Working Paper Series

#2011-011

**Microeconomic analysis of rural nonfarm activities in the Kyrgyz Republic:
What determines participation and returns?**
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Microeconomic analysis of rural nonfarm activities in the Kyrgyz Republic: What determines participation and returns?

Abstract

This paper uses two representative household budget surveys from the Kyrgyz Republic to analyze factors influencing participation and returns from different types of nonfarm activities in 2005 and 2006. Nonfarm activities are found to be most important for the poor, who are pushed out of agriculture due to limited and poor land resources. We also show that different nonfarm activities have different human capital requirements. Unlike other studies, we use the double hurdle model which allows us to demonstrate that a number of variables have different effects on participation and income from nonfarm activities. For example, residing in remote areas and lack of capital are found to stimulate participation in nonfarm activities, but decrease nonfarm income. Overall, the empirical analysis confirms the importance of rural nonfarm activities and indicates that equipping poor households to enable them to move towards better remunerative nonfarm activities should be a priority for Kyrgyz rural policy makers.

Keywords: nonfarm activities, rural areas, Kyrgyz Republic, nonfarm income

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Introduction

Despite economic growth and various reforms, Central Asia is still a poor and predominantly rural region. In three of the five Central Asian republics (Kyrgyzstan, Tajikistan and Uzbekistan), more than 60% of the population lived in rural areas, and agriculture provided more than 25% of national income in 2007 (FAO, 2009). In comparison, other former Soviet republics have a more urban-based, non-agricultural economy. Poverty is mostly concentrated in rural areas in Central Asia, and throughout the region there is a need for policies to respond to this challenge.

Policy makers and the donors' community increasingly acknowledge that agriculture alone is not sufficient to achieve sustainable poverty reduction in the Central Asian context of high population pressure, constrained land resources, and unfinished agricultural reforms (World Bank, 2004; Spoor, 2008; Maddock, 2009). Until recently, labour migration was a widely used income diversification strategy (see, ADB, 2008a; ADB, 2008b), but the current economic crisis makes migration prospect uncertain. In such circumstances, the rural non-farm economy (RNFE) may act as a cushion, absorbing rural labour and providing an opportunity to earn money.

Empirical studies often demonstrate that the RNFE comprises a set of heterogeneous activities, ranging from employment in high productive sectors to low productive activities earning just enough to sustain subsistence (Reardon, 1997). This heterogeneity is driven by different incentives and capacity to undertake nonfarm activities among rural household. Many poor households are excluded from nonfarm activities due to the lack of assets required to overcome entrance barriers. Others are trapped in low-remunerative activities that do not allow them to grow out of poverty. Consequently, identification of the factors shaping access and income from nonfarm activities is crucial for policy makers to inform and adjust policies in the rural domain (Reardon et al., 2006).

In spite of the large number of studies analyzing the nature and consequences of the associated agricultural reforms in the region (Lerman, 2007; Lerman and Sedic, 2009), there is almost complete lack of empirical evidence on the nature and drivers of the rural nonfarm economy (RNFE) in post-Soviet Central Asia. To fill this gap, this paper analyzes the determinants of participation and income from nonfarm activities for the Central Asian republic of Kyrgyzstan. This is the only study analysing quantitatively determinants and income from nonfarm activities in Kyrgyzstan. Moreover, in our regression analysis we control for the fact that some variables may diminish incentives to start nonfarming, but in case of participation increase nonfarm income by means of the strengthened capacity or better access to higher remunerative activities. High rural poverty, slowing agricultural growth and accelerating labour

migration with uncertain prospects make this regional advanced agricultural reformer very interesting to study, and the results can be informative for the broader regional discussion on finding prospects to improve the livelihoods of the rural population.

The layout of the paper is as follows. It starts from the brief country background. The third section discusses methodological issues. The fourth section covers the magnitude and the structure of the RNFE at the county level. Section five presents the results from the empirical models and is followed by conclusions.

2. The county context

Kyrgyzstan is a small landlocked mountainous former Soviet Republic located in Central Asia. It has a predominantly rural population of around 5.2 mln. people (65% live in rural areas). Kyrgyzstan is a low-income country with a Gross National Income per capita of USD1980 in 2007 (World Bank, 2009). Regional differences in landscape and climatic conditions are substantial. The South is characterised by a relatively warm climate and high population pressure in comparison to the North.

According to the National Statistical Committee, in spite of the fast growth of the service sector, agriculture still plays a leading role in the economy, contributing to 26% of GDP in 2008. It was the engine behind the economic growth in Kyrgyzstan in the second part of the 1990s, when early liberalization, land reform and farm individualisation boosted agricultural output. The rapid growth in agriculture decreased rural poverty substantially, but it remains high: 36.8% of the rural population lived below the poverty line in 2008 (www.stat.kg).

According to the World Bank (2007), the main reason for rural poverty is high underemployment in agriculture combined with a scarcity of non-farm opportunities. Rural unemployment was 6.4% in 2005, which is much lower than the urban unemployment of 11.1%. In contrast, poverty rates are eight percentage points higher in rural areas than in urban areas. This suggests subsistence nature of agriculture (World Bank, 2007: 14). In general, employment in rural areas has high level of informality (54% of rural employment were informal in 2005), with labour relations outside the formal legal environment and concentrated in low-productivity sectors.

There are different market imperfections in rural areas of the Kyrgyz Republic. Private property of land (for juridical persons, urban residents and local self-governance units) is restricted, which seriously limits the functioning of the land market. In addition, commercial banks are not allowed to take land as collateral (USAID, 2008). This constrains access to financial resources, and only 15% of rural households used credit in 2005, the majority from informal sources and to cover basic consumption needs (World Bank, 2007). According to

Guadagni and Fileccia (2009), inadequate access to credit is the main factor behind low farm mechanization and, as a result, low agricultural productivity.

3. Methodology

3.1. Theoretical model

The theoretical framework for the analysis of non-farm activities involves different streams of literature and cuts across several disciplines (Ellis, 1998). At the micro level, the starting point is the theory of agricultural household models, where the household has a dual role of producer and consumer. If markets are perfect, the household first maximises profit by choosing different sets of income activities based on its resources and prices, and then maximises utility by choosing between different levels of consumption and leisure given profits. However, in case of market imperfects production and consumption decisions become non-separable (Taylor and Adelman, 2003). This implies that households maximise utility, given their resources, the available technology, and (often household-specific) market-access and prices (De Janvry and Sadoulet, 1995). The first order conditions of farm household models provide a system of supply and demand functions that permits formulating labour allocation decision between different agricultural and non-agricultural activities.

Labour participation in nonfarm activities is a function of incentives and constraints (Barret and Reardon, 2000; Reardon et al., 2006). Incentives include the level and variability of prices and wages in both farm and non-farm activities. These prices may differ substantially among households due to heterogeneous access to markets, human capital, and assets endowments. Constraints are related to the capacity of a household to diversify into nonfarm activities. They include household assets, education, size, age, gender structure of the household, and access to credit resources.

The combination of constraints and incentives leads to paradoxes at the meso and micro-level, as described by Reardon et al. (2006). At the meso level, households have higher incentives to engage in non-farming in poor resource areas, but their capacity to generate these activities is limited in these regions. At the household level, the same picture evolves, when poor households have higher incentives to diversify into nonfarm activities but a lower capacity to do this successfully due to the lack of assets. In this case, the poor are often engaged in badly paying non-farm activities equivalent to subsistence farming.

