Determinants of the rural nonfarm economy in Tajikistan

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Abstract

This paper explores determinants of participation, intensity and the magnitude of the rural nonfarm economy (RNFE) in Tajikistan. Conducting analysis at the district level, in addition to traditional individual and household levels, helps to test the impact of institutional determinants of the RNFE invariant at the micro level. We have found that rural residents in Tajikistan are mostly pushed into nonfarm activities in areas with scarce land resources of poor quality. Moreover, market imperfections in the agricultural sector are also found to induce participation and intensity of the rural nonfarm activities. While nonfarm activities are found to be mostly driven by "push" factors, poor education and the access to infrastructure are found to be important barriers constraining the poor from participation in nonfarm activities.

Keywords: nonfarm economy, determinants, rural, Tajikistan
JEL: J21, J22, J24

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Introduction

Agriculture is still the main sector in rural areas of developing countries. However, declining rates of poverty reduction during recent years and the depletion of the natural resource base have raised concerns about the capacity of the agricultural sector to offer a pathway out of poverty for the rural poor (IFAD, 2011). In these circumstances, the rural nonfarm economy has a potential to absorb abundant rural labour, to provide cash for financing agricultural inputs and to smooth the intra-seasonal variation in rural income. Whether this potential is realized depends on the development of the rural nonfarm economy (RNFE) and whether the rural poor have access to growing nonfarm market niches (Haggblade, Hazell and Reardon, 2010). Understanding determinants of nonfarm activities and the nature of rural nonfarm economy is therefore crucial for policy makers.

The theoretical literature emphasizes the role of individual, household and locational characteristics as factors determining the incentives and capacity of rural inhabitants to participate in nonfarm activities (Barret and Reardon, 2000; Reardon et al. 2006). Empirical studies, however, usually focus mainly on individual and household characteristics and include only a very limited number of locational characteristics reflecting mainly geography and the development of physical infrastructure. At least as relevant but mostly ignored are institutional variables related to the development of input and output markets for agriculture, which determine the performance of farm sector and as a result incentives and capacity of farmers to diversify into nonfarm activities. Considering the impact of such institutional variables is especially interesting in the context of a transition country where the agricultural sector has been undergoing substantial changes.

The main goal of this paper is therefore to analyse determinants of participation, intensity and the magnitude the rural nonfarm economy in Tajikistan, a poor predominantly rural former Soviet republic in Central Asia, with a special focus on the role of institutions. Tajikistan is a mountainous country with a paucity of land resources, and agriculture alone cannot sustain a decent living in rural areas. Tajikistan has become a prominent supplier of labour migrants to the Russian Federation, and international migration plays an enormous role in the social-economic development of the country (Mughal, 2006; Mohapatra et al., 2010). In contrast to migration (Olimova and Bosc, 2003; Jones, Black and Skeldon, 2007; Asian Development Bank, 2008b; World Bank, 2009), the rural nonfarm economy has not been studied intensively yet. Yet local nonfarm activities could present a more sustainable alternative to stagnating agriculture than international migration and can also help to avoid the brain drain associated with it.

Tajikistan is also an interesting case because the agricultural reforms have been far from completed and the level of reforms differs across regions. For example, the cotton growing areas are characterized by strong distortions caused by the state interventions affecting farmers' incentives and input and output prices (USAID, 2004; World Bank, 2005; Ivaschenko and Mete, 2008). In other areas where cotton growing is not widespread, agricultural system seems to be more liberalized and reforms more advanced (Lerman and Sedik, 2008).

The empirical analysis will be based on two national household budget surveys in 2003 and 2007. Determinants of the RNFE will be explored at three different levels, which is rarely done in empirical studies: participation at the individual level, intensity at the household level and the magnitude at the district level. Conducting analysis at the district level can help us to test the role of institutions which can be invariant at the micro level.

The paper continues as follows. It stars from theoretical framework. The third section presents background information on Tajikistan. The fourth section covers the magnitude and the structure of the RNFE at the country and regional levels. Section five presents the results from the empirical models and is followed by conclusions.

2. Theoretical framework

Participation in nonfarm activities is a result of the incentives and capacity of individuals/households. Incentives include relative profitability and riskiness of farm and nonfarm activities. The capacity to access the existing nonfarm opportunities depends on financial, human, physical and social capital. Capacity variables determine whether nonfarm activities can be developed and accessed if there are incentives to do so (Reardon et al., 2006)

Depending on the underlying factors affecting incentives, it is possible to distinguish between "pull" and "push" factors (Reardon et al., 2006). If returns are higher in the nonfarm sector than in farming, the RNFE is driven by "pull" factors. This usually happens in areas with a dynamic agricultural base, when a growing agricultural sector stimulates development of rural nonfarm activities through different forward and backward linkages. "Pull" factors are also relevant in areas with other sources of growth such as mining and resort areas. The role of "push" factors is more complicated and is mainly related to the riskiness of agricultural activities and different market imperfections (Ellis, 1998). The RNFE is driven by "push" factors if the agricultural sector does not generate enough income and employment either because of temporary events (e.g. harvest failure) or due to structural issues such as lack of arable land and seasonality. Rural households can also engage in nonfarm activities to overcome imperfections of insurance and credit markets as suggested by the New Economic of Labour Migration. Income

from nonfarm activities can be used to finance agricultural inputs or to smooth fluctuations in income -*ex post* in case of a sudden drop of agricultural income or *ex ante* to diversify risk.

The combination of constraints and incentives leads to interesting paradoxes at the meso and micro levels (Reardon et al., 2006). The capacity of rural inhabitants to engage in the nonfarm economy can be seriously constrained by missing credit and insurance markets and a lack of infrastructure in regions with depressed agriculture where there are stronger incentives to engage into nonfarm activities Following the same logic, the poor have less agricultural resources and are more vulnerable to risk and therefore have stronger incentives to engage in nonfarm activities, but due to the lack of assets, access to capital and poor education they are seriously constrained in doing so.

3. Background information

Tajikistan is a small landlocked country in Central Asia with an area of 143,000 square kilometres. It is a mountainous county with only 7 per cent of land available for lowland agriculture. According to the Statistical Agency under the President of the Republic of Tajikistan (SAPRT), the 2008 population was estimated at 7.4 million of which 73 per cent lived in rural areas. In addition to the capital Dushanbe, the country consists of four regions: Khatlon, an agricultural area with large cotton growing districts, the Rayons of Republican Subordination (RRS), including aluminium-producing industrial areas in the west and agricultural areas in the east, Sughd, the most industrialized region, and Gorno-Badakhshan Administrative Oblast (GBAO), the most remote and sparsely populated area with the highest unemployment rates (World Bank, 2005, see also table 1). These regions comprise 62 districts which are subdivided into 368 local self-governance units called jamoats (SAPRT).

