results for year dummies are not reported and are available upon request.

As argued earlier, remittances can increase the commercialization of farm products through less consumption of self-produced products or the investment channel to agricultural assets such as tractors and other machinery. In both cases, we expect a higher impact of international migration and remittances on households with a lower level of agricultural commercialization. We, therefore, analyze the data using quantile regression and disaggregate by commercialization level.

Table 3 reports the quantile regression results. The 3-SLS regression results give similar conclusions indicating the robustness of the results. The results show little heterogeneity between the selected quantiles, indicating a monotonic increase or decrease in specific parameters. For example, households with the lowest level of commercialization have a greater negative impact from sending migrants than households with the highest level of commercialization. In contrast, the households with the lowest level of commercialization benefitted the most from received remittances, suggesting the partial offset of the negative impacts of migration only for the lower level of commercialized farmers.

Table 3. Regression results based on quantile regression via the method of moments

Variables	Quantiles			
	0.25	0.5	0.75	0.9
Number of migrants in the hh*	-0.222 (0.012)	-0.164 (0.013)	-0.078 (0.018)	-0.013 (0.022)
Weekly working hours of farmers*	0.001 (0.000)	0.001 (0.000)	0.000 (0.000)	0.000 (0.000)
Received remittances*	0.001 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Share of males adults in the hh	0.056 (0.013)	0.046 (0.013)	0.033 (0.018)	0.023 (0.023)
Share of adults with higher education	-0.063 (0.012)	-0.046 (0.013)	-0.021 (0.017)	-0.002 (0.022)
Land per capita, ha	0.017 (0.003)	0.017 (0.003)	0.017 (0.004)	0.017 (0.005)
Income from social transfers	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)
Income from employment	-0.001 (0.000)	-0.000 (0.000)	-0.000 (0.000)	0.000 (0.000)
Agricultural assets	-0.003 (0.008)	0.005 (0.008)	0.015 (0.011)	0.023 (0.015)
Time to the nearest bus, min	0.003 (0.000)	0.003 (0.000)	0.002 (0.000)	0.002 (0.000)
Rural households	0.114 (0.006)	0.121 (0.006)	0.131 (0.008)	0.139 (0.010)
Household head's age	0.001 (0.000)	0.001 (0.000)	0.000 (0.000)	0.000 (0.000)
Household head's gender	0.034 (0.005)	0.022 (0.005)	0.004 (0.007)	-0.010 (0.009)
Number of observations	20,378	20,378	20,378	20,378

Notes: Variables marked with * are predicted values obtained from the 3-SLS model. Robust weighted standard errors are in parenthesis. Results for year dummies are not reported and are available upon request.

6. Discussion

Overall, this paper identifies the negative impact of international migration on the commercialization of agriculture, despite the importance of high remittance inflows for general economic welfare as approximated by the GDP. Migrant families are likely to spend the

remittances received for other purposes, such as improving their livelihoods, besides stimulating agriculture commercialization, especially in rural areas. Our findings align with Atamanov & Van Den Berg (2012), who find an overall negative effect of migration on crop income for permanent migrants. According to their findings, seasonal migration from smaller farms positively impacts crop income, but the amount is negligible.

Zhunusova & Herrman (2018), analyzing the impact of international migration on different sources of income, suggest that the negligible negative impact of migration on crop income does not decrease crop output which contradicts our findings. However, their analyses differ from ours as they ignore the time constraint of migrant-sending farmers. Furthermore, our analyses show a negligible impact of all types of income on agricultural commercialization, referring to the importance of lifting the labor deficiency rather than income in stimulating a commercial agricultural sector.

7. Conclusion and policy implication

Using the rich household data from Kyrgyzstan and various regression techniques, we analyze the effect of international migration on agricultural commercialization. International migration and remittance inflows in Kyrgyzstan play a vital role in the livelihoods of households sending their members, mainly to Russia, Kazakhstan, and other countries. Some studies focused on the impact of international migration on crops and other income in Kyrgyzstan (Atamanov et al., 2012; Zhunusova et al., 2018), and several studies examined the possible links between international migration and agricultural development. However, we are aware of only one study exploring the implications of intra-rural migration on crop output commercialization in Ethiopia (Aabate et al., 2020).

The contribution of the current study to the literature lies particularly in the analysis of migration through the prism of labor losses covering all types of agricultural commercialization, such as crops, livestock products, and live animals. Another novelty of our study is that we have estimated the heterogeneous effect of migration using quantile regression via moments which has yet to be done previously. Results show that migration's labor-loss effect dominates the income effect of remittances, leading to a shrinkage of agricultural commercialization. The quantile regression results show homogeneity between quantiles and the detrimental effect of migration on

the lowest level of commercialization, indicating/ suggesting that less commercialized migrant-sending households reduce sales more than others.

The study's policy implications are that commercialization should be promoted by increasing market access for smallholder farmers through public investment in infrastructure and strengthening market institutions. Furthermore, initiatives that increase farm commercialization should include developing and spreading agricultural technologies, including new machinery. Finally, public policies should stimulate collaboration across rural households in the form of labor exchange, agricultural services, or other efforts to lift households' time constraints. After all, remittance inflows invested in Kyrgyzstan's agricultural sectors are small and insufficient to replace old machines with new ones, as most of them are consumed or spent on other everyday needs.

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