Following the incentives and capacity approach, we hypothesise that the same characteristic of a region or household may have a dual impact on the participation in nonfarm activities through its potentially conflicting effect on incentives and capacity. For example, larger land endowments may diminish the incentives to engage in the RNFE but can increase the

capacity to undertake or expand nonfarm activities with high returns by either investing cash from agricultural activities or using land as collateral to get financial resources. Similarly, cattle ownership may decrease the need to engage in the RNFE but its proceeds may facilitate engagement in profitable non-farm activities. Human capital may also have a diverse impact on participation and income from the RNFE. For example some nonfarm activities may traditionally be mostly occupied by women, while returns are biased towards men.

3.2. *Data description and proposed estimation techniques and specification*

The data used for the analysis are based on two representative household budget surveys conducted by the National Statistical Committee of the Kyrgyz Republic in 2005 and 2006[1]. We use only data for rural households, comprising about 1800 observations for each year. Information on individual employment is available at the quarterly basis and includes time spent, sector of occupation, and type of employment. In this work only locally employed people are considered, and migrants are excluded from the analysis.

We consider all economic activities in rural areas except primary agriculture, livestock, fishing and hunting part of the RNFE. We distinguish two types of nonfarm activities. Following World Bank (2007), we classify nonfarm employment financed mainly through state or local government budgets as public employment. This includes education, public administration, health and social services. The remainder of nonfarm employment is commercial employment and includes both private sector employment and provision of public services on a commercial basis. We used this distinction because commercial nonfarm activities are likely to have different determinants than those financed through public budgets and we are particularly interested what stimulates commercial initiatives. Total nonfarm income includes self-employment and wage income from all (primary and additional) nonfarm jobs of the different household members. We include only earned income, as we are interested in nonfarm employment and the incomes associated with this.

Total income is the sum of nonfarm income, farm income, and unearned income from scholarships, interest income, social benefits, and net transfers. We calculated farm income as the sum of aggregate farm wages for all household members and income from the peasant farm or subsidiary plot, which includes net income from crops and animals. Net crop income is obtained by subtracting gross costs from the volume harvested times median sales prices at the regional level. Livestock income consists of net income from sold live animals and raw animal products, such as meat, eggs, milk, skin etc. Net income is obtained by subtracting gross

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[1] We are very thankful to Mr. Chuikov from the National Statistical Committee for making the data of the household budget surveys (HBS) of the Kyrgyz Republic conducted by the National Statistical Committee in 2005 and 2006 available for this research.

production expenditure from the quantity of sold animals times producer median prices and the quantity of produced raw animal products times consumer median prices in the relevant region.

The empirical models are specified as follows:

$Y_i = \Phi(I, H, A, Inf, Lct)$, i=1,2,3,

where *Y* is the dependent variable reflecting individual participation in non-farm activities. In the first model, Y is participation in three distinct sets of activities, using data for both primary and secondary employment: farm activities only, nonfarm activities only, and a combination of farm and nonfarm activities. In the second model, Y reflects participation in specific primary non-farm activities based on functional and sectoral criteria: wage employment in private organizations, wage employment in the public sector, self-employment, and employment by individuals. For the third model Y reflects the logarithm of income from primary nonfarm self-employment, public and private wage employment. The explanatory variables are derived from the theoretical considerations described above and are grouped into individual characteristics (*I*), household characteristics (*H*), household assets (A), location characteristics (*Lct*), and access to infrastructure (*Inf*).

Individual characteristics include age, gender, marital status, education level (higher, vocational, secondary and less than secondary). Education is an important part of human capital, which determines both participation in and income from non-farm activities (Reardon et al., 2006). In Latin American countries, for instance, more educated people avoid farm wage employment and are mostly engaged in wage employment in non-farming (Reardon et al., 2001).

Household characteristics mostly involve the demographic structure of the household, namely size of the household, dependence ratio measured as a ratio of children (under 15) and old people (older 65) to total household size, and age, gender and education of the head of the household. Many studies found a positive relationship between the labour endowment (measured as the number of adults) of the household and its participation in the RNFE (Davis et al., 2007).

The asset group of explanatory variables includes the number of cattle and the size of owned land. Both variables can affect participation and income from nonfarm activities. In Africa, many studies found that land had a positive impact on the probability of being employed in nonfarm activities and that larger landowners received higher share of income from nonfarm activities (see, for example, Abdulai and CroleRees, 2001). In contrast, in Latin America, the share of nonfarm income was found to fall with land size, meaning that poor households were pushed into non-farming due to land scarcity and excess of labour (see Reardon et al., 2001; Davis et al., 2007). The size of livestock also found to be important determinant of participation in high-return nonfarm activities versus low-return ones (see, for example, Lay et al., 2007).

Location characteristics and access to infrastructure are measured at the rayon level. The normative values of land tax on arable land are included as a measure of land quality: higher tax means better quality of land. The size of the rural population in the rayon and the distance from the rayon centre to the regional centre serve as a proxy for market size and access. We include a dummy for a famous resort area to test the hypothesis about importance of the local "engines" of growth besides agriculture. Dummy variables for regions and quarters are used to control for regional fixed effects and seasonality. Access to public assets is measured by percentage of the population having access to clean water through infrastructure (pipe, pump etc), and average time needed to get to the closest bus-stop at the district level.

Several empirical studies demonstrate the importance of location characteristics and access to infrastructure for participation in the RNFE. Isgut (2004), for example, found that wage employment in the RNFE was located closer to urban areas, while self-employment mostly depended on local motors, such as profitable agricultural activity, tourist attraction etc. Reardon et al. (2001) demonstrated that access to infrastructure was crucial for participation and income from nonfarm activities compensating for lack of other assets in Latin American countries.

The choice of dependent variables is based on specific research questions to be answered and will require various estimation techniques that account for their specific distribution. The first question is which factors determine the choice of an individual between doing farm, nonfarm or combination of both activities. Since we have more than two outcomes, we used multinomial logit regression to estimate the first model. As we are particularly interested which variables explain the choice between pure farm and nonfarm activities, pure farm category is chosen as a reference one.

The second question is which variables determine participation in particular nonfarm activities. We hypothesise that different nonfarm activities may have different determinants of participation. As we are not interested in obtaining results in comparison to one particular group, as participation in pure farming in the first model, we use probit regression to estimate our equations for participation in four particular groups of primary nonfarm activities. Both multinomial logit and probit were frequently used for the analysis of participation in the RNFE (Corral and Reardon, 2001; Escobal, 2001; Woldenhanna and Oskam, 2001).

Finally, we analyze the income from nonfarm activities. As our data do not allow us separating income into the four categories used for the probit regressions, but we distinguish between self-employment, public wage employment and private wage employment instead. For the third model, yet another econometric technique is needed as our dependent variable, nonfarm earnings, is continuous but censored at zero. As OLS will give biased results, Tobit regression is

usually used for such data. This method has, however, two important limitations. First, it assumes that explanatory variables have the same impact on the probability of being employed in nonfarm activities and on the size of nonfarm income. This does not allow accounting for situations in which some variables may diminish incentives to start non-farming but in case of participation increase nonfarm income by means of the strengthened capacity or better access to higher remunerative activities. Second, the Tobit model considers zero values as corner solution, but an individual may prefer not to engage into non-farming for social reasons irrespective of the value of exogenous variables. On the contrary, the widely used Heckman selection model allows for such reasons for non-participation but rules out corner solution, when zeros in nonfarm income are driven by economic reasons (Matshe and Young, 2004).

