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Vulnerability to Poverty in select Central Asian Countries*

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Abstract

In the extant literature either income or consumption expenditures as measured over short periods of time have been regarded as a proxy for the material well-being of households. However, economists have long recognized that a household's sense of well-being depends not just on its average income or expenditures, but also on the risks it faces and its ability to deal with these risks. Hence vulnerability is a more satisfactory measure of welfare. In this study we used the concept of vulnerability as expected poverty to assess the household vulnerability to poverty in four Central Asian countries: Azerbaijan, Kazakhstan, Kyrgyzstan, and Tajikistan. Except for Tajikistan, headcount poverty and vulnerability rates are significantly different. We also find that vulnerability differs significantly across households by location and selected household characteristics. In this paper we use a simple empirical measurement that allows estimating the headcount vulnerability to poverty using cross-section data. This measurement is based on the strong assumption that households have the same conditional distribution of consumption in a stationary environment. While this approach cannot capture all dimensions of vulnerability, it at least begins to raise the policy issue that vulnerability should be considered alongside poverty.

JEL codes: C21, C23, I32, O57

Keywords: Poverty, Vulnerability, Cross-section data, Central Asia

1. Introduction

In the extant literature either income or consumption expenditures, as measured over short periods of time (say a year), has been regarded as a proxy for the material well-being of households. However, economists have long recognized that, under the assumption that a household is risk averse, its sense of well-being depends not just on its average income or expenditures, but also on the risks it faces. Thus the concept of vulnerability extends the notion of poverty to include idiosyncratic as well as aggregate risks. It is defined as the probability or risk today of being in poverty or to fall deeper into poverty in the future.

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Although they are different concepts, Holzmann and Jørgensen (2001) argue that poverty and vulnerability are closely related due to two established facts: (i) the poor are typically most exposed to diverse risks, and (ii) the poor have the fewest instruments to deal with these risks. However, we should be concerned about vulnerability because if policymakers design poverty alleviation policies in the current year on the basis of a poverty threshold of income or consumption in the previous year, 'the poor' who receive income support may have already escaped from poverty and 'the non-poor' who do not receive such support may have slipped into poverty due to various unanticipated shocks (e.g. increase in the relative price of food, or an illness incapacitating the main bread winner). Therefore, assessing vulnerability helps to distinguish between ex-ante poverty prevention interventions and ex-post poverty alleviation interventions. Moreover, analysing vulnerability allows us to investigate the sources and forms of risks households face, which helps to design appropriate safety net programs to reduce or mitigate risk, hence vulnerability to poverty. To deal with *temporary* poverty we can give poor households aid but to address vulnerability we need strategies like prevention, mitigation and coping arrangements (informal, market-based, and public).[1]

Because poverty is normally defined as income or consumption being below a given level, income or consumption dynamics and variability can be proxies for vulnerability. This suggests three measurements of vulnerability: vulnerability as expected poverty (VEP), vulnerability as expected utility (VEU) and vulnerability as inability to insure consumptions. The main purpose of this paper is to assess VEP in the Central Asian region. Because data for other countries in this region were not available we study four countries: Azerbaijan, Kazakhstan, Kyrgyzstan and Tajikistan. Interest in economic conditions in Central Asian countries has recently grown for at least three reasons (Dowling and Wignaraja, 2006). First, the Central Asian region is rich in natural resources. Second, it has a strategic geographic position between Europe and Asia. Third, the Central Asian countries are former Soviet republics which followed socialist-oriented economic policies and are now reforming towards market-oriented policies. This last reason is particularly relevant in the context of poverty and vulnerability analysis because the transition process in Central Asian countries from centrally planned to market economies has exacerbated the incidence of poverty and income inequality (Heller and Keller, 2001, Bandara et al. 2004/05).

Vulnerability in developing countries in general, and transition ones in particular, would differ from that of developed countries because of several reasons. First, financial markets in developing and transition countries are considered to be less efficient than those in developed countries so the poor in developing/transition countries have fewer market-based instruments like insurance to handle idiosyncratic risks. Second, social insurance programs such as those relating to unemployment, old-age, work injury, disability, widowhood, and sickness are hardly established in developing/transition countries. Third, empirical vulnerability assessment ideally requires panel data which is rarely available in developing/transition countries.

The plan of this paper is as follows. Section II discusses some definitional and measurement issues relating to vulnerability. Section III lays out strategies to measure vulnerability as expected poverty for the Central Asian countries using cross-section data is available. Section IV briefly reviews the economic and poverty situation in these

[1] For more details see Holzmann, et. al (2003).

countries. Section V analyses estimation results for assessing vulnerability to poverty. Section VI concludes the paper.

2. Measurements of vulnerability

Different measures of vulnerability have different data requirements. We review these below.

2.1 Vulnerability as expected poverty (VEP)

As expected, poverty vulnerability is measured as that probability that consumption (or income) will fall or remain below the poverty line (Christiaensen, 2000, Chaudhuri et al. 2002).[2] This measure is particularly useful when, as in the case of the four countries being considered here, only cross-section data are available. Vulnerability as expected poverty (VEP) of household (or individual) i at time t is defined by

$$VEP_t^i = \Pr(c_{t+1}^i) \le z) = \int_0^z f(c_{t+1}^i)\, \mathrm{d}c_{t+1}^i \qquad (1)$$

where c_{t+1}^i is the per capita consumption (or income) of household i at time $t+1$, f is consumption distribution of the household and z is the per capita expenditure (or income) requirement defined as the poverty line. A household (or individual) is then considered as vulnerable to poverty if its VEP is larger than a probability threshold level p:

$$V^i = \begin{cases} 1 & \text{if} \quad VEP^i > p \\ 0 & \text{if} \quad VEP^i \le p \end{cases}$$

where, V^i is a binary variable indicating whether household i is vulnerable or not. So, while VEP is a probability (between zero and one), being vulnerable is a state indicating the probability that the household's consumption is below the poverty line. In practice, the most common threshold for VEP is 0.5 which indicates that a household whose VEP exceeds 50% is more likely than not to end up being poor and can thus be considered to be vulnerable to poverty. This threshold has the advantage that if a household is just at the poverty line and expects a mean zero shock it has vulnerability to poverty of 0.5 (Pritchett et al., 2000).

It should be pointed out that being poor is also a state but indicates that consumption is *actually* below the poverty line. While 'poverty and vulnerability (to poverty) are two sides of the same coin' (Chaudhuri et al., 2002, p. 3) they are different concepts. For example, suppose we have two poor households: one in a rural and the other in an urban area. Although both of them are currently observed to be poor the rural household is actually more vulnerable to poverty than the other, if income earning opportunities are likely to be lower in the rural as compared to the urban area. This implies that among the poor, certain groups of poor people are more vulnerable to poverty than others. Thus, the VEP measure is useful in distinguishing between those

[2] This definition is referred to as the outcome approach to vulnerability in Scaramozzino (2006).

who are currently poor and those who are permanently poor and so 'could help by preventative measures before adverse events are realized' (Kamanou and Morduch, 2005, p. 164).

2.2 Vulnerability as expected utility (VEU)

The VEU measurement takes into account the fact that individuals are risk-averse so that expected utility falls as the uncertainty of income increases. Thus, vulnerability is defined by Ligon and Schechter (2003) as the utility lost due to risk, as the difference between the expected household consumption and the certainty-equivalent consumption.[3] With this approach, the utility function can be decomposed into two distinct components measuring vulnerability: poverty and risk (aggregate and idiosyncratic risk). Thus, analysis of vulnerability helps to investigate sources and forms of risks households face. This helps to design appropriate safety net programs to reduce or mitigate risk, hence vulnerability.

> However, for this measurement the data requirements are too high to be of much practical use here. Not only are utility function unobservable, but there are just a handful of longitudinal data sets from low-income countries with an adequate time dimension to yield precise measures of household-specific consumption variability. (Kamanou and Morduch, 2004, p. 162)

2.3 Vulnerability as inability to insure consumption

Vulnerability can also be defined as the households' inability to smooth (insure) consumption, while preserving a minimum level of assets, when faced with income shocks. Under this approach, vulnerability is tantamount to consumption volatility. More precisely, household vulnerability is the conditional covariance between changes in household consumption and changes in income, subject to an asset constraint (Holzmann et al., 2003, Holzman and Jørgensen, 1999). In this context Gaiha and Imai (2006) study three India villages and consider a household to be more vulnerable if the effect of income shocks (idiosyncratic and covariate shocks) on consumption is greater. Like the VEU, this measurement also requires panel data to determine factors that underlie consumption variability.

3. Empirical strategy toward measuring VEP

Ideally, for VEP measurement, with a panel data of sufficient length we can directly estimate the distribution f of the household's consumption in (1). However, panel data are typically not available, especially in developing countries like the Central Asian countries being studied here. In practice, cross-sectional data can be used to estimate vulnerability, as a second-best solution (Chaudhuri, 2003; Chaudhuri et al., 2002). Using the cross-section data for estimating vulnerability is based on the strong assumption that the environment is stationary so that the current cross-sectional variance can be used to estimate the variance in the future. While the current cross-

[3] This definition is referred to as the utility-based approach to vulnerability in Scaramozzino (2006).

sectional variance can explain the part of future variance due to idiosyncratic shocks, the impact of aggregate shocks will be missed. Therefore, the model can produce good estimates of vulnerability only for situations where the distributions of risks, and the risk-management instruments, are similar from one period to another.