Table 1. Regional characteristics in Tajikistan, 2009

Name	Territory, km^2	Population, thousand	Share of rural population, %	Sown area, ha	Productivity of land, somoni/ha[a]	Unemployment rate
RRS	28.6	1685.8	86.5	150905	540	8.8
Sughd	25.4	2217	74.7	272460	540	7.6
Khatlon	24.8	2700.2	82.8	439128	724	9.4
GBAO	64.2	220.6	86.7	12418	100	31.2

Source: SAPRT.

[a] Productivity of land is taken from Lerman and Sedik (2008).

During the Soviet time Tajikistan was the poorest agrarian republic with cotton as a main export crop and the main source of employment. Mean per capita income was less than half of that in Russia in 1989 (World Bank, 2005). The county's economy was heavily linked to the Soviet Union and collapse of these ties and the loss of budget transfers (estimated at 50 per cent of total government budget) led to tremendous economic problems after independence. The

situation was exacerbated by a cruel civil war resulting in 100,000 people being killed, with some 700,000 persons internally displaced. The economy shrank by 70 per cent during 1991-1997, and economic reforms started yielding positive results only after 1996 (Meyers et al., 2004).

Tajikistan remains the poorest Former Soviet Republic, even though it demonstrated impressive rates of economic growth after 1999. Poverty rates declined from 72.4 per cent in 2003 to 46.7 per cent in 2009, with rural poverty rates slightly higher at 73.8 per cent and 50.8 per cent in 2003 and 2006, respectively (SAPRT). The agricultural sector accounted for 52.9 per cent of total employment and 21 per cent of GDP in 2009 (SAPRT), while the services sector contributed 31.5 per cent and 51 per cent, respectively. Industry took up the rest. The state still plays an important role in the economy. Thus, the private sector accounts for 51 per cent of the agricultural employment, 68 per cent of industrial employment and 43 per cent of employment in services. With regards to particular sub-sectors, education, health and social sectors are almost fully state owned, while construction, trade and hotel services are almost fully privatized.

Tajikistan's economy depends very much on two main exported commodities: cotton and aluminium. Aluminium accounted for 58 per cent of total exports and cotton for 19 per cent in 2000-2004 (Kie and Eschonov, 2009). Remittances from international labour migrants are also an important source of income. According to Mohapatra et al., 2010, remittances accounted for 35 per cent of GDP in 2009, while about 28 per cent of the economically active male population was working abroad (Mughal, 2006). The highly specialized export portfolio and strong dependence on remittances make the county's development very vulnerable to external factors.

Reforms in the agricultural sector started in 1995 with a land reform involving allocation of land to private persons as so-called household plots. The Government also decided to reorganize state and collective farms into new corporate forms better suited to a market economy hoping to improve agricultural productivity by restructuring the inefficient sector. As a result, the 3627 large agricultural enterprises operating in 1991 were transformed into 28388 *dehkan* (family) farms and 1419 large agricultural enterprises by 2007 (Aminjanov, 2007).[1] It is important to mention that about one third of the *dehkan* farms are organized as collective farms with incentive structures the same as in old collective farms. According to estimates from Lerman (2008), individual farmers (household plots and family *dehkan* farms) hold about 60 per cent of arable land, while the corporate sector (large enterprises and collective dehkan farms)

[1] The process of farm restructuring and land reform was rather spontaneous with many agencies involved. This led to a lack of clarity in the new organizational forms and the number of newly established entities as was clearly shown in Aminjanov (2007).

hold about 40 per cent of arable land in Tajikistan, signalling that reforms are far from completion.

State intervention highly distorts the cotton sector. The Government strongly intervenes in cotton production by setting "production forecasts". Local governors have to insure that farms meet these forecasts by requiring them to grow cotton in at least on 70 per cent of their farmland. In the five cotton-growing districts observed by USAID (2005), none of the *dehkan* farmers were free to choose what to grow in comparison to full freedom on the household plots.

In addition to their limited freedom to choose the crops they grow, farmers are often "tied" to one investor due to the uncompetitive environment in input financing, while the non-transparent relationship between farm managers and farm members leads to delays with payment of wages. Coupled with soft budget constraints, these problems led to a huge accumulation of farm debt and a worsening of social-economic conditions in cotton-growing areas (Bale, 2008; Lerman and Sedik, 2008).

In spite of all unresolved problems, agricultural production in Tajikistan started recovering after the individualization of state collective farms. The recovery was mainly driven by higher productivity of household plots and increases in sown land in *dehkan* farms. The recovery in livestock production was also mostly driven by household production.

4. The RNFE in Tajikistan

4.1 Data description

For our empirical analysis we use cross-sectional data from the Tajikistan Living Standard Survey (TLSS) implemented by the National Statistical Committee of Tajikistan with the support from the World Bank and the United Nations Children's Fund in 2003 and 2007. The data is available through the Living Standards Measurement Study project of the World Bank. This survey provides detailed information at the individual level about demographic characteristics, employment, labour income, time worked during a surveyed week, and weeks worked during the year. At the household level data is available on agricultural income and expenditures, other income sources and asset ownership. There is also a special section in the survey devoted to the community characteristics of primary sampling units (psu). We selected only rural households for the analysis and used weights to ensure representativeness of the obtained results at the rural country and regional levels. Following a conventional rule, we consider the rural nonfarm economy to include all rural income activities except the production of primary agricultural commodities (Haggblade et al., 2010).

We conduct our analysis at four different levels: the descriptive analysis at the regional level, and the econometric analysis at the district, household and individual levels. Here we

explain indicators calculated at the regional level to measure the magnitude and structure of the RNFE, while dependent variables used for regression analysis are presented in section 5.1. The magnitude of the RNFE at the regional level is measured by three indicators. We construct the shares of people employed in nonfarm activities in the total regional employment accounting for primary, secondary and tertiary employment in 2003 and 2007 years. Due to the data limitations and poor data quality in 2003 we calculate two other indicators only for 2007 year. Namely, we calculate the share of time in nonfarm activities to total time worked in the region and the mean share of nonfarm income in total yearly household income.