An alternative to Tobit and Heckman models is the two step double-hurdle model initially developed by Cragg (1971) to model the demand for durable goods. In the first step, the probit model represents an individual's choice of whether to participate in the RNFE or not. If the first "hurdle" is crossed, a truncated regression describes how much he or she can earn from non-farm activity. The choice between Tobit and double hurdle model can be made based on likelihood test (Green, 2000). To the best of our knowledge, only Matshe and Young (2004) used double hurdle models to explain off-farm labour allocation decisions. They found that gender, education and assets had different impacts on participation in nonfarm activities and hours worked of small households in Shamva district in Zimbabwe.

4. Magnitude and structure of the RNFE at the country level

While most people in rural areas of the Kyrgyz Republic were still employed in agriculture in 2005 and 2006, the RNFE provided substantial employment. The nonfarm sector provided 37.8% and 39.6% of all primary jobs, but only a very small share of secondary and tertiary jobs. The shares of nonfarm time in total time worked also demonstrate the importance of the RNFE, and for primary employment they are even higher than shares of nonfarm jobs. This is related to farm underemployment reflected in higher primary workload in the RFNE in comparison to highly seasonal and much smaller workload in agriculture.

Table 1. Share of non-farm employment to total rural employment and share of time worked in nonfarm activities to total hours worked in rural areas, %

	2005	2006
By type of employment		
Main employment	37.8%	39.6%
Secondary employment	2.7%	2.2%
Tertiary employment	0.2%	0.1%
By hours worked in nonfarm activities to total hours worked		
Main employment	44.3%	48.2%

	2005	2006
Secondary employment	2.2%	2.0%
Tertiary employment	0.1%	0.0%
Total nonfarm employment	46.4%	50.0%

Source: NSC, authors' calculation

Note: indicators are obtained by summing individual data on employment status and time worked during the week at the regional and country levels.

The structural distribution of primary non-farm employment shows that in 2005 and 2006 61% and 65% were generated in commercial sectors accordingly. The most important commercial sectors in 2005 were trade (19%), processing (11%), transport and communications (10%). Education played the leading role among public non-farm sectors accounting for 20% in total non-farm employment.

The mean share of nonfarm income in total rural income followed the employment pattern and increased from 31% in 2005 to 39% in 2006. The functional distribution of nonfarm income shows that income from wage employment represented the largest share in total nonfarm income followed by nonfarm self-employment income.

Table 2. Mean nonfarm income shares, nonfarm and farm income per capita across quintiles based on total income per capita, som

	2005			2006		
Quintiles	Nonfarm income share, %	Nonfarm income per capita, som	Farm income per capita, som	Nonfarm income share, %	Nonfarm income per capita, som	Farm income per capita, som
1	44%	2367 (68.7%)	1552 (83.3%)	45%	2627 (60.8%)	1575 (83.4)
2	36%	2955 (76.6%)	3184 (96.3%)	52%	4427 (84.4%)	2806 (90.7)
3	29%	4209 (65.2%)	5943 (90%)	38%	5163 (74.6%)	5800 (92.6)
4	25%	4652 (70%)	8851 (97.4%)	35%	7309 (76.7%)	9096 (97.5)
5	19%	9069 (58.8%)	28724 (99.8%)	24%	11614 (63.7)	24081 (94.8%)

Source: NSC, authors' calculation

Notes: average incomes for households having a certain income source are given. % of households with this source of income in each quintile is provided in brackets.

The distribution of nonfarm earnings across income quintiles demonstrates the importance of nonfarm income for poor rural households. For both years the share of nonfarm income was decreasing with larger total income per capita. For example, in 2006 the poorest rural households obtained 45% of their total income from non-farming versus 24% of the richest households. Differences between quintiles were also pronounced for farm and nonfarm income per capita. Thus, in 2005 farm income per capita for the fifth quintile was three times larger than income from non-farming.

5. Empirical results

Table 3 presents the determinants of individual participation in nonfarm activities based on multinomial logit regressions for 2005. We do not report and discuss here results for 2006, but they are available in the annex. Two categories of nonfarm participation - pure nonfarm and a mixture of farm and nonfarm activities are compared to the base category of pure agricultural activities. The table reports risk ratios, which are the coefficients in exponential form and indicate how the risk of the outcome falling in the comparison group compares to the risk of the outcome falling in the reference group changes with the variable in question. A ratio greater than (less than) one indicates a higher (lower) probability of choosing nonfarm activities or a mixture of nonfarm with farm over pure agricultural activities.

Both Hausman and Small-Hsiao tests of independence of irrelevant alternatives did not reject the null hypothesis indicating appropriateness of the estimation method (Hausman and McFadden, 1984; Small and Hsiao, 1985). We also use Wald and log-likelihood tests to check whether outcomes can be combined, but tests reject it.

Table 3. Relative risk ratios for participation in nonfarm activities based on multinomial logit[a]

		2005	
		only nonfarm	farm and nonfarm (mixed)
individual characteristics	Age	1.245*** [0.0402]	1.245*** [0.0402]
	Age squared	0.997*** [0.000423]	0.997*** [0.000409]
	Dummy, 1 for male	1.223 [0.150]	1.043 [0.134]
	Dummy, 1 for married	0.507*** [0.0783]	1.159 [0.178]
	Dummy, head	0.991 [0.151]	1.236 [0.192]
	Dummy, Kyrgyz	0.560*** [0.0922]	0.560*** [0.0897]
	Dummy, higher education (university degree)	21.53*** [5.923]	14.59*** [4.558]
	Dummy, vocational education	3.867*** [0.805]	3.088*** [0.823]
	Dummy, secondary education	1.421* [0.282]	1.144 [0.304]
household characteristics	Size of the household	1.057 [0.0428]	0.984 [0.0345]
	Dependence ration	0.299*** [0.0965]	0.544** [0.149]
	Age of the head of household	0.992 [0.00566]	0.990* [0.00591]
	Gender of the head of household, 1 for male	0.862 [0.151]	0.797 [0.133]
	Dummy, head of household has higher education (university degree)	1.144 [0.308]	1.407 [0.319]
Assets	Number of cattle at the beginning of the year	0.982*** [0.00518]	0.996* [0.00245]

		2005	
		only nonfarm	farm and nonfarm (mixed)
	Owned land, ha	0.771*** [0.0404]	0.763*** [0.0367]
	Owned land squared	1.005*** [0.00108]	1.005*** [0.000965]
Access to public utilities	% of having access to water	1.013*** [0.00344]	1.013*** [0.00308]
	Time needed to get to the bus stop	1.011 [0.0219]	1.075*** [0.0210]
	Basic land tax at rayon level, higher tax means better quality of land	0.997*** [0.000792]	1 [0.000756]
locational characteristics	Size of rural population in rayon	1.005*** [0.00159]	1.002 [0.00157]
	Distance from rayon centres to regional centres	1.003 [0.00208]	1.009*** [0.00201]
	Dummy for resort area in Issykkul region	1.636 [0.656]	3.788*** [1.372]
	Observations	12069	
	Pseudo R	0.2173	
	Wald chi2	958.63	
	Probability>chi2	0.00	

Source: NSC, authors' estimation
Notes: [a] The base category is pure farming. *** p<0.01, ** p<0.05, * p<0.1 Intercepts, dummy for 2005, regional and quarterly dummies are not reported. Robust, clustered standard errors are in parentheses.