Chaudhuri (2003) and Chaudhuri et al. (2002) assume further that the household's consumption is conditionally log-normally distributed.[4] Thus, vulnerability of household *i* at time *t* is estimated by

$$VEP_t^i = \Phi\left(\frac{\ln z - \ln c_{t+1}^i}{\sigma_i}\right)$$

where Φ is the cumulative log-normal distribution function. Log-normal distributions are completed determined by two parameters: mean and variance. The conditional mean and variance of a household's future consumption can be estimated by the following heteroscedasticity regressions:

$$\left.\begin{aligned}\ln c^i &= X_i\beta + \varepsilon_i \\ \sigma_{\varepsilon i}^2 &= X_i\theta + e_i\end{aligned}\right\} \quad (2)$$

where X_i presents a bundle of observed house household characteristics, such as the number of household members or the proportion of children. 'So if we are able to generate predicted probabilities of poverty for households with different sets of characteristics (which some but not all poverty assessments attempt), we will have, in effect, estimates of the vulnerability of these households' (Chaudhuri et al., 2002, p. 3)

4. Economic and poverty situation in the Central Asian countries

After gaining independence in 1991, the Central Asian countries initiated a transition to market economies resulting in severe economic hardships for most of the population. The sharp output declines along with hyper-inflation resulting from price liberalization and the monetization of large fiscal deficits led to significant increases in poverty (Bandara et al., 2004/05). Since 1995, the Central Asian countries have pursued anti-inflation policies and initiated macroeconomic reforms which led to economic recovery and greater price stability (see Table 1 and Figures 1 and 2). As a result, the incidence of poverty in Central Asia decreased, especially in Kazakhstan. The incidence of poverty reached 68% in Armenia in 1995, 35% in Kazakhstan in 1996, 48% in Kyrgyzstan in 2001, and 75% in Tajikistan in 1999. The poverty rates then decreased to

[4] To test for the robustness of the cross-section estimations, Chaudhuri (2003) used data from a single cross-section of a two-year panel, for Philippines and Indonesia, to obtain estimates of vulnerability for each household. He ordered and grouped households into quintiles (Philippines) or deciles (Indonesia) based on these vulnerability estimates and then compared the predicted poverty rate for each quintile or decile with the actual incidence of poverty in the following year. The vulnerability estimates reproduced the ordinal properties of the true distribution of poverty in the population.

50% in Azerbaijan in 2001, 15% in Kazakhstan in 2002, 43% in Kyrgyzstan in 2005 and 62% in Tajikistan in 2005 (Table 2).

Table 1: Select development indicators in four countries of Central Asia, 2006

	GDP per capita (constant 2000 US$)	GDP growth (annual %)	Life expectancy at birth (years)	Population growth (annual %)	Urban population (% of total)
Azerbaijan	1,571	34.5	72.3	1.1	51.6
Kazakhstan	2,166	10.7	66.2	1.1	57.6
Kyrgyz Republic	326	2.7	67.7	0.9	36.0
Tajikistan	247	7.0	66.5	1.4	24.6

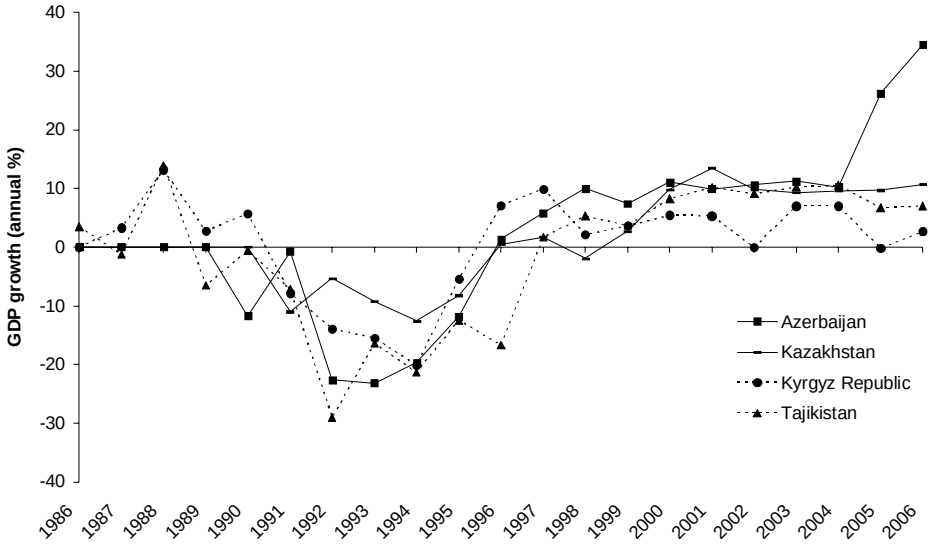
Source: World Development Indicators (The World Bank)

Table 2: Percentage of the population below the national poverty line in select countries of Central Asia, 1995–2005

	1995	1996	1999	2001	2002	2003	2005
Azerbaijan	68	..	..	50	..	..	..
Kazakhstan	..	35	..	18	15	..	..
Kyrgyz Republic	..	..	..	48	..	50	43
Tajikistan	..	..	75	..	..	64*	62**

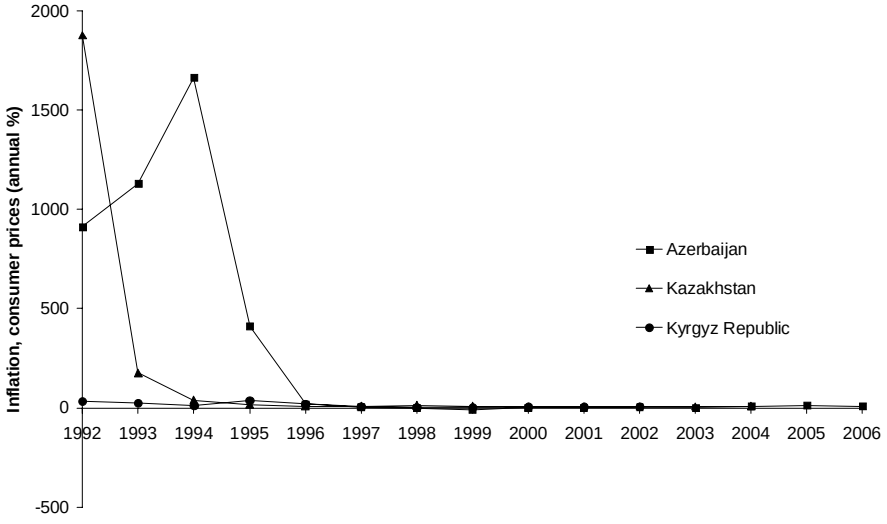
*Notes :*State Statistics Committee of Tajikistan. ** Our estimate.*
Source: World Development Indicators (The World Bank)

Figure 1: GDP growth in select countries of Central Asia, 1986–2006



(Source: World Development Indicators)

Figure 2: Inflation in select countries of Central Asia, 1986–2006



(Source: World Development Indicators)

However, the transition to a market economy also increased income inequality within these countries. The Gini coefficients increased from their 1995 levels in all countries except Kyrgyzstan (Table 3). In Azerbaijan, for instance, the value of the Gini coefficient increased from 34.96 in 1995 to 36.5 in 2001. In Kazakhstan, the Gini coefficient was 35.32 in 1996 and came down to 31.3 in 2001 but it went up to 34.95 in 2000 and 33.91 in 2003. In Tajikistan, the Gini coefficient went up to 33.59 in 2004 from only 31.52 in 1999. Obviously, worsening income equality had a negative impact on the poverty situation in these countries.

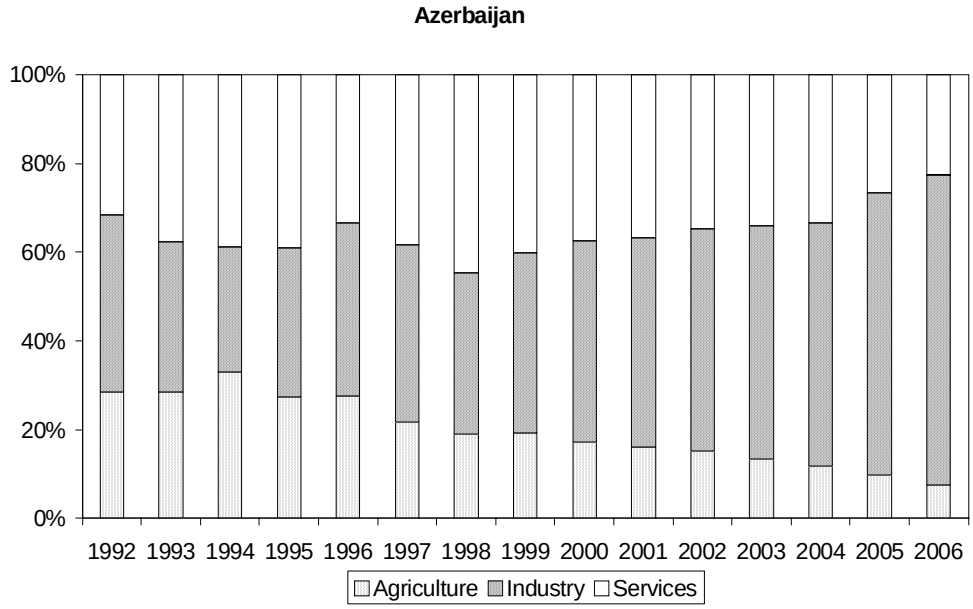
Table 3: Gini coefficient in select countries of Central Asia, 1995–2004