Nonfarm income is calculated by multiplying individual nonfarm income (cash and in-kind) plus benefits on time worked during the year and summed up over all household members. We also added net household business income. Total household income is calculated as a sum of nonfarm income, net farm income, and unearned income from remittances, scholarships, interest incomes, social benefits, selling property, rent, and transfers. We calculated farm income as the sum of aggregate farm wages for all household members, income from sold crops, animals and animal products and the value of farm products produced and consumed at home. Net farm income is obtained by subtracting gross production expenditure from farm income.

4.2 Magnitude and the structure of RNFE

We start the description of the RNFE in Tajikistan by presenting the share of people employed in nonfarm activities to total employed people and the share of nonfarm jobs in total number of jobs in primary, secondary and tertiary occupations. We include only those individuals above 13 and below 70 years old that reside in Tajikistan.

Table 2. Nonfarm employment in 2003 and 2007

	2003	2007
People in nonfarm employment/all people employed		
Main employment	18%	44%
Secondary employment	0%	0%
Tertiary employment	0%	0%
Nonfarm jobs/total jobs		
GBAO	21%	52%
Sughd	21%	50%
Kahtlon	17%	35%
RRS	17%	52%

Source: TLSS, authors' calculation.
Notes: indicators are obtained by summing individual data on employment status and time worked during the week at the regional and country levels.

We can see that the RNFE in 2003 was rather small accounting for 18 per cent of total primary employment in rural areas. It has expanded substantially during the subsequent four years

reaching 44 per cent of total primary employment in 2007. Due to poor data quality in 2003 we continue our detailed analysis of the RNFE using the 2007 data only.

The main RNFE sectors were construction (20 per cent), trade (19 per cent), education (16 per cent) and transport (8 per cent). The structure of the RNFE differs across regions. For instance, education accounted for 40 per cent of total nonfarm jobs, while trade and construction accounted only for 5 per cent and 4 per cent accordingly in the most remote and mountainous Gorno-Badakhshan Administrative Oblast.

Most people in the RNFE were contracted for wages. 44 per cent of nonfarm jobs were performed by employees who were paid regular wages, and 33 per cent of nonfarm jobs were performed by employees who were paid based on a piecework basis. Self-employment accounted for only 18 per cent of total nonfarm jobs, and unpaid employment in family business accounted for 5 per cent. Again, GBAO had a distinct pattern with more than 80 per cent of nonfarm jobs performed by employees with regular wages.

Median net monthly payments in the RNFE were much higher than in agriculture sector (64 somoni). The highest nonfarm monthly payment was observed in the production of wood products (1050 somoni, compared to 64 somoni in agriculture), production of basic metals (350 somoni), extraction of crude oil (400 somoni) and construction (400 somoni). This is consistent with the World Bank (2009: 7) findings.

Table 3. Different income indicators across income per capita quintile and groups with different access to land, 2007

	Mean nonfarm income shares, %[b]	HH received nonfarm income, %	Mean nonfarm income per capita, somoni[c]	Mean farm income per capita, somoni
Across total income per capita quintiles [a]				
1.00	14%	25%	128.2	80.9
2.00	31%	50%	262.7	255.7
3.00	35%	63%	378.8	384.3
4.00	40%	75%	604.6	499.6
5.00	40%	76%	1613.9	1337.8
Total	32%	58%	718.3	520.0
Across groups with different access to land (own/rented), used for farming (hundredth of a hectare)				
no	49%	62%	694.1	286.2
1 - 10	40%	65%	790.3	363.7
11 - 20	27%	54%	702.4	555.5
21+	23%	48%	618.2	762.6
Total	32%	58%	718.3	520.0

Source: TLSS, authors' calculation.

Notes: Among 3050 rural households 51 had negative total household income due to negative farm income and 31 had zero income.

[a] For calculation of income per capita quintiles households with negative and zero household income were also taken into account.

[b] Nonfarm income share is calculated only for those households with nonfarm income shares large or equal to zero and less or equal to one.

[c] Mean farm income includes negative and positive farm income, while mean nonfarm income includes numbers larger than zero.

The distribution of mean nonfarm income shares across per capita income quintiles demonstrates that nonfarm activities play more important role for wealthier households. Thus, among the poorest households, nonfarm income share is only 14 per cent, while among the richest rural household the share is 40 per cent. This is the result of the fact that only 25 per cent of the poorest had earned nonfarm income, while this number is three times higher for the richest households. There are not substantial differences between farm and nonfarm income per capita across income per capita quintiles, but nonfarm income per capita is slightly higher than farm for the poorest and two richest quintiles. Access to land is also related to participation in nonfarm activities. There are more households who receive nonfarm income among landless and those with a very small size of landholdings, which could be expected.

Interestingly, the distribution of nonfarm income is different from the similar study conducted in the Kyrgyz Republic, where the poor households benefit more from nonfarm activities than wealthier ones (Atamanov and Van den Berg, 2011). This contrast in findings requires further analysis, but may be a result of differences in the path of general and agricultural reforms in the two Central Asian countries.

5. Determinants of RNFE in Tajikistan

5.1 Model specification

We estimate empirical models at three different levels: individual, household and district level. The models are specified as follows:

$Y_i = \phi(I_i, H_i, A_i, G_i, R_i, NR_i, Inst_i, Inf_i, R_i),\ i = 1,2,3,$ i is the number of individuals

$Y_h = \psi(H_h, A_h, G_h, R_h, NR_h, Inst_h, Inf_h, R_h),\ h = 1,2,3,$ h is the number of households

$Y_{dt} = \theta(G_{dt}, R_{dt}, NR_{dt}, HC_{dt}, Inst_{dt}, Inf_{dt}, R_{dt}),\ d = 1,2,3,$ d is the number of districts, t is years (2003, 2007)

Explanatory variables vary depending on the model and the level of analysis.