We find empirical evidence that participation in nonfarm activities is driven mostly by "push" factors, but there is also an indication of "pull" factors at work. A "push" scenario happens when participation in nonfarm activities is driven by inability to earn enough from agricultural activities due to the poor asset base or risky agricultural environment. Imperfections in rural institutions, such as access to credit or insurance markets can also stimulate nonfarm activities. A "pull" scenario means that participation in nonfarm activities is driven by higher payoffs or lower risk in the nonfarm sector compared to agriculture. The combined relevance of "push" and "pull" factors suggests that there are two sets of nonfarm activities: those who serve as last resort activities for the poor, and those that provide profitable opportunities for those who have access. Most of the obtained results are robust across the two years and the two outcomes for pure nonfarm and a mixture of nonfarm with farm activities. Let us consider which factors contributed to particular scenarios.

Quite some variables provide evidence of "push" incentives behind participation in the RNFE. Small land size and poor land quality make individuals choose employment in the nonfarm sector over agricultural activities. The negative influence of the number of cattle[2] and age of household head is also in line with the "push" scenario and indicates that access to liquid

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[2] This is different from empirical findings in some African countries where possession of cattle may help to overcome entrance barriers to start nonfarm activities with high returns (see for example Abdulai and CroleRees, 2001).

assets or a stable source of cash through pension system diminishes incentives to choose nonfarm activities over farming. Finally, the positive effect of the distance from rayon centres to regional centres on the choice of nonfarm activities over pure agriculture suggests that households start non-farming in remote areas to compensate for low agricultural margins.

There is also some evidence in favour of "pull" scenario behind participation in nonfarm activities. For instance, a marginal increase in the size of land decreases probability to choose nonfarm employment at a decreasing rate, indicating that there may be less incentives for individuals with ample land to divert from nonfarming since they may be able to engage in more profitable activities due to access to cash resources from agriculture or because they can develop nonfarm activities dependent on agriculture. Yet, a large majority of individuals are on decreasing part of the curve where more land means less participation. Last "pull" factor is related to the impact of other sources of growth. In our case, availability of resort area is found to pull individuals from farm activities into the RNFE.

Besides "push" and "pull" factors, participation in nonfarm activities is influenced by different human capital variables and development of infrastructure which affect the capacity of rural inhabitants to divert from pure farm activities. Thus, better educated individuals, especially with higher or vocational education, are more likely to choose pure nonfarm activities or a mixture of farming and nonfarming, mostly because they are better qualified for formal nonfarm jobs. Having more dependents constrains participation in the RNFE due to the trade-off in allocation of labour between farm and nonfarm activities.

To get more insight in the determinants of specific nonfarm activities we analyzed participation in self-employment, private organizations, public organizations and employment by individuals. Marginal effects of the probit regressions are presented in table 4. Several interesting findings are discussed below.

Different nonfarm activities require different types of capital. For example, there are significant differences in effects of gender and education on employment in organizations, self-employment and employment by individuals. Women are more likely to be engaged in public RNFE, while men are more likely to be employed by private organizations or individuals. Employment in public and private organizations requires higher education in contrast to participation in self-employment/employment by individuals which require only secondary or vocational education. Access to public services, proxied by the access to clean water, stimulates participation in private nonfarm employment, indicating that such services facilitate a profitable private sector.

With regards to "push" and "pull" scenarios behind specific nonfarm activities, we again found a combination of mostly "push" and some "pull" factors, consistent with the results from multinomial logit. Few land, its poor quality and lack of access to cash resources push individuals into all types of nonfarm employment. Interestingly, low, but secure payment in public organizations works as a "harbour" attracting individuals in areas with lower economic potential due to poor quality of land, remoteness and lack of other sources of growth.

Table 4. Marginal effects of the probit model for primary participation in rural nonfarm activities at the mean of explanatory variables, 2005

		Self-employment	Employment by individuals	Employment in commercial organizations	Employment in public organization
individual characteristics	Age	0.0135***	0.00316**	0.00503***	0.00895***
		[0.00294]	[0.00132]	[0.00182]	[0.00330]
	Age squared	-0.000170***	-5.24e-05***	-5.30e-05**	-9.17e-05**
		[3.91e-05]	[1.76e-05]	[2.23e-05]	[4.24e-05]
	Dummy, 1 for male	0.0144	0.0203***	0.0289***	-0.0937***
		[0.00974]	[0.00479]	[0.00695]	[0.0136]
	Dummy, 1 for married	0.00219	-0.0194**	-0.0124	-0.0302
		[0.0139]	[0.00754]	[0.00992]	[0.0185]
	Dummy, head	0.00523	0.0011	0.00526	-9.29E-05
		[0.0139]	[0.00662]	[0.00870]	[0.0158]
	Dummy, Kyrgyz	-0.0481**	-0.0204**	-0.0145	0.0263*
		[0.0192]	[0.00836]	[0.00984]	[0.0145]
	Dummy, higher education	-0.0179	-0.0124	0.201***	0.512***
		[0.0228]	[0.00860]	[0.0511]	[0.0653]
	Dummy, vocational education	0.0579**	0.00454	0.0797***	0.169***
		[0.0255]	[0.00864]	[0.0249]	[0.0447]
	Dummy, secondary education	0.0356**	0.00181	0.0322***	-0.00385
		[0.0166]	[0.00711]	[0.0119]	[0.0267]
household characteristics	Size of the household	0.000472	0.000243	0.000131	0.00179
		[0.00317]	[0.00142]	[0.00195]	[0.00388]
	Dependence ration	-0.0561**	-0.00173	-0.0330**	-0.0479*
		[0.0272]	[0.0120]	[0.0165]	[0.0274]
	Age of the head of household	-0.000383	-7.60E-05	0.000319	-0.000881
		[0.000541]	[0.000232]	[0.000291]	[0.000616]
	Gender of the head of household, 1 for male	-0.0197	0.00103	0.000605	0.00648
		[0.0163]	[0.00664]	[0.00884]	[0.0168]
	Dummy head of household	0.0257	-0.0112	0.00102	0.0132
		[0.0286]	[0.00795]	[0.0119]	[0.0188]
Assets	Number of cattle by the beginning of the year	-0.000483	-0.00131***	-0.000121	-0.000324
		[0.000332]	[0.000258]	[0.000171]	[0.000219]
	Owned land, ha	-0.0190***	-0.00557**	-0.00715***	-0.00147
		[0.00653]	[0.00230]	[0.00262]	[0.00373]
	Owned land squared	0.000374***	9.42e-05*	0.000130***	2.64E-05
		[0.000124]	[5.30e-05]	[4.99e-05]	[7.99e-05]
public utilities	% of having access to water	0.000574*	0.000290**	0.000299*	0.000807***
		[0.000321]	[0.000134]	[0.000182]	[0.000264]
	time needed to get to the bus stop	0.000611	-0.00123	-0.00211	0.00624***
		[0.00167]	[0.000906]	[0.00136]	[0.00172]

		Self-employment	Employment by individuals	Employment in commercial organizations	Employment in public organization
locational characteristics	Basic land tax at rayon level, higher tax better quality of land	-0.000158**	-3.20E-06	-4.19E-05	-0.000107
		[6.53e-05]	[2.95e-05]	[4.69e-05]	[7.38e-05]
		0.000302**	0.000119*	-5.83E-05	-3.34E-05
	Size of rural population in rayon	[0.000130]	[6.18e-05]	[9.06e-05]	[0.000153]
	Distance from rayon centres to regional centres	0.000302	0.000188**	-5.99E-05	0.000391**
		[0.000196]	[7.98e-05]	[0.000107]	[0.000167]
	Dummy for resort area in Issykkul region	0.112	0.0042	0.255***	-0.0742***
		[0.0851]	[0.0138]	[0.0754]	[0.0103]
	Observations	12069	12069	12069	12069
	Pseudo R2	0.143	0.209	0.209	0.286
	Wald chi2(33)	243.99	361.4	361.42	546.46
	obs. P	0.098	0.069	0.069	0.141
	pred. P	0.067	0.0347	0.0347	0.083

Source: NSC, authors' estimation

Note: *** p<0.01, ** p<0.05, * p<0.1 Regional and quarterly dummies are not reported. Robust and clustered standard errors are in parenthesis.