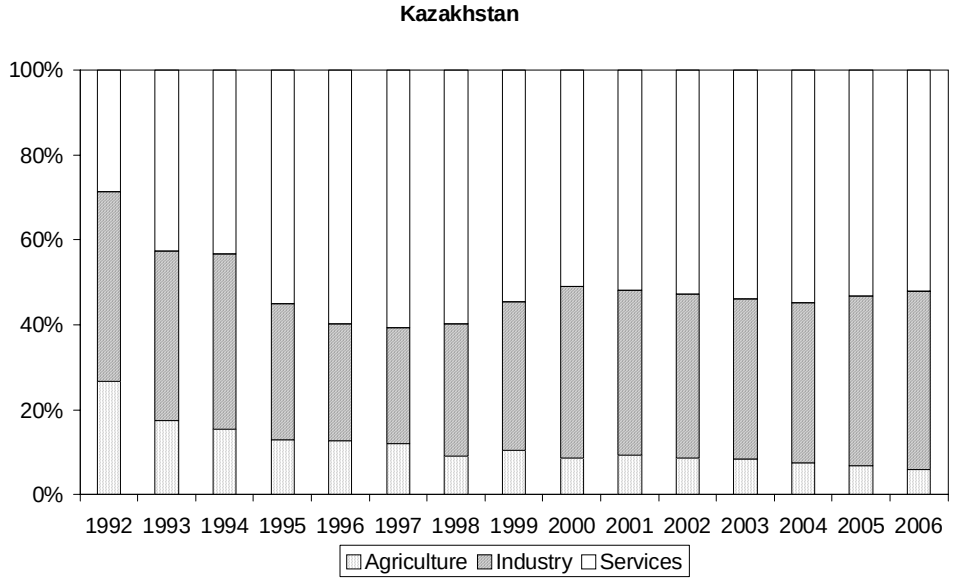
	1995	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
Azerbaijan	34.96	..	..	..	..	..	36.5	..	..	..
Kazakhstan	..	35.32	..	..	..	..	31.3	34.95	33.91	..
Kyrgyz Republic	..	..	40.5	35.98	34.6	30.27	29.03	31.67	30.31	..
Tajikistan	..	..	..	..	31.52	..	..	..	32.63	33.59

Source: World Development Indicators (The World Bank)

Kyrgyzstan and Tajikistan are richly endowed with agricultural land. Reflecting this, their agricultural sectors account for sizeable shares of respective GDPs. Thus, during the period 1992–2006 agriculture accounted for on average of about 39% of GDP in Kyrgyzstan and 28% of GDP in Tajikistan. Meanwhile, the share of industry in GDP in Azerbaijan and Kazakhstan is high, reflecting significant oil and gas deposits as well as large deposits of coal and many rare and precious metals, including gold (Bandara et al., 2004/05). However, in Kazakhstan, the largest sector is services, contributing over 50% of GDP recently (Figure 3).

Figure 3: Economic structure of countries of Central Asia, 1992–2006





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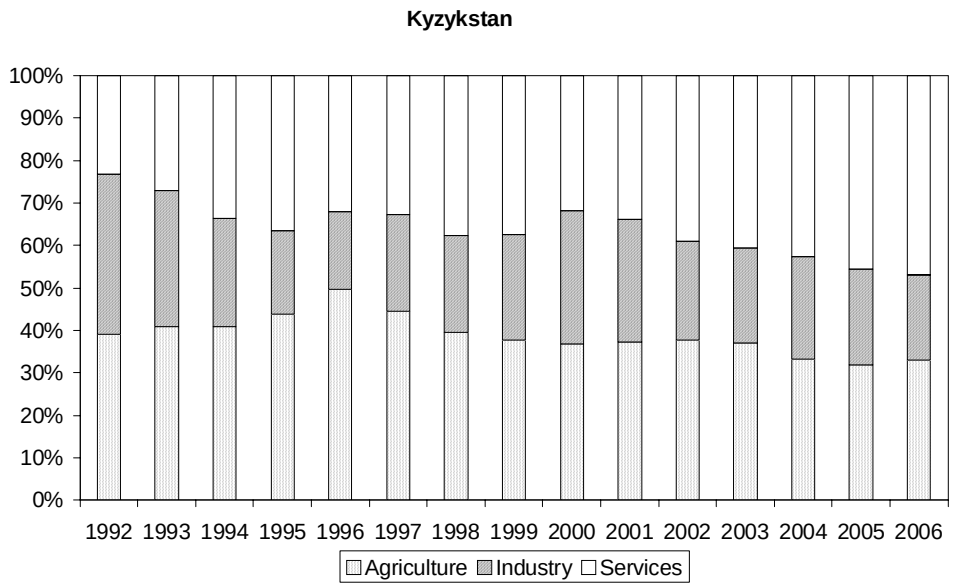
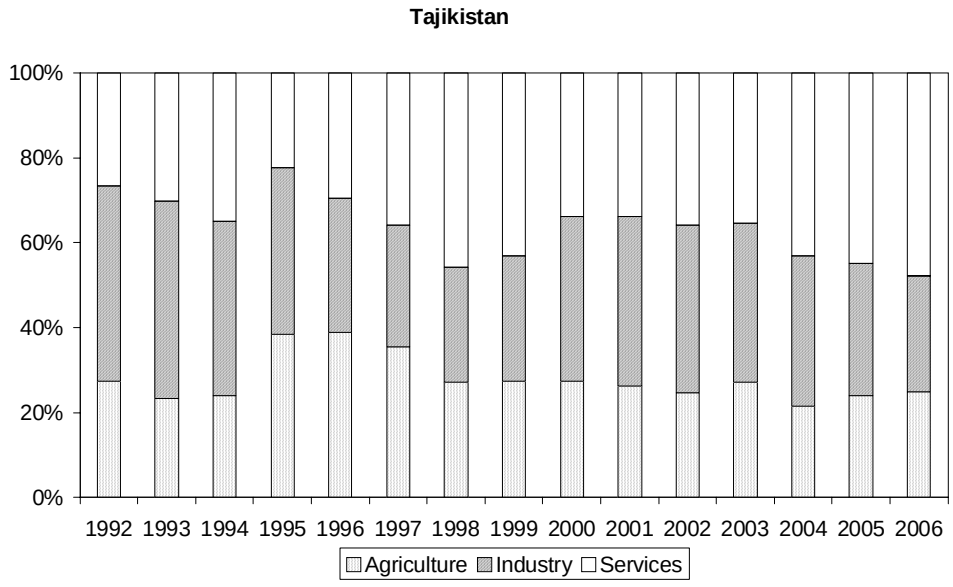




5. Estimation results

5.1 Data

5.1.1 Data for Azerbaijan

The data for Azerbaijan are from the 1995 Azerbaijan Survey of Living Conditions (ASLC). This survey applies many of the features of LSMS surveys, developed by the World Bank, to provide data for assessing poverty. It covers all of the topics covered in most LSMS surveys but contains far fewer questions, and therefore, less detail. The survey includes questionnaires at the individual, household and population point (community) levels.

The survey covered a sample of 2016 households. Three separate populations were covered: households in Baku (capital), households outside of Baku and households of Internally Displaced Persons (IDPs). The sample design included 408 households in Baku, 1200 households outside of Baku, and 408 households among IDP. Within each of those populations, the sample was chosen in such a manner that each household had an equal probability of being selected. Weighting factors are provided to account for the difference between the population and sample distributions. The regional areas covered by the sample included: i) South west from Baku, site of many displaced persons camps; ii) Far northwest; iii) Center north; iv) Naxichevan autonomous region, separated from the rest of Azerbaijan the southwest; v) The far south coastal area along the Caspian and Iranian border, vi) The area in the near northwest of Baku; vii) The central region near the occupied territory; and viii) The Apsheron peninsula and other large urban areas.

The poverty line is not available but the food-only poverty line is. The food-only poverty line used was developed by the government, based on an average daily intake of 2,360 calories (adjusted for age and gender). Thus, our analysis is based on food expenditure only.

5.1.2 Data for Kazakhstan

The 1996 Kazakhstan Living Standard Measurement Survey of the World Bank (Kazakhstan LSMS) covered a sample of 1995 households. The survey presents five regions: the central, the southern, the western, the northern, and the eastern; and three types of location: urban, poselki (villages of a city type) and rural. The poverty rate in 1996 was 34.6% at a government-defined subsistence minimum of Tenge (T) 2,861 per capita per month.

5.1.3 Data for Kyrgyzstan

The data for Kyrgyzstan are from the 1998 Kyrgyz Poverty Monitoring Survey (KPMS). The 1998 KPMS has a large sample size of 2962 households. The KPMS surveys were carried out using a household questionnaire and a community (population point) questionnaire. The household questionnaires were used to collect demographic information on the composition of the household, housing, household consumption

including home production, as well as economic activities in agricultural and non-agricultural sectors. For each household member, individual level data on health, education, migration and labour was collected using household questionnaires. Community questionnaires were used to collect price data and the presence of social services and infrastructure in the community (population point) where the sampled household is located.

5.1.4 Data for Tajikistan

The data for Tajikistan are from the 2000 Tajikistan Living Standards Survey (TLSS) which was conducted jointly by the State Statistical Agency, the Center for Strategic Studies, the United Nations Development Programme (UNDP) and the World Bank (WB). The purpose of the survey is to provide data at the individual, household and community level for investigating issues of welfare and living standards of the population of the Republic of Tajikistan in 1999.

The 2000 TLSS contained 2,000 households with 14,142 individuals. Households were randomly selected over 125 population points, which were stratified across urban and rural areas within oblasts, to ensure a nationally representative sample. In the first stage 125 primary sample units (PSU) were selected with the probability of selection within strata being proportional to size. At the second stage, 16 households were selected within each PSU, with each household in the area having the same probability of being chosen. The two-stage procedure has the advantage that it provides a self-weighted sample.

5.2 Determinants of vulnerability

Based on the empirical strategy described in Section 3, we estimated the coefficients on the different determinants of the ex ante mean and variance of future consumption (per capita) as specified by (2). The estimated results, i.e. the relative importance of different factors to vulnerability, are presented in Table 4 for all countries. In Table 4 we include a set of common explanatory variables for expectation and variance of consumption for all four countries. Tables 5 and 6 present results for Azerbaijan and Kazakhstan[5] respectively. Tables 7 and 8 present results on Kyrgyzstan and Tajikistan respectively.

Except for Kazakhstan, *urban* households tend to have significantly higher expectation of future consumption compared with *rural* households. However, there is no clear indication of whether households in urban or rural areas have the higher variance of consumption.

Controlling for all other determinants, large *household size* tends to reduce the future consumption of the household, thereby increasing household vulnerability. It is well-known that, *ceteris paribus*, households with many children are on average poorer than households with fewer children. However, this negative effect weakens with the household size because the coefficient on size squared is positive and significant. Except

[5] To check for robustness we present two alternate sets of results (Appendix Tables 1 and 2) with augmented and restricted estimation for Kazakhstan. The results are broadly similar to those in Table 7. We are grateful to an anonymous referee for suggesting this.

in Kazakhstan, larger household size is also associated with a significant decrease in the variance of consumption (see Christiaensen and Subbarao, 2005 and Christansen and Boisvert, 2002 for possible reasons for this result).