Y_i measures the primary participation in nonfarm activities at the individual level in 2007 for adults aged 14-70 ages. It measures participation in a set of three activities: farm activities, nonfarm self-employment and nonfarm wage employment. Y_h is a dependent variable at the household level and measures the share of nonfarm time in total time worked during 2007 reflecting intensity of nonfarm activities. Y_d is a dependent variable at the district level in 2003

and 2007 years. It measures the magnitude of rural nonfarm activities as the share of nonfarm jobs in total number of jobs at the district level by aggregating individual information on primary, secondary and tertiary 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), geographical characteristics (*G*), riskiness of agriculture (R), natural resources (NR) access to infrastructure (*Inf*), institutions (*Inst*), and regional dummies (*R*). All explanatory variables from each particular group are described below. The set of explanatory variables for the regression at the district level is slightly different from variables for the regressions at individual and household level. Thus, it does not have the group of individual and household characteristics, but has the group of human capital (*HC*). We show the level of measurement for each explanatory variable across different levels of analysis in table 4 below.

Individual characteristics include age, gender, whether a person is head of the household, and the level of education (degree obtained: 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). Moreover, nonfarm activities in some economic sectors, such as education or heath, may require very specific skills. 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). For the regression at the district level, we have constructed a human capital variable showing the share of people with higher education among rural adults by summing up individual level information.

Household characteristics mostly involve the demographic structure of the household, namely size of the household, dependency ratio measured as a share of children (under 14) and old people (above 70) to household size, age, gender and education of the head of the household. Many studies found a positive relationship between the labour endowment of the household (measured as the number of adults) and its participation in the RNFE (Davis et al., 2007). We also added ethnicity of the head of household. In several studies it was shown that access to some nonfarm jobs can be facilitated by belonging to a particular ethnic group, cast or religion. For example, Lanjouw and Murgai (2009) showed that depending on the region both cast and religion effects are significant in explaining participation in farm work, nonfarm self-employment and nonfarm wage employment in India.

The asset group of explanatory variables includes the number of livestock units at the beginning of the year. Livestock herd size was converted into livestock units by weighing types of livestock on the basis of nutritional or feed requirements (http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Glossary:LSU). Access to

livestock may have a two-fold effect on participation in nonfarm activities. Larger livestock endowments can weaken the incentives to participate in nonfarm activities as was shown in Peru by Escobal (2001). On the other hand, in the presence of capital or liquidity constraints, wealthier households with large livestock units can rely on these liquid assets to invest in nonfarm self-employment activities.[2]

Almost all nonfarm studies try to take into account specific locational conditions (Jonasson and Helfand, 2010). Most frequently used variables include distances to the nearest towns, regional centres, local population densities, share of urban population and so forth (see, for example, Berdegue et al., 2001; Escobal, 2001; Van den Berg and Kumbi, 2006). In our study we decided to separate natural resources from the geographical factors.

Natural resources determine the agricultural potential of the local economy. We measured this by using the following variables: the size of sown area per capita, its squared term, and the quality of land. The size of sown area per capita is calculated by taking the ration of total sown area at the district level to its population. The data were taken from the SAPRT publication about the regions in Tajikistan (2011). The quality of land at the local community is proxied by using a question from the community section of survey showing what part of agricultural products was produced on irrigated land. The answer ranges from 1 (all products were produced on irrigated land) to 6 (none of products were produced on irrigated land). This means that higher values are associated with worse quality of land. We expect higher participation in nonfarm activities in areas with less land and worse irrigation as was shown in many studies (Reardon et al., 2001). In order to control for the nonlinearities in the relationship between land size and participation in nonfarm activities, we included a squared term of sown land per capita. We also included an interaction term of land per capita and its quality controlling for the combined effect of these two variables.

The set of geographical variables includes remoteness from the capital, population size, dummies for altitude, and the dummy for districts bordering Kyrgyzstan. The altitude determines incentives and the capacity of rural households to participate in nonfarm activities. Residing in areas with high altitude implies adverse agricultural conditions, and as a result stronger incentives to undertake nonfarm activities. At the same time, remoteness of these areas and underdevelopment of infrastructure may seriously limit development of nonfarm activities. The dummy for areas bordering the Kyrgyz Republic reflects migration possibilities. Several empirical studies mention Tajik migrants working in Kyrgyzstan (Asian Development Bank,

[2] Taking into account that the livestock units can be endogenously determined with nonfarm activities, we have run regressions without this variable as well. Since exclusion of this variable did not affect coefficients of other variables, we decided to keep it in the regression.

2008a). As international migration can be an alternative to local nonfarm activities in areas with missing markets and poor agricultural conditions, we expect weaker incentives to participate in the RNFE in these communities.

As discussed in the theoretical part, nonfarm activities can often be an ex-post strategy to cope with adverse weather conditions, therefore we included a dummy taking one if the level of precipitation was lower in the current year relative to the previous year. This variable measures the shock affecting agricultural activities of all residents in the particular area. It is expected that less precipitation may stimulate nonfarm activities.

Access to infrastructure is a crucial factor affecting development of rural nonfarm economy. Access to electricity, water and roads was found to be positively associated with participation and nonfarm income in many empirical studies (see for Latin America Reardon et al (2001) and for African studies Barrett et al. (2001). In this study we used availability of central water supply to measure the development of infrastructure at the community level. Partially, the development of infrastructure is also captured by some geographic variables explained above such as the part of products produced on irrigated land, distance to capital, and the altitude.

Finally, we include a range of institutional variables or proxies for institutional development in the agricultural sector. We included a variable which measures the share of sown area at the district level under cotton. It is difficult to predict the sign of the coefficient for this variable a priory. We may expect that distortions, stemming from cotton production in these districts, may push rural inhabitants to participate in nonfarm activities. However, obligatory cotton growing can also compete for household labour resources and discourage participation in nonfarm activities. Moreover, as cotton growing areas are in general characterized as poorer than other areas, households may have less capacity to access nonfarm activities.[3]

We included a proxy for the progress in restructuring of collective and state farms, measured as the share of workers employed by non-household members in total employment in the agricultural sector. We expect that in areas with unfinished restructuring of collective and state farms, it is easier to find a job in agriculture (even with low returns) and therefore there should be weaker incentives to undertake nonfarm activities.

Development of output markets for agricultural products is measured by the availability of a bazaar at the community. A bazaar is a local mini-market where mostly agricultural products are sold. Lack of possibility to sell part of their products can stimulate farmers to engage in nonfarm activities.

[3] One may say that cotton production can also lead to development of nonfarm activities related to processing of cotton products. However, we found that shares of jobs in textile sector are only slightly larger than one percent across cotton growing and non cotton growing areas.