Having identified determinants of participation in non-farm activities, we can proceed with the analysis of nonfarm income determinants (self-employment, private and public salary) to test our hypothesis that some explanatory variables may have different effects on the probability of participation in nonfarm activities and on income from them. Results from a double hurdle model are presented in table 5. As the first stage represents participation, which has been discussed extensively above, we now focus on the second stage, which describes the determinants of the level of income given that a person participates in a certain activity. Due to space limitation we present below the results for 2005 year. Results for 2006 year are very similar and are available in the annex.

We identified that human capital, access to infrastructure and cash resources not only influence access to nonfarm activities, but also determine income from these activities. Thus, being older increases the level of salary in public and private nonfarm employment, but age does not have an impact on self-employment income given participation. This may be related to the fact that self-employment income is based on low-returns activities, income from which does not depend much on experience.

Gender and education were also identified as crucial determinants of nonfarm income. Males, for instance, receive higher nonfarm income both from self and wage employment. Even in case of public nonfarm sectors, where females have much higher probability to work in, males receive higher salaries than females. Education, and especially higher education, is also found to be a strong positive determinant of nonfarm income and wages. Interestingly, while higher education has no effect on participation in self-employment activities, it significantly increases self-employment income.

Some locational characteristics and access to cash resources help rural individuals to get higher nonfarm income and salaries even though they affect participation in the RNFE negatively. Access to infrastructure and markets, measured as time needed to get to the closest bus stop and as the distance from rayon centres to regional cities, significantly increases income from self-employment and salary level from private wage employment. This means that residence in remote areas pushes households into nonfarm activities, but given participation inadequate access to infrastructure seriously limits nonfarm income.

The availability of non-agricultural sources of growth, proxied by a famous resort area in our model, substantially increases income from private nonfarm activities. Finally, in spite of its negative impact on participation in private non-farm wage and self-employment, access to liquid assets in the form of cattle is found to have significant positive impact on the size of non-farm income. Hence, being an alternative income source, cattle ownership discourages participation in the nonfarm sector, but for those who participate, it is associated with higher income levels. For nonfarm self employment this could mean that households use livestock income to invest in profitable activities. In the case of private nonfarm salaries a possible explanation is that high wages are related to a post stream of similar wages that have partly been invested in livestock.

Table 5. Double hurdle model, marginal effects after probit and results after truncated regression for logarithm of income from primary rural nonfarm activities, 2005 year

		Received income from nonfarm self-employment	Logarithm of self-employment income	Received public nonfarm salary	Logarithm of public nonfarm salary	Received commercial nonfarm salary	Logarithm of commercial nonfarm salary
individual characteristics	Age	0.0138***	-0.00429	0.0102***	0.0523***	0.00825***	0.0435**
		[0.00289]	[0.0244]	[0.00307]	[0.0147]	[0.00275]	[0.0199]
	Age squared	-0.000172***	4.65E-05	-0.000107***	-0.000563***	-0.000103***	-0.000646**
		[3.84e-05]	[0.000311]	[3.95e-05]	[0.000191]	[3.50e-05]	[0.000258]
	Dummy, 1 for male	0.0167*	0.172**	-0.0902***	0.160**	0.0668***	0.339***
		[0.00919]	[0.0757]	[0.0126]	[0.0638]	[0.00999]	[0.0823]
	Dummy, 1 for married	0.00167	0.0975	-0.0154	-0.1	-0.0385***	0.112
		[0.0130]	[0.0975]	[0.0164]	[0.0611]	[0.0147]	[0.0979]
	Dummy, head	0.00376	0.162*	0.0114	0.013	0.00463	-0.00371
		[0.0129]	[0.0911]	[0.0149]	[0.0695]	[0.0132]	[0.0930]
	Dummy, Kyrgyz	-0.0484***	-0.178**	0.0254**	0.124*	-0.0533***	-0.0465
		[0.0187]	[0.0887]	[0.0126]	[0.0668]	[0.0166]	[0.0766]
	Dummy, higher education	-0.016	0.594***	0.529***	1.249***	0.142***	0.329**
		[0.0215]	[0.191]	[0.0684]	[0.140]	[0.0427]	[0.167]
	Dummy, vocational education	0.0580**	0.275*	0.184***	0.906***	0.0628***	0.129
		[0.0253]	[0.152]	[0.0485]	[0.135]	[0.0237]	[0.136]
	Dummy, secondary education	0.0369**	0.181	0.0187	0.717***	0.0253	0.182
		[0.0162]	[0.146]	[0.0247]	[0.145]	[0.0166]	[0.129]
household characteristics	Size of the household	0.000489	0.0281	0.00299	-0.0261*	0.000214	-0.0479***
		[0.00301]	[0.0229]	[0.00332]	[0.0156]	[0.00316]	[0.0182]
	Dependence ration	-0.0530**	0.0635	-0.0478*	0.128	-0.0425*	0.216
		[0.0262]	[0.171]	[0.0245]	[0.122]	[0.0254]	[0.174]
	Age of the head of household	-0.000445	0.000449	-0.000632	-0.00391	0.000119	-0.00315
		[0.000495]	[0.00406]	[0.000580]	[0.00244]	[0.000497]	[0.00289]
	Gender of the head of household, 1 for male	-0.0189	0.0239	-0.00509	0.079	0.00538	0.0615
		[0.0156]	[0.0955]	[0.0165]	[0.0679]	[0.0145]	[0.0816]
	Dummy head of household	0.0274	0.0608	0.0139	0.0685	-0.00362	0.113
		[0.0279]	[0.131]	[0.0170]	[0.0568]	[0.0189]	[0.116]
Assets	Number of cattle by the beginning of the year	-0.000366	0.00656**	-0.000355	0.00203	-0.000770*	0.00809***
		[0.000295]	[0.00272]	[0.000226]	[0.00126]	[0.000411]	[0.00278]