Table 4 also shows that the variable *head of household* has an important role in determining household vulnerability in these countries. Indeed, after controlling for all other characteristics, male headed households are associated with significantly higher means of future consumption. This can be explained by the fact men engage in more wage-generating activities and also get paid more than women. We don't find a clear effect of age of household head on household vulnerability. For instance, in Azerbaijan and Kazakhstan a household with an older head tends to have a significantly lower expectation of future consumption. In contrast, in Kyrgyzstan, a household with an older head has a significant and higher expectation of future income and food consumption. However, this effect is not significant for total consumption in Kyrgyzstan and Tajikistan. Our results also confirm that enhanced education of household head significantly reduces the household's vulnerability by increasing expectation of future consumption, but its effect on the variability of consumption is not statically significant.

We also model the effect of *ethnicity* of household head on household vulnerability in Kyrgyzstan. In Kyrgyzstan, households which are headed by a person of Russian ethnicity have a significantly higher expectation of income and lower variance of total and food consumption and households with heads who are Kyrgyz have significantly lower expectation of total and food expenditure. However, we don't find a significant evidence of the impact of ethnicity on consumption and income in Tajikistan.

In general, we find that the larger the *dependency ratio* (defined as the proportion of household members who are (typically) younger than 16 or older than 60) the larger is the household's vulnerability, as manifested by a significantly lower expectation of future consumption.

Although over the past several years the Central Asia countries have enjoyed strong economic growth, they still have high *unemployment* (ESCAP, 2004). Indeed, we find that in Azerbaijan households the higher the proportion of income earners in the household the higher the expectation of future consumption. Unemployment in Central Asia may be due to the slow speed of privatization and creation of small and medium enterprises (SMEs), as well as the lack of industrial reform and dynamism in the agricultural sector. The problems of unemployment were compounded by low unemployment benefits and inadequate employment and training services.

Obviously, possession of *assets* leads to an increase in the expectation of future consumption. First, assets like land or agriculture properties provide a means for households to obtain income, thereby increasing consumption, on average. In addition, assets provide a secure source of income in the face of negative shocks to income. In Azerbaijan, Kazakhstan, and Tajikistan, ownership of land has a significant and sizable effect on mean of future consumption. However, we don't find significant impact of house ownership on vulnerability in Kazakhstan. This may be due to the fact that a household cannot sell their house, at least in the short run, to reduce income shocks but can sell land and other properties. In Kyrgyzstan, the larger the per capita landholding the (significantly) higher the household mean of future income and food expenditure.

Beside land, agriculture property and durable goods are also considered assets. Our results confirm that in Azerbaijan an increase in agricultural property per capita reduces household vulnerability by increasing expectation of consumption. In

Kazakhstan, value of durables also has a positive and significant effect on mean and negative effect on variance of future consumption, thus reducing household's vulnerability. In Tajikistan, the possession of yaks also enhances future consumptions (total and food).

For Kazakhstan, our results confirm that the availability of *public transport* reduces household vulnerability by increasing average consumption. A reason for this is that public transport helps farmers deliver their goods to urban markets better.

Table 4: Determinants of expectation and variance of consumption in select Central Asian countries

	Azerbaijan		**Kazakhstan**		**Kyrgyzstan**		**Tajikistan**	
Variable	Expectation	Variance	Expectation	Variance	Expectation	Variance	Expectation	Variance
Rural	- (*)	+	+ (***)	+ (*)	- (***)	us	-	-
Household Size	- (***)	- (**)	- (***)	+	- (***)	- (*)	- (***)	- (**)
Household size squared	+ (***)	+ (**)	+ (***)	-	+ (***)	+	+ (***)	+
Whether hh head is male	+ (***)	+	+ (*)	-	+ (***)	-	+ (***)	-
Age of hh head	- (***)	0	- (***)	-	+	-	-	-
Education of hh head	+ (*)	+	+ (***)	-	+ (***)	+	+	- (*)
Dependence ratio	- (***)	+	- (***)	us	- (***)	-	- (***)	-
Whether hh owns (uses) land	+ (***)	-	+ (***)	-	0	-	+ (***)	-

Note: Expressions in parentheses ( ) indicate the coefficient is significant at the 10% (*), 5% (**), and 1 % (***) respectively, us means unspecified.

Table 5: Determinants of vulnerability in Azerbaijan

	log hh total expenditure		log hh food expenditure	
	per capita		per capita	
	expectation	variance	expectation	variance
Regions				
Urban	0.086*	-0.035	0.124**	-0.180***
Rural				
Near southwest	0.247***	-0.061	0.352***	-0.235***
Far Northwest	0.308***	-0.152***	0.365***	-0.189***
Central North	-0.015	-0.191***	0.164**	-0.284***
Naxichevan	-0.275***	-0.193**	-0.155*	-0.289***
Far South	0.294***	-0.102	0.241***	-0.234***
Near Northwest	0.208***	-0.166**	0.191***	-0.245***
Household characteristics				
Household size	-0.145***	-0.057**	-0.188***	-0.032
Household size squared	0.005***	0.004**	0.008***	0.002
Whether household head is male	0.082**	0.019	0.089**	-0.019
Age of household head	-0.005***	0	-0.004***	0
Number of years household head spent on studying	0.005*	0.001	0.007**	0.002
Prop. members chronically ill during the last 4 weeks	-0.046	0.025	-0.04	0.06
Prop. of household members age 0-14	-0.185**	0.047	-0.161**	-0.025
Prop. of household members age >60	-0.229***	0.014	-0.152*	0.113
Prop. of members working for income	0.083**	-0.019	0.066**	-0.073**
Assets				
Whether household owns land	0.185***	-0.03	0.163***	-0.009
Agr. property per capita owned by hh (mil. Manats)	0.160***	0.012	0.188***	0.03
Constant	13.026***	0.575***	12.118***	0.498***
No. of obs	2016	2016	2016	2016
R-squared	0.179	0.02202	0.1847	0.0205

*Note: * indicates the coefficient is significant at the 10%, ** 5%, *** at 1% levels respectively.*

Table 6: Determinants of vulnerability in Kazakhstan

	Log total consumption per capita	
	expectation	**variance**
Areas		
Urban	-0.129***	-0.047*
Poselki	-0.168***	-0.086**
Regions		
Central	-0.042	0.084***
Southern	-0.420***	0.019
Western	0.099**	0.040
Northern	0.254***	-0.048
Household characteristics		
Household size	-0.223***	0.009
Household size squared	0.011***	-0.003
Age of household head	-0.004***	-0.001
Whether household head is male	0.051*	-0.016
Education degree of household head	0.024***	-0.006
Prop. of children (<=15)	-0.360***	0.080
Prop. of old (>=60)	-0.206***	-0.014
Prop. of members who have good or normal health	0.078*	0.004
Assets		
Whether household owns house	0.037	-0.048
Log total value of durables in the household	0.030***	-0.016***
Whether household has the use of any private plot	0.272***	-0.030
Community		
Whether public transport goes through	0.127***	0.004
Constant	11.052***	0.561***
Number of observations	1940	1941
R-squared	0.3625	0.03483

*Note: * indicates the coefficient is significant at 10%, ** at 5%, *** at 1% levels respectively.*

Table 7: Determinants of vulnerability in Kyrgyzstan

	log hh income		log hh total expenditure		log hh food expenditure	
	per capita		per capita		per capita	
	expectation	variance	expectation	variance	expectation	variance
Areas						
North Urban	0.167***	-0.106	0.193***	0.070***	0.129***	0.100***
North Rural	-0.04	0.160**	0.007	0.109***	-0.076***	0.132***
South Urban	-0.212***	0.036	0.193***	-0.009	0.134***	-0.032
Household characteristics						
Household size	0.288***	0.022	-0.177***	-0.021*	-0.180***	-0.011
Household size squared	-0.012***	-0.002	0.006***	0.001	0.006***	0
Age household head	0.008***	-0.006***	0.001	-0.001	0.002**	-0.001
Whether hh head is male	0.134***	-0.082	0.089***	-0.029	0.096***	-0.029
Ethnic of household head						
Kyrgyz	-0.011	0.113	-0.250***	-0.107***	-0.287***	-0.079*
Russian	0.291***	-0.195	0.071	-0.148***	0.028	-0.159***
Ukrainian	0.143	-0.072	0.082	-0.177**	0.018	-0.203**
Uzbek	-0.260**	0.127	-0.443***	-0.081*	-0.435***	-0.054
Kazakh	-0.078	-0.175	0.02	-0.095	0.11	-0.026
Beylorussian	0.602**	-0.266	0.316	-0.277	0.152	-0.336
Tadjik	-0.639***	-0.258	-0.440***	-0.191*	-0.262	-0.124
Tatar	0.151	-0.231	0.006	0.006	0.001	0.009
Dungan	-0.041	-0.138	0.290**	-0.115	0.071	-0.094
Highest certification of hh head	0.045***	-0.041***	0.059***	0.005	0.042***	-0.004
Prop. of members age 0-14	-0.639***	-0.648***	-0.389***	-0.033	-0.278***	-0.039
Prop. of members age > 60	-0.362***	-0.402**	-0.327***	-0.073	-0.204***	-0.018
Assets						
Per capita land area available to hh	0.005**	-0.005*	0	-0.001	0.001*	0
Constant	6.358***	1.061***	9.306***	0.415***	8.802***	0.389***
Number of observations	2752	2794	2869	2869	2869	2869
R squared	0.2178	0.02836	0.4227	0.02821	0.4076	0.02888

*Note: * indicates the coefficient is significant at 10%, ** at 5%, *** at 1% levels.*