Access to input markets is proxied by computing the share of households who indicated problems with an access to agricultural equipment among those households who rented agricultural equipment. We assume that markets are underdeveloped at the communities where nobody used agricultural equipment. We hypothesize that the development of agricultural activities is constrained in areas with underdeveloped equipment markets and therefore this can push rural residents to diversify into nonfarm activities.

Finally we included a range of regional dummies to control for unobserved regional factors and a year dummy to the district level regression explaining the magnitude of nonfarm activities.

We use different estimation methods depending on the nature of the dependent variables. The dependent variable for the individual level regression has three options (farm, nonfarm self-employment and nonfarm wage employment). We use the multinomial probit because it is free from the "independence of irrelevance alternatives" property of the multinomial logit which was rejected by Hausman and McFadden test (Wooldridge, 2002).

The dependent variable at the household level, measured as the share of time in nonfarm activities to total hours worked, requires a different estimation strategy. This variable ranges from zero to one or in other words is censored. Using the Ordinary Least Squares method for such variables is inconsistent (Wooldridge, 2002). The Tobit estimator is frequently used to model censored variables, but as it is very sensitive to the violation of homoskedasticity and normality assumptions. Therefore, we test the robustness of the results obtained using the censored least squared absolute deviations method (CLAD) which is robust against departures of errors from homoskedasticity and normality (Wilhelm, 2008).

Finally, for the analysis at the district level, we use the OLS for pooled sample for two years. Another option would be to use the dataset as a panel and to use panel data methods to control for the fixed effects, but most of the variables are either invariant or slowly changing and will be swept with the fixed unobservable characteristics at the district level. [4]

Table 4. Description of variables, initial level of data and the level of aggregation in regressions across three dependent variables

		Individual level Participation	Household level Intensity	District Level Magnitude
Variables	Initial level of data	Participation in nonfarm activities	Share of nonfarm time in total time worked	Share of jobs in total number of jobs
Age of individual	Individual	x		
Gender	Individual	x		
Head of household	Individual	x		

[4] Random effects regression yields the same results as the OLS and results are not reported, but available upon request.

		Individual level Participation	Household level Intensity	District Level Magnitude
Variables	Initial level of data	Participation in nonfarm activities	Share of nonfarm time in total time worked	Share of jobs in total number of jobs
Individual has higher education	Individual	x		
Individual has vocational education	Individual	x		
Individual has general secondary education	Individual	x		
Head of household is Tajik	household	x	x	
Head of household is Uzbek	household	x	x	
Size of household	household	x	x	
Dependence ratio	household	x	x	
Livestock units	household	x	x	
Dummy, altitude less than 400 meters	household	x	x	x (for mean altitude at the district level)
Dummy, altitude 400-700 meters	household	x	x	x (for mean altitude at the district level)
Dummy, altitude 700-1000 meters	household	x	x	x (for mean altitude at the district level)
Dummy, altitude 1000-1500 meters	household	x	x	x (for mean altitude at the district level)
Dummy if there was less precipitation at the community	community	x	x	x (share of communities)
Distance to capital, km	community	x	x	x (mean distance at district level)
Population size at the community level	community	x	x	[a]
Irrigation indicator showing what part of agricultural products was produced on irrigated land (higher means worse quality of land)	community	x	x	x (mean indicator at the district level)
Sown area per capita in the district, one hundredth of hectare	district	x	x	x
Sown area per capita, squared[b]	community	x	x	x (share of communities)
Interaction term of sown area and irrigation indicator[c]	district			x
Dummy, central water at the community	community	x	x	x (share of communities)
Share of sown land under cotton	district	x	x	x
Dummy for district which borders Kyrgyzstan	Individual	x	x (aggregated to community level)	x (aggregated to district level)
Share of employed in agriculture hired by non-household members	Individual	x	x (aggregated to community level)	x (aggregated to district level)
% of those what did not have problems accessing agricultural equipment	community	x	x	X (share of communities)
Dummy if there is a market at the community	Individual			x (aggregated to the district level)
Share of individuals with higher education among rural population, >=14<=70	household	x	x	x (for mean altitude at the district level)

Notes: x means the variable is used in the regression at this particular level. If the level of variables is different from the initial level, it is reflected in the parentheses.

Notes: [a] We excluded this variable from the district level regression because it was not significant and was strongly correlated with the dummies for altitude, regional and cotton areas. [b] The squared term of sown area of land per capita was not significant in the regressions at individual and household levels and was excluded.

[c] The interaction term was excluded from household and individual level regressions as not significant, but it was significant at the district level regression and its omission affected significantly other coefficients.

5.2 Empirical results

We start the discussion of empirical results from the regressions where we explain participation in nonfarm activities at the individual level (table 5) and the intensity of nonfarm activities at the household level (table 6).[5] Regression results are presented across groups of explanatory variables discussed above.

Many individual characteristics are significant in affecting the likelihood of working in farm sector relative to the base outcome of having wage work in nonfarm activities. Thus, younger people are more likely to engage into farming, while nonfarm activities attract more mature rural residents. This can be probably related to the fact that old people have more experience and useful contacts important for undertaking nonfarm activities.

In contrast to findings in Kyrgyzstan where females are more likely to occupy public wage nonfarm employment (Atamanov and Van den Berg, 2011), women are more likely to occupy the low paying agricultural sector in Tajikistan. That was also mentioned in the World Bank (2009b), where quantitative and qualitative studies showed that women were more likely to work on large collective farms for low remuneration due to the structure of village economy.

Education seems to play a crucial role in accessing wage nonfarm jobs and diverting from agriculture. All education dummies are significant and reduce the chances of choosing farm activities versus nonfarm wage employment. Better education decreases also the likelihood of choosing nonfarm self-employment over wage nonfarm activities. This is in line with many empirical studies indicating importance of higher education for nonfarm wage employment. See, for instance, the review of nonfarm studies for Latin American countries in Reardon et al. (2001). Education is also positively related to the intensity of nonfarm activities at the household level. Both the number of adults with high education and higher education of the head of household significantly increase the share of time worked in nonfarm activities.

Table 5. Multivariate probit of participation in farm, nonfarm wage and self-employment among adults (>=14 and <=70) in 2007, N=5858

	Farming	Nonfarm self-employment
Individual characteristics		
Age of individual	-0.120***	0.0311*
	[0.0177]	[0.0176]
Age of individual squared	0.00157***	-0.000361
	[0.000227]	[0.000221]
Gender, male	-1.036***	-0.0574
	[0.0815]	[0.0909]
Individual is the head of household	0.0753	0.15

[5] As the Tobit and CLAD regressions provide qualitatively similar results, we focus on the discussion of marginal effects from the Tobit.