		Received income from nonfarm self-employment	Logarithm of self-employment income	Received public nonfarm salary	Logarithm of public nonfarm salary	Received commercial nonfarm salary	Logarithm of commercial nonfarm salary
Access to public utilities	Owned land, ha	-0.0180***	0.0752	-0.00128	-0.0123	-0.0167***	-0.0563
		[0.00620]	[0.0771]	[0.00331]	[0.0148]	[0.00438]	[0.0420]
	Owned land squared	0.000357***	-0.00693	2.84E-05	0.000239	0.000311***	0.00555
		[0.000118]	[0.0109]	[7.07e-05]	[0.000340]	[8.68e-05]	[0.00359]
	% of having access to water	0.000453	-0.00271*	0.000672***	0.00018	0.000644**	-0.00139
		[0.000301]	[0.00161]	[0.000241]	[0.00106]	[0.000274]	[0.00183]
	time needed to get to the bus stop	0.000302	-0.0194	0.00552***	0.00955	-0.00469**	-0.0216*
		[0.00157]	[0.0151]	[0.00152]	[0.00735]	[0.00221]	[0.0117]
locational characteristics	Basic land tax at rayon level, higher tax better quality of land	-0.000151**	0.00018	-0.000106	-0.000217	-8.62E-05	8.72E-05
		[6.19e-05]	[0.000381]	[6.57e-05]	[0.000344]	[7.45e-05]	[0.000454]
	Size of rural population in rayon	0.000279**	-0.000331	-5.78E-05	-0.000953*	8.82E-05	-0.000251
		[0.000123]	[0.000764]	[0.000139]	[0.000562]	[0.000138]	[0.000809]
	Distance from rayon centres to regional centres	0.000303*	-0.00506***	0.000362**	-0.00105	0.000159	-0.00250*
		[0.000184]	[0.00106]	[0.000149]	[0.000677]	[0.000169]	[0.00133]
	Dummy for resort area in Issykkul region	0.115	0.429***	-0.0615***	0.122	0.293***	0.114
		[0.0845]	[0.154]	[0.00920]	[0.163]	[0.0724]	[0.171]
	Pseudo R2	0.14		0.2976		0.2142	
	Observations	12069	940	12069	1662	12069	1373
	Log likelihood	-2811.1605	-860.9	-3422.9649	-1125.9112	-3387.7254	-1316.1605
	Log likelihood of Tobit[a]		-5658.7174		-8296.8463		-7506.1895
			3973.3		7495.9		5604.6
	LR test for Tobit vs double hurdle model		[0.00][b]		[0.00]		[0.00]

Source: NSC, authors' estimation

Note: *** p<0.01, ** p<0.05, * p<0.1 Regional and quarterly dummies are not reported. Robust and clustered standard errors are in parenthesis.

[a] The Tobit model can be tested against double hurdle model by computing the following likelihood ratio statistic $\lambda = 2(\ln L_{binary} + \ln L_{truncated} - \ln L_{Tobit})$, where λ is distributed as chi-square with R degrees of freedom (R is the number of independent variables including a constant). The Tobit model will be rejected in favor of double hurdle model if λ exceeds the appropriate chi-square critical value (Green, 2000). Log likelihood obtained for regressions without weight and cluster options.

[b] Numbers in parenthesis are associated with chi-square probabilities. Rejection of Ho means rejection of restriction imposed by Tobit in favour of the double hurdle model.

Conclusions

High rural poverty, farming underemployment and widespread labour migration strengthen the importance of nonfarm activities for rural households in poor Central Asian countries where agriculture can not alone bear the burden of poverty reduction in rural areas. This paper uses two representative household budget surveys from the Kyrgyz Republic to analyze factors influencing participation and returns from different types of nonfarm activities in 2005 and 2006.

At the aggregated level, the RNFE played important role both in terms of generated employment (37.8% and 39.6%) and income (31% and 39%) in 2005 and 2006 accordingly. By far most of employment in the RNFE is primary and generates a full workload due to the large share of formal employment in both private and public organizations. Public nonfarm employment accounts for about 37% of total rural nonfarm employment in the considered period.

Empirical analysis of the RNFE determinants reveals that participation in nonfarm activities instead of undertaking pure farming can be driven by insufficient land size, its poor quality, lack of cattle and the remoteness of the area of residence. These determinants point to a "push" nature of the RNFE when a poor asset base, insufficient agricultural income and market imperfections make individuals resort to nonfarm activities to supplement their meagre agricultural income or to smooth intra-seasonal cash flows and consumption. "Push" factors are found to be particularly important drivers of participation in nonfarm self-employment, employment by individuals and public employment, but are less important for jobs in private organizations. Moreover, it is often women who choose relatively badly paying nonfarm public employment, but probably more secure and stable than agricultural income in areas with poor agricultural base.

Besides "push" factors, we identified some signs of "pull" factors which can stimulate nonfarm activities. The size of land decreases the probability of participation in nonfarm activities at a decreasing rate suggesting a potentially positive contribution of land size to participation in nonfarm activities for households with ample land. Moreover, people in a famous resort area are more likely to engage in nonfarm activities which indicates importance of local "engines" of growth besides agriculture.

There are several important determinants which affect the capacity of an individual to participate in nonfarm activities. Better education is a crucial factor explaining the choice between nonfarm and farm activities. Higher education is also the main determining factor which allows participating in public and private nonfarm organizations, while participation in self-

employment nonfarm activities requires only vocational or secondary education. The last important capacity variable is an access to infrastructure, which stimulates participation in nonfarm employment over pure farming.

Interestingly, the determinants of nonfarm income given participation are not identical to the determinants of participation. Specifically, the number of cattle owned diminishes incentives to participation in the RNFE as being an alternative source of income. However, it has a positive impact on income from these activities given participation by investing livestock income into more profitable nonfarm activities. Higher education has positive impact on nonfarm self-employment income, but does not affect participation since self-employment activities are mostly in informal sectors not requiring higher education. Larger transaction costs caused by remoteness of the area stimulate participation in the RNFE, but affect nonfarm earnings negatively.

Distributional analysis shows that earnings from nonfarm activities are more important for poor households generating about 50% of their total income consistent with predominantly "push" nature of the RNFE in Kyrgyzstan. Nonfarm per capita income is also slightly higher than farm income for the poorest quartile, but the opposite holds for richer households. Taking into account that education, access to infrastructure, size of cattle are found to have a positive impact on nonfarm earnings, inadequate access and possession of these capacity variables confines rural the poorest to low-productive nonfarm employment opportunities which probably offer a few pathways out of poverty. Therefore, equipping poor households to move towards better remunerative RNFE should be a priority. Investment in infrastructure, access to financial resources, skill building and enhancing of human capital along with local engines of growth can help to crease such a favourable environment and should be taken into account while designing and implementing rural policies in the Kyrgyz Republic.

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Annex

Table 1. Descriptive statistics, 2005

	Obs	Mean	Std. Dev.	Min	Max
Dummy for having nonfarm salary	12069	0.25	0.43	0.00	1.0
Logarithm of nonfarm salary	12069	2.04	3.54	0.00	10.71
Logarithm of nonfarm self-employment income	12069	0.66	2.26	0.00	10.78
Dummy for having income from nonfarm self-employment	12069	0.08	0.27	0.00	1.0
Dummy for participation in self-employment	12069	0.08	0.27	0.00	1.0
Dummy for employment by individuals	12069	0.05	0.22	0.00	1.0
Dummy for employment in public nonfarm organizations	12069	0.15	0.36	0.00	1.0
Dummy for employment in private nonfarm organizations	12069	0.07	0.26	0.00	1.0
Age	12069	36	12	15	70
Dummy, 1 for male	12069	0.58	0.49	0.00	1.00
Dummy, 1 for married	12069	0.70	0.46	0.00	1.00
Dummy, 1 if the head of household	12069	0.36	0.48	0.00	1.00
Dummy, Kyrgyz	12069	0.83	0.38	0.00	1.00
Dummy, higher education	12069	0.12	0.33	0.00	1.00
Dummy, vocational education	12069	0.22	0.42	0.00	1.00
Dummy, secondary education	12069	0.55	0.50	0.00	1.00
Size of the household	12069	5.11	1.81	1.00	15.00
Dependence ration	12069	0.34	0.23	0.00	1.00
Age of the head of household	12069	50.46	12.76	21.00	105.00
Gender of the head of household, 1 for male	12069	0.82	0.38	0.00	1.00
Dummy, head of household has higher education	12069	0.11	0.31	0.00	1.00
Number of cattle, beginning of the year	12069	14.23	37.11	0.00	729.00
Owned land, ha	12069	1.92	3.22	0.00	50.90
% of having access to water	12069	83.73	27.23	0.00	100.00
Time needed to get to the bus stop	12069	13.24	4.12	6.00	32.00
Basic land tax at rayon level, higher tax better quality of land	12069	288.73	95.16	105.00	436.00
Size of rural population in rayon	12069	92.95	60.51	12.60	298.10
Distance from rayon centres to regional centres	12069	50.22	40.53	0.00	180.00
Dummy for resort area in Issykkul region	12069	0.03	0.17	0	1