Table 8: Determinants of vulnerability in Tajikistan

	log hh total consumption		**log hh food consumption**		**log hh income**	
	per capita		per capita		per capita	
	expectation	variance	expectation	variance	expectation	variance
Location						
Whether household lives in urban area	0.014	0.011	-0.002	-0.004	-0.092	-0.275*
Dushanbe – capital	0.365***	0.02	0.307***	-0.023	0.273***	-0.006
GBAO	-0.203***	-0.03	-0.083	0.028	0.158	-0.342
RSS	0.297***	0.091**	0.271***	0.026	-0.114	0.468***
Leninabad	0.021	0.006	-0.005	-0.059*	-0.281***	0.183
Household characteristics						
Household size	-0.139***	-0.034**	-0.142***	-0.022	-0.121***	0.038
Household size squared	0.005***	0.001	0.005***	0.001	0.004***	-0.004
Age of household head	-0.001	-0.001	0.001	-0.001	-0.003	0.007
Whether household head is male	0.124***	-0.052	0.124***	-0.055	0.221***	0.091
Ethnicity of household head						
Tajik	0.179	-0.066	0.145	-0.111	0.056	-0.209
Russian	0.192	-0.129	0.219	-0.126	0.118	-0.164
Uzbek	0.142	-0.058	0.125	-0.093	0.128	-0.103
Tartar	-0.182	0.329	-0.111	0.301	0.102	0.529
Kyrgyz	0.133	-0.219	0.143	-0.253	-0.104	-0.451
Whether hh head obtained at least 8th class	0.017	-0.055*	0.03	-0.063**	0.089*	0.061
Prop. of members Age 0-14	-0.483***	-0.061	-0.352***	-0.037	-0.639***	-0.027
Prop. of members age > 64	-0.371***	-0.073	-0.178	0.016	-0.128	-0.804
Prop. of member with poor health	-0.058	0.074	-0.201**	0.01	-0.305*	0.750*
Assets						
Whether household owns land	0.141***	-0.038	0.104**	-0.024	-0.186*	-0.057
Whether household owns yak(s)	1.103***	-0.234	1.185***	-0.2	0.823	-0.751
Constant	10.027***	0.643***	9.573***	0.587***	9.702***	0.576
Number of observations	1632	1633	1631	1632	1611	1614
R squared	0.1929	0.02251	0.2007	0.02126	.08998	.02209

*Note: * indicates the coef. is sign. at 10%, ** at 5%, *** at 1% level*

5.3 Estimating the level of vulnerability

Our assessment of vulnerability in the Central Asian countries is based on the probability of future consumption as estimated. This estimation used past realizations of consumption expenditures, assuming that the environment is stationary. It is worth noticing that the target of policy in this paper is a population of households, not individuals, simply because the data on consumption expenditures are obtained from the countries' household surveys. This means that if we consider a household as poor or vulnerable every member in this household is deemed equally poor or vulnerable.

5.3.1 Vulnerability at the aggregate level

Table 9 describes the distribution of vulnerability at the aggregate level in the countries being studied. Tajikistan is not only the poorest but also the most vulnerable to poverty among these countries. Almost all households in Tajikistan are expected to continue to be poor in the future. Although the observed incidence of poverty of 56.3% in Kyrgyzstan is significantly lower than that of 67.7% in Azerbaijan, there is a risk that Kyrgyzstan poverty rate could rise up to 62.6%, which is very close to the current poverty rate in Azerbaijan.

Table 9: Cross-distribution between poverty and vulnerability in Central Asia

	Non-vulnerable	**Vulnerable**	
Azerbaijan	15.8	84.2	100
Non-poor	29.5	70.5	32.3
Poor	9.2	90.8	67.7
Kazakhstan	71.8	28.2	100
Non-poor	86.6	13.4	65.0
Poor	44.3	55.7	35.0
Kyrgyzstan	37.4	62.6	100
Non-poor	53.9	46.1	43.7
Poor	24.5	75.5	56.3
Kyrgyzstan*	41.1	58.9	100
Non-poor	57.0	43.0	45.1
Poor	28.0	72.0	54.9
Kyrgyzstan**	41.0	59.0	100
Non-poor	57.0	43.0	45.1
Poor	27.9	72.1	54.9
Tajikistan	0.2	99.8	100
Non-poor	3.2	96.8	5.1
Poor	0.0	100.0	94.9

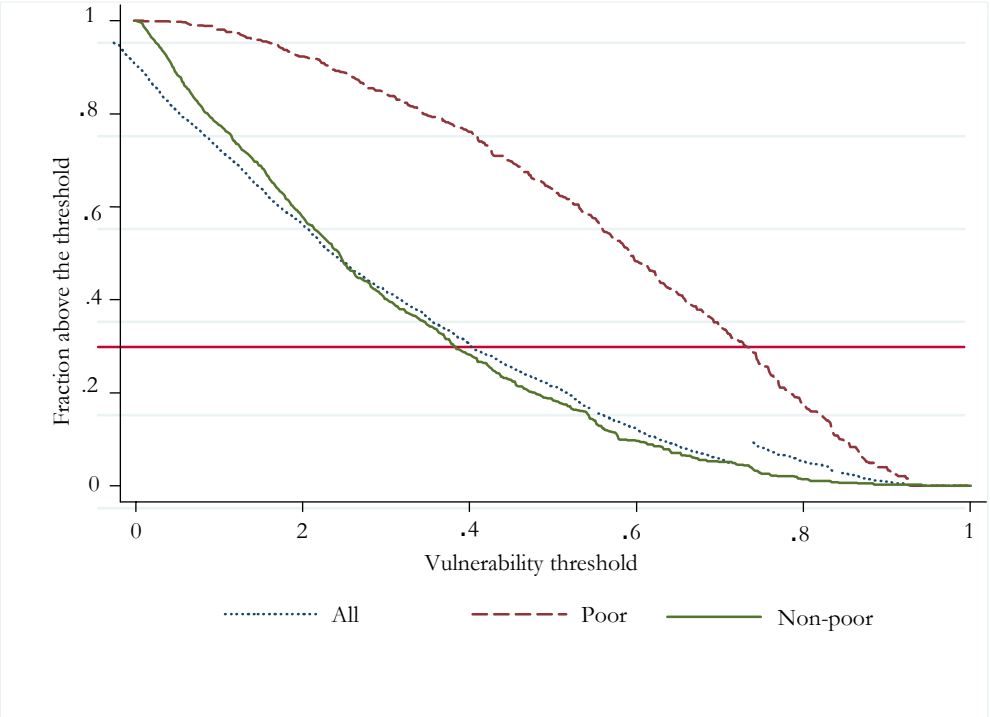
*Note: * and ** indicate the augmented (derived from Appendix Table 1) and restricted (derived from Appendix Table 2) estimations for robustness check.*

Except for Kazakhstan, the poverty rate underestimates the fraction of the population vulnerable to poverty. For example, in Azerbaijan, while 67.7% of the population is observed to be poor, up to 84.2% of the population is estimated to be vulnerable to poverty. However, for Kazakhstan, the poverty rate overestimates the fraction of population vulnerable. While 35% of the Kazakhstan population is poor, only 28.2% are expected to be poor in the future. Hence, vulnerability measures differ from measures of static poverty. Given the information that measures of vulnerability provide these should be estimated alongside measures of static poverty.

A sizable fraction of non-poor are vulnerable to poverty in these countries. For example, in Kazakhstan, of the 65% of the population observed to be non-poor, 13.4% are estimated to be vulnerable to poverty. Similarly, in Kyrgyzstan, of the 43.7% of the population observed to be non-poor, 46.1% are estimated to be vulnerable to poverty. Thus there are differences in the size of the population that is vulnerable as compared to the size of the population that is poor. Azerbaijan is the country which has the highest proportion of the non-poor vulnerable to poverty. In this country, up to 70.5% of the non-poor are estimated to be vulnerable to poverty. Thus, these people while not poor based on the data for the current period are likely to become poor in the future. These estimates support the claim that while poverty and vulnerability are closely related concepts, there remain important distinctions between the two and neither notion nests the other. Thus poverty reduction strategies in Central Asia need to incorporate not just alleviation efforts but also prevention. However, programs that aim to reduce vulnerability in the population need to be targeted differently from those aimed at poverty alleviation.

To check for other vulnerability thresholds, Figure 4 depicts the Kazakhstan estimated incidence of vulnerability to poverty for the population, the poor and the non-poor for various vulnerability thresholds — ranging from 0 to 1 — measured along the horizontal axis. The horizontal line depicts the (observed) poverty rate of the population. The figure shows that for any threshold less than 0.45 the vulnerability rate of the population is higher than the poverty rate. The figure also suggests that for almost any threshold, the incidence of vulnerability to poverty of the population, the poor and the non-poor are significantly different and a non-zero fraction of the non-poor are vulnerable to poverty. The fraction of the non-poor that is vulnerable is much closer to the vulnerable fraction of the population than the vulnerable fraction of the poor. This implies that the incidence of vulnerability of the poor is much higher than that of the overall population.

Figure 4: Estimated incidences of vulnerability to poverty for poor and non-poor in Kazakhstan



5.3.2 Vulnerability by selected segments of the population

We now analyse the distribution of vulnerability (along with poverty) over locations and selected household and community characteristics. This is shown in Tables 10 to13. Except Tajikistan, of which nearly 100% of the population are poor and vulnerable, we find some interesting patterns of poverty and vulnerability distribution over selected segments of the population in these countries.

1. By and large, vulnerability (and poverty) in these countries are rural phenomena. In all countries studied (except Azerbaijan) rural households are over-represented among the poor and the vulnerable relative to their share in the population (Tables 9 to 12). For instance, in Kazakhstan, while 42.4% of the population live in rural areas, 48.8% of the poor and 53.2% of the vulnerable are rural. Similarly, in Kyrgyzstan, while 74.5% of the population are rural, 80.5% of the poor live in rural areas as do 82.9% of those we estimate to be vulnerable.