	Farming	Nonfarm self-employment
	[0.105]	[0.0984]
Individual has higher education	-2.197***	-1.157***
	[0.160]	[0.150]
Individual has vocational education	-1.200***	-0.356**
	[0.128]	[0.154]
Individual has general secondary education	-0.425***	-0.198*
	[0.0980]	[0.106]
Household characteristics		
Head of household is Tajik	0.967**	0.555
	[0.449]	[0.463]
Head of household is Uzbek	1.158**	0.503
	[0.458]	[0.472]
Number of family members	0.023	0.0334*
	[0.0156]	[0.0186]
Dependence ratio	0.795***	0.256
	[0.208]	[0.239]
Assets		
Livestock units	0.0230*	-0.00808
	[0.0131]	[0.0134]
Natural resources		
Indicator showing what part of agricultural products was produced on irrigated land (higher means worse quality of land)	-0.176***	-0.0870**
	[0.0468]	[0.0405]
Sown area per capita in the district, squared	4.109***	1.106
	[1.240]	[0.935]
Geography		
Dummy, altitude less than 400 meters	-0.866***	0.508*
	[0.302]	[0.289]
Dummy, altitude 400-700 meters	-1.324***	0.136
	[0.283]	[0.275]
Dummy, altitude 700-1000 meters	-1.242***	0.414*
	[0.227]	[0.251]
Dummy, altitude 1000-1500 meters	-1.082***	0.306
	[0.208]	[0.254]
Distance to capital, km	-0.00013	-0.000567
	[0.000811]	[0.000550]
Population size at the community level	-1.74e-05**	1.08e-05*
	[8.56e-06]	[5.94e-06]
Dummy for district which borders Kyrgyzstan	0.236	-0.226
	[0.213]	[0.176]
Shock		
Dummy if there was less precipitation at the community in 2007 relative to 2006	-0.108	-0.0851
	[0.131]	[0.0989]
Infrastructure		
Dummy, central water at the community	-0.391***	0.126
	[0.145]	[0.115]
Institutions		
Share of land under cotton at the district level, %	0.408	-0.13
	[0.663]	[0.470]
Share of employed in agriculture hired by non-household members	0.00224	-0.000916
	[0.00354]	[0.00227]
% of those what did not have problems accessing agricultural equipment	0.00266	-0.00127
	[0.00169]	[0.00128]
Dummy if there is a market at the community	0.17	-0.111
	[0.177]	[0.126]
Regional and yearly dummies		

	Farming	Nonfarm self-employment
Dummy for RRS region	0.772*	-0.153
	[0.429]	[0.326]
Dummy for Sughd	0.409	-0.152
	[0.364]	[0.302]
Dummy for Khatlon	0.65	-0.00373
	[0.454]	[0.346]

Notes: *** p<0.01, ** p<0.05, * p<0.1 Robust standard errors are weighted and clustered at the psu level are in parentheses.

Household characteristics and assets are found to affect significantly the likelihood of participation in agricultural activities over nonfarm wage employment. Thus, less labour available in the household due to many dependents reduces the likelihood of participating in nonfarm wage employment. Besides labour availability, participation in farm activities depends significantly on the number of livestock units. Availability of livestock reduces the likelihood of participation in nonfarm activities and the intensity of nonfarm activities because it provides access to liquid assets and as a result cash income.

As expected and found in many empirical studies, larger land size per capita at the district level and its better quality at the community level is positively associated with the participation in agricultural activities at the individual level and the reduction of intensity of nonfarm activities at the household level. Therefore, nonfarm activities in Tajikistan seem to be associated with land scarcity and its poor quality which do not allow rural households to earn enough from agriculture.

Geography is found to play important role for employment outcomes. Interestingly, the likelihood of participation in farm activities over participation in nonfarm activities increases with altitude at a decreasing rate. This can imply that due to the remoteness and the lack of infrastructure in high altitude areas, agriculture (probably livestock breeding) stays the only option for rural inhabitants who can not engage into nonfarm activities. These hypotheses are supported by the crucial role of infrastructure, measured as availability of central water supply and the distance from capital which were found to be important both for participation and time in nonfarm activities.

Table 6. Results from the Tobit (censored at zero and one) and CLAD models explaining the share of nonfarm time in total time worked at the household level in 2007, N=2773

	Marginal effects after Tobit		CLAD		
Variables	E(Y|Y>0)	Pr(Y>0)	Observed	Bias corrected interval	
	Household characteristics				
Household size, people	-0.0096	-0.00554	0.000	-0.009	0.016
	[0.00591]	[0.00340]	[0.006]		
Head of household male	-0.0523	-0.0292	0.002	-0.061	0.085
	[0.0444]	[0.0240]	[0.037]		
Head of household has higher education	0.151***	0.0800***	0.141	0.076	0.219