Table 2. Relative risk ratios for participation in nonfarm activities based on multinomial logit[a], 2006

		2006	
		only nonfarm category	farm and nonfarm (mixed) category
individual characteristics	Age	1.235*** [0.0355]	1.363*** [0.0460]
	Age squared	0.997*** [0.000379]	0.996*** [0.000429]
	Dummy, 1 for male	1.195 [0.141]	1.129 [0.143]
	Dummy, 1 for married	0.461*** [0.0638]	0.747* [0.114]
	Dummy, head	1.046 [0.152]	1.179 [0.180]
	Dummy, Kyrgyz	0.477*** [0.0742]	0.405*** [0.0666]
	Dummy, higher education	13.34*** [3.511]	20.95*** [6.405]
	Dummy, vocational education	3.515*** [0.725]	5.314*** [1.350]
	Dummy, secondary education	1.33 [0.254]	1.984*** [0.495]
household characteristics	Size of the household	1.038 [0.0336]	0.921** [0.0343]
	Dependence ration	0.309*** [0.0869]	0.986 [0.282]
	Age of the head of household	0.993 [0.00516]	0.990* [0.00546]
	Gender of the head of household, 1 for male	0.957 [0.146]	0.835 [0.135]
	Dummy head of household	1.272 [0.254]	1.459 [0.357]
assets	Number of cattle by the beginning of the year	0.958*** [0.00821]	0.998 [0.00366]
	Owned land, ha	0.776*** [0.0404]	0.786*** [0.0369]
	Owned land squared	1.005*** [0.00107]	1.005*** [0.000946]
access to public utilities	% of having access to water	1.014*** [0.00416]	1.018*** [0.00405]
	time needed to get to the bus stop	1.014 [0.0218]	1.040* [0.0217]
locational characteristics	Basic land tax at rayon level, higher tax better quality of land	0.997*** [0.000748]	1 [0.000741]
	Size of rural population in rayon	1.002 [0.00136]	1 [0.00155]
	Distance from rayon centers to regional centers	1.003* [0.00182]	1.010*** [0.00192]
	Dummy for resort area in Issykkul region	5.013*** [1.685]	2.261** [0.750]

	2006	
	only nonfarm category	farm and nonfarm (mixed) category
Observations		13408
Pseudo R		0.2136
Wald chi2		1018.5
Probability >chi2		0.00

Source: NSC, authors' estimation.

Notes: [a] The base category is pure farming. *** p<0.01, ** p<0.05, * p<0.1 Intercepts, dummy for 2005, regional and quarterly dummies are not reported. Robust, clustered standard errors are in parentheses.

Table 3. Marginal effects of the probit model for primary participation in rural nonfarm activities at the mean of explanatory variables, 2006

		Self-employment	Employment by individuals	Employment in private organizations	Employment in public organization
individual characteristics	Age	0.0150*** [0.00282]	0.00265* [0.00146]	0.00661*** [0.00177]	0.00820*** [0.00297]
	Age squared	-0.000183*** [3.73e-05]	-5.74e-05*** [1.88e-05]	-7.21e-05*** [2.16e-05]	-8.01e-05** [3.78e-05]
	Dummy, 1 for male	0.0141 [0.0103]	0.0267*** [0.00623]	0.0381*** [0.00756]	-0.0907*** [0.0119]
	Dummy, 1 for married	-0.00608 [0.0131]	-0.0259*** [0.00892]	-0.00964 [0.0105]	-0.0430** [0.0171]
	Dummy, head	0.015 [0.0137]	0.0103 [0.00895]	-0.00171 [0.00922]	-0.0121 [0.0129]
	Dummy, Kyrgyz	-0.0339** [0.0168]	-0.0359*** [0.0113]	-0.0263** [0.0119]	0.00465 [0.0157]
	Dummy, higher education	-0.0463*** [0.0172]	-0.00625 [0.0128]	0.152*** [0.0437]	0.584*** [0.0659]
	Dummy, vocational education	0.0207 [0.0229]	0.0187 [0.0125]	0.0743*** [0.0237]	0.228*** [0.0515]
	Dummy, secondary education	0.0126 [0.0193]	0.0141 [0.00899]	0.0286** [0.0131]	0.0312 [0.0252]
household characteristics	Size of the household	0.00142 [0.00279]	-0.00151 [0.00217]	-0.0019 [0.00219]	0.0022 [0.00299]
	Dependence ration	-0.0337 [0.0266]	0.00271 [0.0152]	-0.0106 [0.0167]	-0.0828*** [0.0257]
	Age of the head of household	9.76E-05 [0.000451]	0.000268 [0.000282]	6.75E-07 [0.000334]	-0.00138*** [0.000508]
	Gender of the head of household, 1 for male	0.00157 [0.0131]	-0.00476 [0.00799]	-0.00264 [0.0106]	0.00483 [0.0144]
	Dummy head of household	0.0362 [0.0311]	-0.000957 [0.0136]	-0.0015 [0.0106]	0.0171 [0.0186]
assets	Number of cattle by the beginning of the year	-0.00083 [0.000583]	-0.00255*** [0.000527]	-0.00041 [0.000267]	-0.000503 [0.000329]
	Owned land, ha	-0.0217*** [0.00525]	-0.00728** [0.00289]	-0.00652* [0.00334]	-0.00103 [0.00319]
	Owned land squared	0.000381*** [0.000102]	0.000144** [5.97e-05]	0.000110* [6.03e-05]	2.81E-05 [7.08e-05]
access to public utilities	% of having access to water	0.00108*** [0.000402]	0.000901*** [0.000239]	1.45E-05 [0.000230]	0.000650** [0.000305]
	time needed to get to the bus stop	0.00334* [0.00199]	0.000707 [0.00128]	-0.00206 [0.00166]	0.00387** [0.00171]
locational characteristics	Basic land tax at rayon level, higher tax better quality of land	-0.000139** [6.20e-05]	-4.03E-05 [3.76e-05]	-5.38E-05 [5.43e-05]	-0.000182*** [6.82e-05]
	Size of rural population in rayon	0.0002 [0.000126]	0.000165** [8.21e-05]	-0.000149 [0.000106]	-5.86E-05 [0.000127]
	Distance from rayon centers to regional centers	0.00011 [0.000180]	0.000337*** [0.000108]	-9.54E-05 [0.000120]	0.000261* [0.000155]
	Dummy for resort area in Issykkul region	0.115 [0.0712]	0.0481* [0.0292]	0.267*** [0.0742]	-0.0491*** [0.0152]
	Observations	13408	13408	13408	13408
	Pseudo R2	0.128	0.22	0.16	0.307
	Wald chi2(33)	194.21	352.2	293	633.65

	Self-employment	Employment by individuals	Employment in private organizations	Employment in public organization
obs. P	0.099	0.08	0.07	0.136
pred. P	0.07	0.04	0.04	0.074

Source: NSC, authors' estimation

Note: *** p<0.01, ** p<0.05, * p<0.1 Regional and quarterly dummies are not reported. Robust and clustered standard errors are in parenthesis.