The disproportionate distribution of rural households to overall poverty and vulnerability leads to the higher poverty and vulnerability rates in rural areas. In Kazakhstan, 40.3% and 35.5% of the rural population are poor and vulnerable, whereas in urban areas, the poverty and vulnerability rates are only 30.3% and 20.3% respectively. Similarly, in Kyrgyzstan, the poverty and vulnerability rates in rural areas are 60.8% and 69.7% respectively, compared with only 43.2% and 42.1% respectively in urban areas. This means that, while the poverty rate underestimates the fraction of population vulnerable in Kyrgyzstan rural areas, it overestimates the vulnerable fraction

in urban areas. This again supports the necessity of distinguishing between the poverty and vulnerability measures.

One reason why poverty and vulnerability in rural areas are more serious than in urban areas could be the presence of high inequality. While inequality in rural areas is roughly comparable to that for urban areas in Azerbaijan and Tajikistan, the Lorenz curves for Kazakhstan (Figures 5 and 6) show that inequality in rural areas in these countries is more severe than in urban areas. However, inequality is not a reason for poverty and vulnerability in Kyrgyz rural areas. The Lorenz curve for this country (Figure 7) shows that inequality in urban areas is more severe than in rural areas. Inequality in rural areas is roughly comparable to that in urban areas (Figure 8).

Figure 5: Lorenz food expenditure curves by area in Azerbaijan

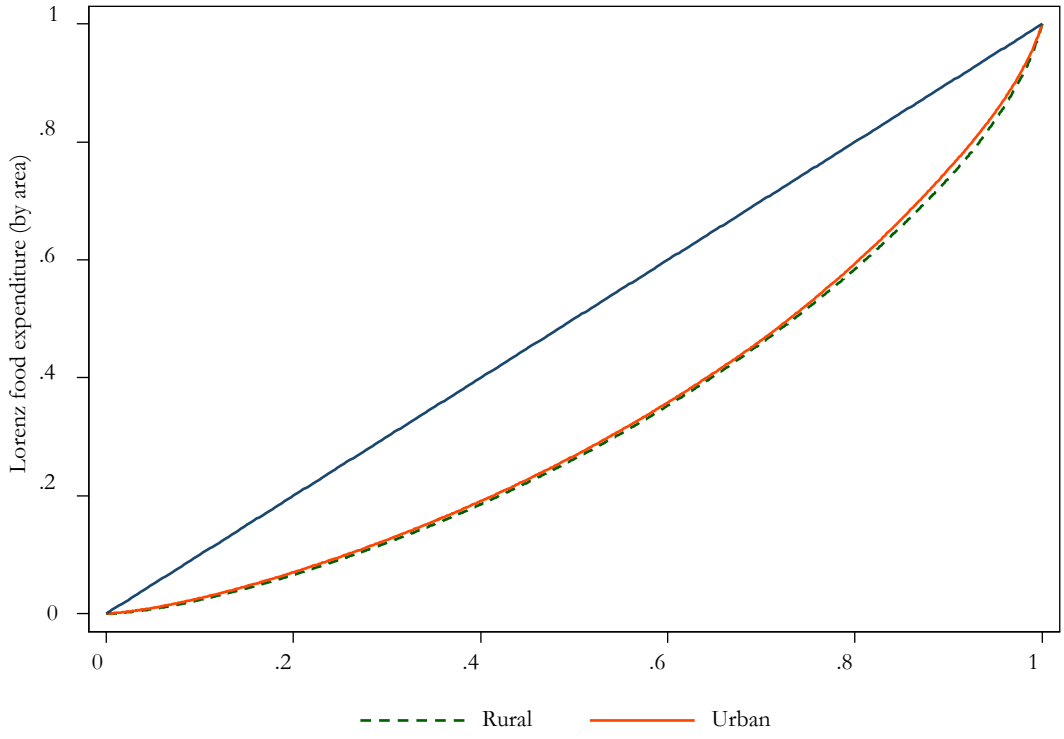


Figure 6: Lorenz consumption curves by areas in Kazakhstan

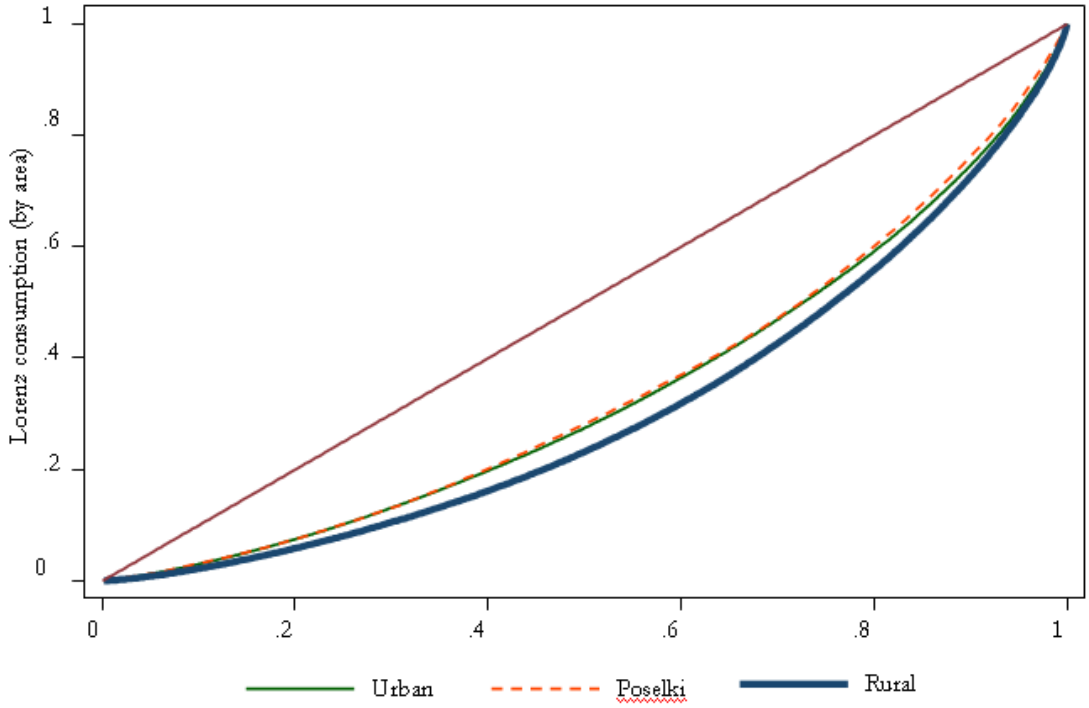


Figure 7: Lorenz total expenditure curves by area in Kyrgyzstan

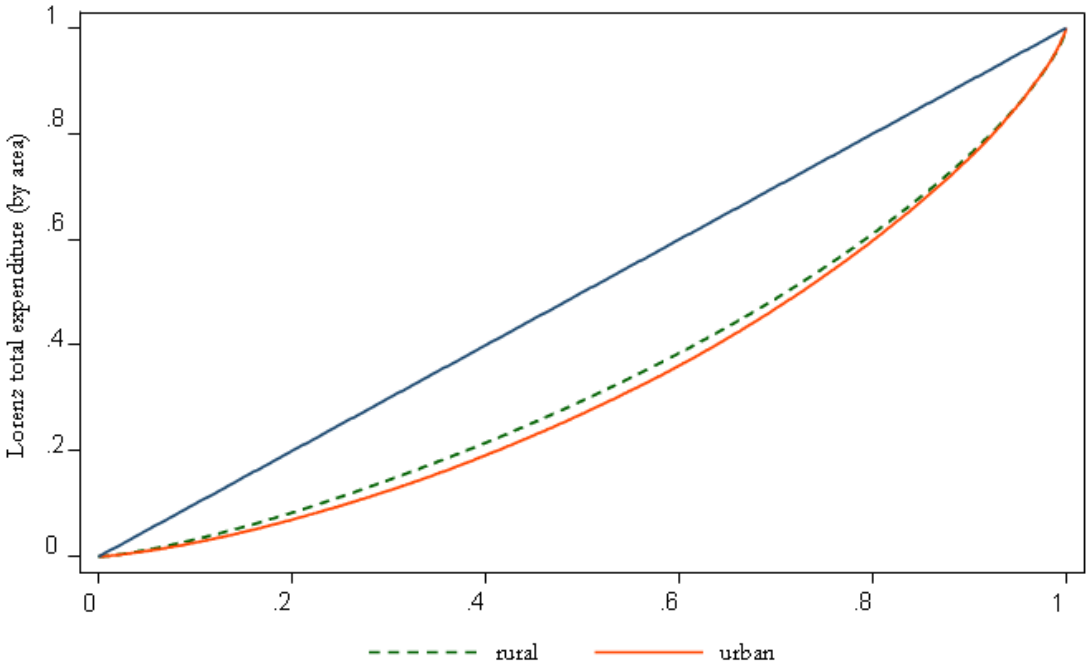
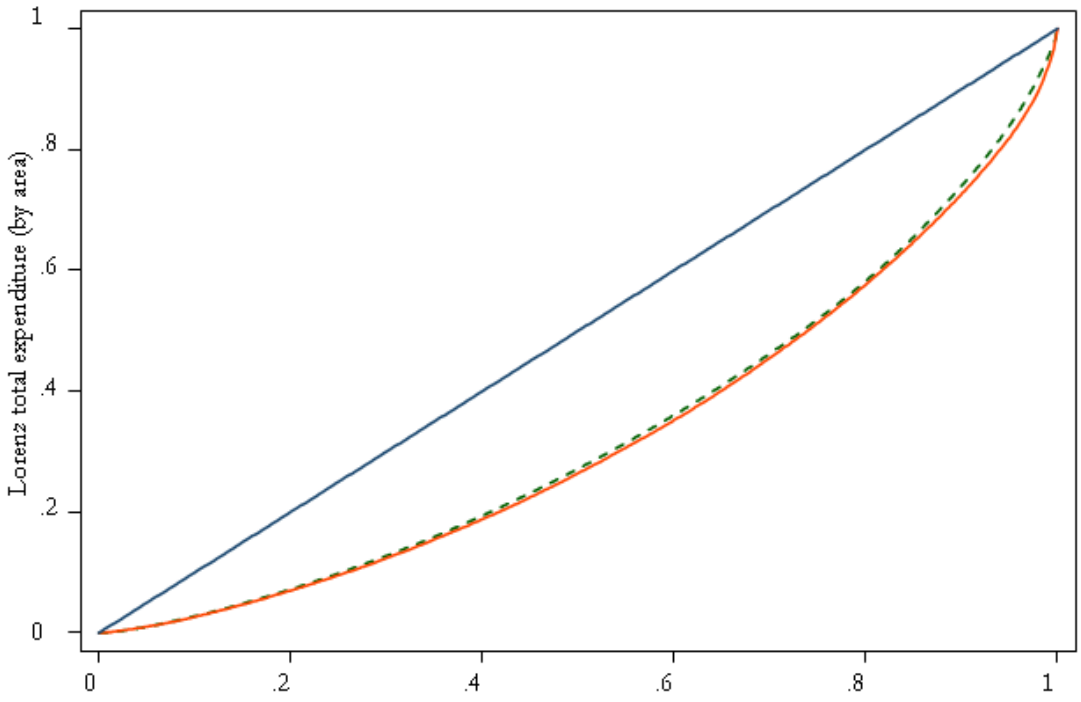