Variables	Marginal effects after Tobit		CLAD		
	E(Y|Y>0)	Pr(Y>0)	Observed	Bias corrected interval	
	[0.0582]	[0.0279]	[0.039]		
Age of the head of household	-0.00256**	-0.00148**	-0.001	-0.003	0.002
	[0.00115]	[0.000662]	[0.001]		
Head of household is Tajik	-0.606***	-0.266***	-0.257	-0.592	0.053
	[0.217]	[0.0693]	[0.167]		
Head of household is Uzbek	-0.526***	-0.368***	-0.279	-0.632	0.006
	[0.130]	[0.101]	[0.176]		
Dependence ratio	0.00809	0.00467	-0.002	-0.148	0.170
	[0.0721]	[0.0416]	[0.076]		
Number of adults with higher education	0.207***	0.120***	0.104	0.051	0.142
	[0.0327]	[0.0187]	[0.026]		
	Assets				
Livestock units	-0.0128***	-0.00740***	-0.060	-0.077	-0.032
	[0.00262]	[0.00151]	[0.013]		
	Natural resources				
Indicator showing what part of agricultural products was produced on irrigated land (higher means worse quality of land)	0.0579***	0.0334***	0.043	0.019	0.064
	[0.0128]	[0.00738]	[0.012]		
Sown area per capita in the district, squared	-5.096***	-2.942***	-3.652	-6.205	-1.705
	[1.164]	[0.669]	[1.285]		
Sown area per capita in the district, hundredth of hectare	10.03***	5.788***	7.678	2.670	14.029
	[3.251]	[1.873]	[3.645]		
	Geography				
Dummy, altitude less than 400 meters	0.526***	0.224***	0.371	0.193	0.692
	[0.119]	[0.0358]	[0.114]		
Dummy, altitude 400-700 meters	0.756***	0.312***	0.567	0.401	0.838
	[0.112]	[0.0314]	[0.103]		
Dummy, altitude 700-1000 meters	0.725***	0.303***	0.539	0.389	0.754
	[0.0986]	[0.0284]	[0.091]		
Dummy, altitude 1000-1500 meters	0.583***	0.244***	0.411	0.250	0.639
	[0.0918]	[0.0264]	[0.089]		
Distance to capital, km	-0.000415**	-0.000240**	0.000	-0.001	0.000
	[0.000174]	[0.000100]	[0.000]		
Population size at the community level	6.30e-06***	3.63e-06***	0.000	0.000	0.000
	[2.12e-06]	[1.22e-06]	[0.000]		
Dummy for district which borders Kyrgyzstan	-0.257***	-0.176***	-0.237	-0.394	-0.114
	[0.0502]	[0.0395]	[0.096]		
	Shock				
Dummy if there was less precipitation at the community in 2007 relative to 2006	0.00803	0.00464	0.062	-0.045	0.102
	[0.0315]	[0.0182]	[0.035]		
	Infrastructure				
Dummy, central water at the community	0.177***	0.0967***	0.134	0.072	0.198
	[0.0365]	[0.0186]	[0.036]		
	Institutions				
Share of land under cotton, %	-0.390***	-0.225***	-0.422	-0.820	-0.055
	[0.147]	[0.0844]	[0.167]		
Share of employed in agriculture hired by non-household members	-0.00097	-0.00056	-0.001	-0.003	0.001
	[0.000790]	[0.000456]	[0.001]		
% of those what did not have problems accessing agricultural equipment	-0.00129***	-0.000743***	-0.001	-0.002	0.001
	[0.000406]	[0.000234]	[0.001]		
Dummy if there is a market at the community	-0.0137	-0.00798	-0.018	-0.095	0.043
	[0.0394]	[0.0231]	[0.039]		
	Regional and yearly dummies				
Dummy for RRS region	-0.426***	-0.284***	-0.374	-0.609	-0.167

Variables	Marginal effects after Tobit		CLAD		
	E(Y|Y>0)	Pr(Y>0)	Observed	Bias corrected interval	
	[0.0901]	[0.0663]	[0.105]		
Dummy for Sughd	-0.159*	-0.0986	-0.179	-0.311	-0.040
	[0.0928]	[0.0613]	[0.091]		
Dummy for Khatlon	-0.346***	-0.215***	-0.383	-0.624	-0.161
	[0.104]	[0.0675]	[0.123]		
963 censored observation					
706 uncensored observations					
1104 right -censored observations					

Notes: *** p<0.01, ** p<0.05, * p<0.1 Significance of the coefficients is only provided for the Tobit model. Standard errors (bootstrapping with 100 replications is used for CLAD) are in parentheses.

Our hypothesis that the residence in districts bordering Kyrgyzstan can offer opportunities of migration and therefore reduces the pressure to undertake nonfarm activities is supported by empirical findings both at the individual and household levels. This can also capture the positive effect from trade of agricultural products local inhabitants may be engaged in.

Regarding institutional performance, access to the agricultural equipment at the community level seems to increase the likelihood of agricultural activities and to discourage individual participation in nonfarm self-employment. Availability of markets also decreases the likelihood of participation in nonfarm self-employment. Residing in districts with cotton growing discourages participation in nonfarm activities and their intensity at the household level.

Concerning the determinants of the magnitude of the rural nonfarm economy, development of the RNFE seems to follow two scenarios in line with the results from individual and household level regression. Under the "push" scenario, the RNFE develops in areas with poor agricultural conditions due to the lack of land and its poor quality. Under the "pull" scenario, the RNFE can also develop in areas with the abundant land resources as reflected by the positive coefficient of land per capita squared. With regards o capacity variables, better human capital and development of infrastructure are also positively related to the magnitude of RNFE.

Several important variables, such as availability of markets for agricultural products at the community level and weather shock are found to be significant at the district level even though were not significant in the regressions at the individual and household levels. Thus, having opportunity to sell agricultural products significantly decreases the magnitude of nonfarm activities probably because rural inhabitants can sell their agricultural products and earn cash. Less precipitation in 2007 stimulated the rural nonfarm economy indicating an important role of nonfarm activities in ex post coping with shocks.

Table 7. The OLS regression explaining the magnitude of the RNFE at the district level in 2003 and 2007, N=98