Table 4. Double hurdle model, marginal effects after probit and results after truncated regression for logarithm of income from primary rural nonfarm activities, 2006

		Received income from nonfarm self-employment	Logarithm of self-employment income	Received public nonfarm salary	Logarithm of public nonfarm salary	Received commercial nonfarm salary	Logarithm of commercial nonfarm salary
individual characteristics	Age	0.0144***	-0.000529	0.00991***	0.0491***	0.00874***	0.0114
		[0.00276]	[0.0189]	[0.00270]	[0.0142]	[0.00267]	[0.0146]
	Age squared	-0.000176***	8.16E-06	-0.000100***	-0.000557***	-0.000126***	-0.000236
		[3.64e-05]	[0.000226]	[3.43e-05]	[0.000184]	[3.34e-05]	[0.000191]
	Dummy, 1 for male	0.0116	0.204***	-0.0833***	0.00874	0.0761***	0.294***
		[0.00995]	[0.0762]	[0.0106]	[0.0655]	[0.0112]	[0.0618]
	Dummy, 1 for married	-0.00112	0.106	-0.0289*	0.0564	-0.0459***	0.147**
		[0.0126]	[0.0878]	[0.0150]	[0.0718]	[0.0157]	[0.0657]
	Dummy, head	0.0183	0.0485	-0.000981	0.126*	0.0129	0.138*
		[0.0133]	[0.106]	[0.0114]	[0.0728]	[0.0156]	[0.0778]
	Dummy, Kyrgyz	-0.0313**	-0.0716	0.00532	0.0451	-0.0902***	-0.168**
		[0.0159]	[0.0779]	[0.0136]	[0.0632]	[0.0186]	[0.0657]
	Dummy, higher education	-0.0479***	0.263	0.571***	1.241***	0.128***	0.271**
		[0.0157]	[0.173]	[0.0703]	[0.236]	[0.0401]	[0.115]
	Dummy, vocational education	0.0215	0.275**	0.225***	0.934***	0.0831***	0.172*
		[0.0228]	[0.128]	[0.0526]	[0.238]	[0.0260]	[0.0945]
	Dummy, secondary education	0.0119	0.154	0.0389*	0.597**	0.0360**	0.137
		[0.0192]	[0.131]	[0.0231]	[0.243]	[0.0182]	[0.0841]
household characteristics	Size of the household	0.00141	0.0728***	0.00266	-0.0191	-0.00305	-0.0383**
		[0.00271]	[0.0212]	[0.00253]	[0.0151]	[0.00358]	[0.0160]
	Dependence ration	-0.0323	-0.208	-0.0748***	-0.0218	-0.00915	0.357***
		[0.0255]	[0.131]	[0.0228]	[0.127]	[0.0255]	[0.137]
	Age of the head of household	0.000294	0.00113	-0.000970**	-0.00203	0.000244	0.000195
		[0.000429]	[0.00331]	[0.000450]	[0.00233]	[0.000525]	[0.00235]
	Gender of the head of household, 1 for male	0.000117	0.017	-0.00381	-0.0157	-0.00625	0.0317
		[0.0129]	[0.0861]	[0.0137]	[0.0734]	[0.0156]	[0.0692]
	Dummy head of household	0.0399	0.088	0.0164	0.104**	0.00754	0.208***

	Received income from nonfarm self-employment	Logarithm of self-employment income	Received public nonfarm salary	Logarithm of public nonfarm salary	Received commercial nonfarm salary	Logarithm of commercial nonfarm salary
	[0.0308]	[0.127]	[0.0163]	[0.0490]	[0.0191]	[0.0803]
Assets — Number of cattle by the beginning of the year	-0.000795 [0.000547] -0.0214***	0.00362 [0.00413] -0.113*	-0.000467 [0.000289] -0.000369	0.00156 [0.00120] -0.00815	-0.00223*** [0.000598] -0.0180***	0.00425 [0.00301] 0.0138
Owned land, ha	[0.00510] 0.000378***	[0.0587] 0.0126	[0.00279] 1.72E-05	[0.0163] 0.000155	[0.00454] 0.000341***	[0.0272] -0.000457
Owned land squared	[9.73e-05] 0.00118***	[0.00773] -0.00269	[6.24e-05] 0.000560**	[0.000344] -0.000293	[9.23e-05] 0.00103***	[0.000599] -0.00286
Access to public utilities — % of having access to water	[0.000411] 0.00256	[0.00200] -0.00446	[0.000265] 0.00364**	[0.00125] 0.0164**	[0.000392] -0.0029	[0.00250] -0.0218**
time needed to get to the bus stop	[0.00196] -9.40E-05	[0.00851] -0.000790**	[0.00149] -0.000168***	[0.00737] -0.000178	[0.00252] -0.000172**	[0.00997] 0.000174
Basic land tax at rayon level, higher tax better quality of land	[5.88e-05] 0.000187	[0.000337] -0.00149**	[6.02e-05] -1.90E-05	[0.000326] -7.22E-05	[7.83e-05] -3.43E-05	[0.000402] -0.000695
locational characteristics — Size of rural population in rayon	[0.000125] 0.000129	[0.000634] -0.00362***	[0.000111] 0.000278**	[0.000543] -0.000119	[0.000149] 0.000316*	[0.000696] -0.00209*
Distance from rayon centers to regional centers	[0.000173] 0.0964	[0.00114] 0.266*	[0.000137] -0.0402***	[0.000628] 0.0416	[0.000189] 0.310***	[0.00110] 0.646***
Dummy for resort area in Issykkul region	[0.0634]	[0.160]	[0.0133]	[0.139]	[0.0674]	[0.143]
Pseudo R2	0.128		0.3109		0.2111	
Observations	13408	1071	13408	1836	13408	1720
Log likelihood	-3259.1	-970.2	-3693.9538	-1252.515	-4125.0408	-1541.8542
Log likelihood of Tobit[a]		-6520.1416		-9107.8828		-9306.3868
LR test for Tobit vs double hurdle model		4581.7 [0.00][b]		8322.8 0.00		7279.0 0.00

Source: NSC, authors' estimation

Note: *** p<0.01, ** p<0.05, * p<0.1 Regional and quarterly dummies are not reported. Robust and clustered standard errors are in parenthesis.

[a] The Tobit model can be tested against double hurdle model by computing the following likelihood ratio statistic $\lambda = 2(\ln L_{binary} + \ln L_{truncated} - \ln L_{Tobit})$, where λ is distributed as chi-square with R degrees of freedom (R is the number of independent variables including a constant). The Tobit model will be rejected in favor of double hurdle model if λ exceeds the appropriate chi-square critical value (Green, 2000). Log likelihood obtained for regressions without weight and cluster options.

[b] Numbers in parenthesis are associated with chi-square probabilities. Rejection of Ho means rejection of restriction imposed by Tobit in favour of the double hurdle model.

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