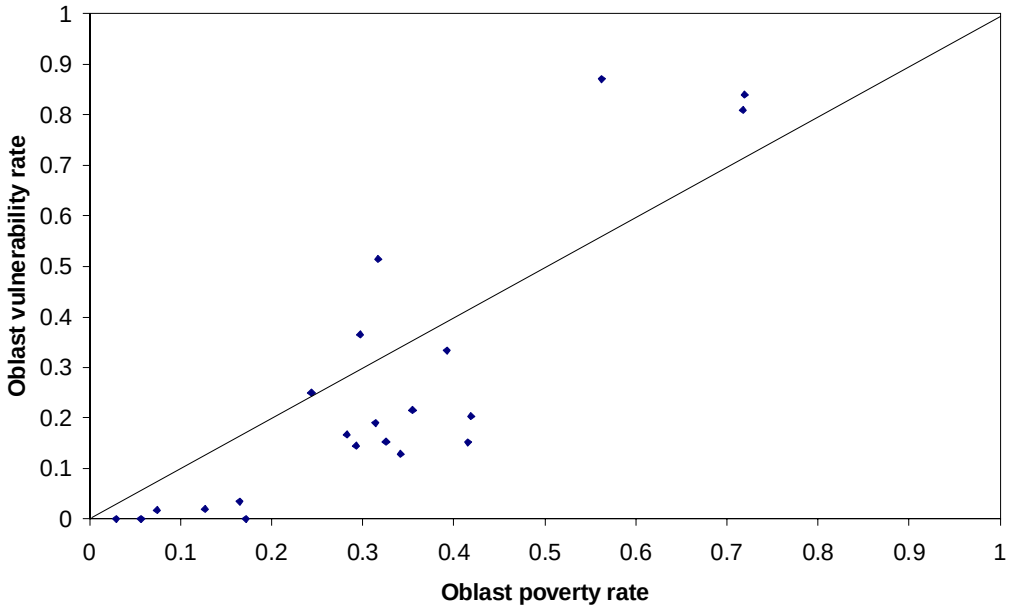
Figure 8: Lorenz total expenditure curves by area in Tajikistan



2. We now discuss the contribution of rural and urban areas to overall poverty and vulnerability in Kazakhstan at the regional level. In this country, inter-regional differences in vulnerability rates are more obvious than the regional disparities in poverty rates. In Table 11, the fraction of population that is poor ranges from a low of 9.2% in the northern region to a high of 69.1% in the southern region. Concurrently, the fraction of population vulnerable to poverty ranges from a low of 0.9% in the northern region to a high of 83.1% in the southern region.

Figure 9 compares the poverty rates and vulnerability rates across oblasts in Kazakhstan. We find that in several oblasts the population fraction that is vulnerable is more than the fraction that is poor. The figure also suggests that there are several oblasts with roughly similar poverty rates but having very different vulnerability rates. For example, in both Shezkazkanskaya and Karagandinskaya, about 32% of their population are poor. However, more than a half of the Shezkazkanskaya population are vulnerable to poverty and only 15% of the Karagandinskaya are vulnerable to poverty.

Figure 9: Poverty and vulnerability rates for oblasts of Kazakhstan



3. In Azerbaijan and Kyrgyzstan poverty and vulnerability rise with household size. For instance, in Azerbaijan, of the 22.6% of the population that live in households with 5 members — the latter accounting for 22.5% of the poor and 24.3% of the vulnerable — 67.2% are poor and 90.7% are vulnerable to poverty. Even worse, of the 47.6% of the population that live in households with 6 members or more, and account for 55% of the poor and vulnerable, 78.1% are poor and nearly 100% are vulnerable to poverty.

Similarly, in Kazakhstan, of the 23% of the population which lives in households with more than 5 members, the latter accounting for up to 40.7% of the poor and 55.1% of the vulnerable, 62% are poor and 67.7% are vulnerable to poverty. Large household size is one reason for the imbalances in the contributions of rural and urban areas to overall poverty and vulnerability because about 66% of households with more than 5 members live in rural areas.

In Kyrgyzstan, strikingly, poverty and vulnerability seem to decrease with larger household size. For example, of the 1.3% of the population who live in households with only one member, the latter accounting for 2.2% of the poor and 2.1% of the vulnerable, 94.2% are poor and 100% are vulnerable to poverty. Concurrently, of the 55.1% of the population which live in households with 6 or more members, the latter accounting for 52.1% of the poor and 48.4% of the vulnerable, only about half are poor and vulnerable to poverty.

4. It is not clear that in these countries, the gender of household head is associated with poverty and vulnerability. In Kyrgyzstan, the poverty and vulnerability rates among households headed by men are lower than that of households headed by women, at 54.5% and 58.7% respectively. This is consistent with the estimated results of determinants of vulnerability in Kyrgyzstan where, controlling for all other characteristics, female headed households are associated with significantly higher means of future consumption. In contrast, in Kazakhstan, the poverty rate among households headed by men is significantly higher than that of households headed by women, at 38.1% and 31.3% respectively. The reason is that about 70% of households headed by

woman live in urban areas which are less poor and vulnerable than rural areas. Further, we don't find an association between poverty and vulnerability and gender of heads of households in Azerbaijan.

5. In general, people who live in households headed by individuals with less education are poorer and more vulnerable to poverty. In Kazakhstan, of the 28% of the population who live in households headed by individuals with no training (except school) — comprising 36.4% of the poor and 42.5% of the vulnerable — about 45% are poor and 43% are vulnerable to poverty. Further, of the 17.2% of the population who live in households headed by individuals with at most occupational course 38.5% are poor and 30.4% are vulnerable, slightly lower than that of the previous group. The poverty and vulnerability rates are improved moderately for the population that live in households headed by individuals with higher than occupational training. However, the drop in the incidence of vulnerability is not clear among the group headed by individuals with higher than occupational training.

Similarly, in Kyrgyzstan, of the 28% of the population that lives in households headed by individuals with no diploma or certificate — who comprise 12.3% of the poor and 15% of the vulnerable — about 64% are poor and 87% are vulnerable to poverty. Meanwhile, of the 14.3% of the population that lives in households headed by individuals with higher education diploma only 34% are poor and 29.9% are vulnerable.

Table 10: Distribution of poverty and vulnerability in Azerbaijan

	Share of population	Share of poor	Share of vulnerable	Poverty rate	Vulnerability rate
Overall	**100**	**100**	**100**	**67.7**	**84.2**
By areas and regions					
Rural	62.6	60.5	59.7	65.4	80.4
Near southwest	8.8	7.3	7.6	56.1	72.3
Far Northwest	15.3	13.0	11.7	57.6	64.3
Central North	7.4	6.9	7.0	62.8	80.0
Naxichevan	4.3	5.7	4.9	89.5	95.9
Far South	7.4	6.9	7.2	63.0	81.4
Near Northwest	7.2	7.1	7.2	66.8	84.9
Central	12.2	13.6	14.2	75.6	97.6
Urban	37.4	39.5	40.3	71.5	90.7
By household size					
1	1.1	0.5	0.1	32.3	7.1
2	3.7	1.9	0.7	34.1	16.2
3	7.7	5.1	4.4	44.8	48.7
4	17.3	15.1	15.4	59.1	74.9
5	22.6	22.5	24.3	67.2	90.7
6 and more	47.6	55.0	55.0	78.1	97.4
By gender of household head					
Female	18.0	18.1	17.8	68.3	83.5
Male	82.0	81.9	82.2	67.5	84.4
By possession of land					
Owns no land	49.1	52.5	53.2	72.3	91.2
Owns land	50.9	47.5	46.8	63.2	77.5

Table 11: Distributions of poverty and vulnerability in Kazakhstan

	Population share	Share of poor	Share of vulnerable	Poverty rate	Vulnerability rate
Overall	**100**	**100**	**100**	**35.0**	**28.2**
By areas					
Urban	49.5	42.8	35.6	30.3	20.3
Poselki	8.1	8.4	11.2	36.3	39.1
Rural	42.4	48.8	53.2	40.3	35.5
By regions					
Central	16.8	13.0	10.3	27.1	17.3
Southern	21.1	41.5	62.0	69.1	83.1
Western	14.0	15.4	10.9	38.4	22.0
Northern	20.6	5.4	0.7	9.2	0.9
Eastern	27.5	24.7	16.1	31.5	16.6
By household size					
1	2.6	0.9	0.4	12.6	3.8
2	10.6	6.2	2.1	20.5	5.7
3	17.1	11.1	5.9	22.9	9.8
4	27.4	18.4	14.0	23.5	14.4
5	19.4	22.6	22.5	41.0	32.8
6 and more	23.0	40.7	55.1	62.0	67.7
By gender of household head					
Female	30.9	24.8	23.3	28.1	21.3
Male	69.1	75.2	76.7	38.1	31.3
By education of household head					
No training	28.0	36.4	42.5	45.4	42.8
Occupational courses	17.2	18.9	18.5	38.5	30.4
PTU, FSO without sec. classes	5.6	5.3	4.1	33.1	20.8
PTU with sec. classes	9.8	8.5	7.8	30.6	22.5
Technical colleges	21.6	18.5	13.9	30.1	18.1
University	17.6	12.2	13.0	24.3	20.9
Post-graduate	0.3	0.2	0.2	31.6	21.1
By possession of house					
Owns no house	10.0	11.9	12.2	41.5	34.4
Owns house	90.0	88.1	87.8	34.3	27.5
By possession of land					
Owns no land	37.0	47.3	54.1	44.8	41.4
Owns land	63.0	52.7	45.9	29.3	20.5