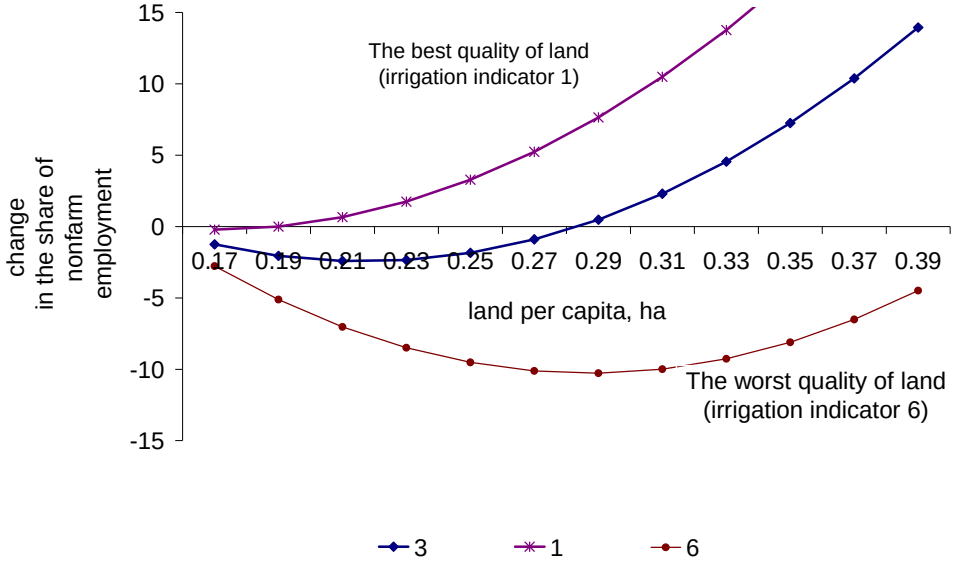
Variables	Share of nonfarm jobs
Geography	
Dummy, altitude less than 400 meters	0.0401
	[0.105]
Dummy, altitude 400-700 meters	0.0735
	[0.0887]
Dummy, altitude 700-1000 meters	0.111
	[0.0745]
Dummy, altitude 1000-1500 meters	0.0218
	[0.0750]
Dummy for district which borders Kyrgyzstan	-0.0949*
	[0.0526]
Distance to capital, km	-0.000493
	[0.00147]
Natural resources	
Indicator showing what part of agricultural products was produced on irrigated land (higher means worse quality of land)	0.0614**
	[0.0260]
Sown area per capita in the district, ha per thousand people	-1.603*
	[0.961]
Sown area per capita, squared	5.467**
	[2.558]
Sown area*irrigation indicator	-0.256*
	[0.148]
Shock	
Dummy if there was less precipitation at the community	0.141***
	[0.0527]
Infrastructure	
Dummy, central water at the community	0.00157***
	[0.000583]
Human capital	
Share of individuals with higher education among rural population, >=14<=65	0.0132*
	[0.00727]
Institutions	
Dummy if there is a market at the community	-0.00137**
	[0.000628]
Share of land under cotton at the district level	-0.0757
	[0.143]
Share of employed in agriculture hired by non-household members	-0.00149
	[0.00104]
% of those what did not have problems accessing agricultural equipment	-0.00110*
	[0.000561]
Regional and yearly dummies	
Dummy for RPS region	-0.0387
	[0.0802]
Dummy for Sogd	0.122
	[0.106]
Dummy for Hatlon	0.0295
	[0.118]
Dummy for 2007 year	0.174***
	[0.0382]
Constant	0.204*
	[0.112]
Observations	98
R-squared	0.65

Notes: Notes: *** p<0.01, ** p<0.05, * p<0.1 Robust standard errors are in parentheses.

The interaction term between the size of land and the quality of land is also significant. The sign is difficult to interpret, but it can imply that nonfarm employment plays more important role in areas with large size of land per capita of poor quality because the negative effect from land is stronger than positive effect of poor quality of land in the interaction.

In order to illustrate which factors were most relevant for the development of the RNFE in Tajikistan "pull" or "push", we simulated the combined impact of land size per capita, the quality of land and the interaction of these variables on the share of nonfarm employment at the district level. The starting point is a district with 0.15 hectares of land per capita of different quality measured by the irrigation indicator. Then we estimated the change in the share of nonfarm employment in step of 0.02 ha. Note that the mean size of land per capita in our data is 0.15 ha with an irrigation indicator of 2 (more than half of agricultural products are produced on irrigated land).

Figure 1. Simulation of the increase of land per capita on the share of nonfarm employment at the district level for different land quality



Source: authors' calculation. Lower irrigation indicator means better quality of land (1 for best, 6 for the worst).

The figure demonstrates that all curves have a U-shape with the parts of the curves below the x-axis of 0 per cent reflecting "push" and parts above the x-axis reflecting "pull" scenarios. Increasing the availability of land leads to a decrease of nonfarm employment on the "push part", while the share of nonfarm employment increases with land availability on the "pull" part. The switch point is much lower for land of the best quality which implies that less land is needed for agriculture to drive a profitable nonfarm economy.

For example, increasing the size of land of slightly lower than average quality (irrigation indictor is equal to 3) from 0,15 ha will decrease the share of nonfarm employment at an accelerating rate, but after reaching 0.23 ha the negative effect starts to decrease. At about 0.29 ha, the effect of an increase in land size will become positive. For the land of best quality (irrigation indicator is equal to 1) the size of 0,21 ha is enough for agriculture to have a positive impact on the RNFE. Nevertheless, such a situation is rather an exemption because only three districts in Tajikistan had an average size of land per capita larger than 0.21 ha with an irrigation indicator of 1 in 2007 year.

6. Conclusions

This study is the first one to thoroughly analyse the magnitude, structure and role of nonfarm activities in Tajikistan. Moreover, unlike the majority of existing studies of the determinants of RNFE, we conduct our analysis at three levels: individual, household and district. This helps to test the role of many institutional variables which do not vary at the micro level.

We show that the RNFE plays important role in Tajikistan expanding during the considered period from 18 per cent in total jobs in rural areas in 2003 to 44 per cent in 2007. Nonfarm income also played an important role accounting for 33 per cent of total household income in 2007. Nonfarm activities play important role among the landless households and household with small size of land holdings.

Only 25 per cent of the poorest households had access to nonfarm income in comparison to 75 per cent of households in the richest quintile based on income per capita. This indicates substantial entry barriers which constrain the poorest to access existing nonfarm activities. These results are different from the results obtained in Kyrgyzstan by Atamanov and Van den Berg (2011). They showed that nonfarm activities played more important role for the poor people in 2006. These contrasting empirical evidence calls for comparative study of these two poorest Central Asian republics.

The econometric analysis of the determinants of nonfarm activities at the individual, household and district levels confirms that the most important driving forces behind the development of the RNFE in Tajikistan are the scarcity of land and its poor quality. Participation in nonfarm activities seems to be associated with the development of input and output markets which affect profitability of agricultural activities. Thus, rural residents are more likely to undertake nonfarm activities in areas with imperfect agricultural input and output markets. Lack of access to credit resources and adverse weather conditions also seem to push rural inhabitants into participation in the RNFE.

With regards to important capacity variables which help to access and develop nonfarm activities, one should take into account enhancing of human capital and investing in infrastructure. This is especially relevant in the most remote regions where agriculture still plays more important role than nonfarm activities in spite of the adverse agricultural conditions.

It is important that the analysis of the RNFE at the individual and household level is not necessarily the best way to capture the role of institutions or shocks which are almost invariant at the micro level. Incorporating regional characteristics at the individual level regressions may yield insignificant results because of insufficient variation of explanatory variables. As empirical research shows, modelling the impact of these variables can benefit from conducting the analysis at the meso level: district, region and so forth because of sufficient variation of the dependent variable. Therefore, it may be beneficial to combine different levels of analysis to have better and complete picture on the determinants of the RNFE.

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