Table 12: Distributions of poverty and vulnerability in Kyrgyzstan

	Share of population	Share of poor	Share of vulnerable	Poverty rate	Vulnerability rate
Overall	**100**	**100**	**100**	**56.3**	**62.6**
By areas					
Rural	74.5	80.5	82.9	60.8	69.7
Urban	25.5	19.5	17.1	43.2	42.1
By household size					
1	1.3	2.2	2.1	94.2	100.0
2	4.6	6.0	6.9	72.8	92.9
3	7.3	7.7	9.0	59.1	76.6
4	13.6	13.3	13.2	55.0	60.9
5	18.1	18.8	20.5	58.6	71.1
6 and more	55.1	52.1	48.4	53.3	55.0
By gender of household head					
Female	21.8	24.5	26.1	63.3	74.9
Male	77.3	74.7	72.5	54.5	58.7
By age of household head					
<20	0.3	0.5	0.4	87.5	90.0
20-40	36.1	38.2	41.4	59.6	71.8
40-60	39.5	34.0	30.9	48.5	49.0
>60	24.1	27.4	27.3	63.9	70.8
By ethnicity of household head					
Kyrgyz	72.3	76.0	78.7	59.2	68.2
Russian	13.1	9.9	7.7	42.5	36.9
Ukrainian	1.1	0.9	0.7	44.7	38.2
Uzbek	7.1	8.2	9.5	65.3	84.7
Kazakh	0.8	0.5	0.1	36.6	8.0
Beylorussian	0.1	0.0	0.0	15.4	15.4
Tadjik	0.4	0.5	0.5	68.6	88.2
Tatar	0.9	0.6	0.5	38.0	31.4
Dungan	0.8	0.2	0.0	16.8	0.0
Others		2.5	1.2	49.2	27.0
By education of household head					
No diploma or certificate	10.8	12.3	15.0	64.3	87.2
Incomplete secondary	14.5	15.9	15.7	61.7	68.1
Complete secondary	37.4	42.2	44.7	63.6	74.7
Prof-tech school	6.8	7.0	6.8	57.8	61.8
Technikum	14.9	12.7	10.6	47.9	44.8
Higher ed. diploma	14.3	8.6	6.8	34.0	29.9
Cand. of science	0.1	0.0	0.1	7.1	50.0
Doctor of science	0.0	0.0	0.0	0.0	100.0
Other	1.2	1.3	0.3	61.0	15.1

Table 13: Distributions of poverty and vulnerability in Tajikistan

	Share of population	Share of poor	Share of vulnerable	Poverty rate	Vulnerability rate
By areas					
Rural	69.8	70.7	69.9	96.1	99.9
Urban	30.2	29.3	30.1	92.2	99.6
By regions					
Dushanbe	9.3	8.4	9.2	85.4	98.7
GBAO	4.9	5.2	4.9	100.0	100.0
RSS	28.0	27.4	28.0	92.6	99.8
Leninabad	35.6	36.1	35.7	96.3	100.0
Khatlon	22.1	23.0	22.2	98.4	100.0
By household size					
1	0.3	0.2	0.3	80.0	100.0
2	1.3	1.0	1.2	76.4	90.9
3	3.3	2.7	3.3	77.9	100.0
4	7.1	6.8	7.1	90.8	100.0
5	14.5	14.3	14.5	94.0	100.0
6 and more	73.5	74.9	73.6	96.6	99.9
By gender of household head					
Female	17.6	17.5	17.6	94.4	100.0
Male	82.4	82.5	82.4	95.0	99.8
By ethnicity of household head					
Tajik	68.2	68.7	68.2	95.5	99.8
Russian	1.2	0.9	1.2	70.9	100.0
Uzbek	28.5	28.4	28.5	94.6	99.8
Tartar	0.5	0.5	0.5	88.6	100.0
Kyrgyz	1.1	1.2	1.1	100.0	100.0
Others	0.4	0.4	0.4	78.9	100.0
By qualification of household head					
None	38.2	38.2	38.2	94.7	99.8
8th (9th) class	11.7	11.8	11.7	96.2	100.0
Secondary school	32.9	32.8	32.9	94.7	99.9
Prof-tech. school	6.8	6.8	6.8	95.2	99.7
Spec tech school	4.6	4.5	4.5	94.6	99.5
Higher ed institute	5.3	5.2	5.3	93.7	99.6
Cand. of science	0.1	0.1	0.1	100.0	100.0
Others	0.5	0.5	0.5	100.0	100.0
By possession of land					
No land	92.3	92.5	92.3	95.1	99.8
Owning land	7.7	7.5	7.7	92.6	100.0

5.4. Robustness check

Lastly, we check the robustness of vulnerability estimations. The scope for doing this was limited by the data. In the case of Kyrgyzstan, however, we were able to distinguish between households according to whether they used electricity. To check for the sensitivity of results we added a dummy for whether the household uses electricity to the original specification for the case of Kyrgyzstan. The results of this augmented and restricted estimation are reported in the Appendix Tables and the cross-section distribution between poverty and vulnerability at the aggregate level is shown in Table 9. From Table 9, we can see the change in model specification doesn't change the original results much. The poverty rate still underestimates the fraction of the population vulnerable to poverty. While 54.9% of the population are observed to be poor, up to 58.9% of the population are estimated to be vulnerable to poverty. There is still a sizable fraction of non-poor which are vulnerable to poverty in Kyrgyzstan. Of the 45.1% of the population observed to be non-poor, 43% are estimated to be vulnerable to poverty.

We also consider the risk of omission by eliminating the variable of per capita land areas available to household from the original model for Kyrgyzstan. Results from alternative specifications are depicted in the Appendix tables. Further, Table 9 shows the cross-section distribution between poverty and vulnerability obtained from the restricted model. Table 9 reveals that the change in model specification doesn't alter the original results much.

6. Conclusions

In their transition to market-based economies since independence, the Central Asian countries studied in this paper initiated macroeconomic reforms. This led to economic recovery and greater price stability. However, these countries are still challenged by poverty and vulnerability to poverty. In this paper, vulnerability was considered alongside static poverty for these countries because the current poverty level may not necessarily be a good guide to expected poverty in the future. We used the expected poverty approach to assess the vulnerability.

Because panel data are typically not available, especially in developing countries like the Central Asian countries, we estimated vulnerability with cross-sectional data as the second-best solution. This necessitated our making the strong assumption that the environment is stationary so the cross-sectional variance can be used to estimate the inter-temporal variance. While cross-sectional variance will indeed be able to explain a part of intertemporal variance (the one due to idiosyncratic or cluster-specific shocks), the impact of inter-temporal or aggregate (household invariant but time variant) shocks will be missed. In other words, the model is likely to produce good estimates of vulnerability for the situations where the distributions of risks, and the risk-management instruments, are similar from one period to another.

Our estimated results showed a sizable fraction of the population in these countries observed to be non-poor is estimated to be vulnerable to poverty. Thus the headcount poverty rate is considerably different from the headcount vulnerability rate. Moreover, the distribution of vulnerability across different segments of the population can differ significantly from the distribution of poverty. Therefore, poverty reduction

strategies in these Central Asia countries need to incorporate not just alleviation efforts but also prevention. Of course, programs that aim to reduce the vulnerability in the population need to be targeted differently from those aimed at poverty alleviation.

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Appendix

Determinants of vulnerability in Kyrgyzstan – augmented estimation

	log hh income		log hh total expenditure		log hh food expenditure	
	per capita		per capita		per capita	
	expectation	variance	expectation	variance	expectation	variance
Areas						
North Urban	0.055	0.005	0.127***	0.114***	0.067*	0.141***
North Rural	-0.034	0.157**	0.011	0.108***	-0.071***	0.130***
South Urban	-0.258***	0.068	0.167***	-0.003	0.103**	-0.028
Household characteristics						
Household size	0.303***	0.011	-0.174***	-0.023*	-0.178***	-0.012
Household size squared	-0.012***	-0.002	0.006***	0.001	0.006***	0
Age household head	0.007***	-0.006***	0.001	-0.001	0.002**	-0.001
Whether hh head is male	0.173***	-0.093	0.097***	-0.031	0.106***	-0.032
Ethnic of household head						
Kyrgyz	0.059	0.126	-0.235***	-0.114***	-0.276***	-0.081*
Russian	0.341***	-0.157	0.072	-0.150***	0.026	-0.155***
Ukrainian	0.185	-0.053	0.091	-0.180**	0.026	-0.204**
Uzbek	-0.181*	0.146	-0.424***	-0.085*	-0.414***	-0.054
Kazakh	-0.065	-0.150	0.043	-0.118	0.129	-0.043
Beylorussian	0.552*	-0.169	0.281	-0.257	0.125	-0.315
Tadjik	-0.551**	-0.271	-0.415***	-0.199***	-0.234	-0.123
Tatar	0.160	-0.209	0.011	-0.004	0.005	-0.004
Dungan	0.055	-0.146	0.319**	-0.141*	0.095	-0.114
Highest certification of hh head	0.042***	-0.036**	0.057***	0.005	0.040***	-0.004
Prop. of members age 0-14	-0.642***	-0.632***	-0.380***	-0.039	-0.270***	-0.044
Prop. of members age > 60	-0.253***	-0.415**	-0.324***	-0.073	-0.200***	-0.016
Assets						
Per capita land area available to hh	0.006**	-0.006*	0.001	-0.001	0.002**	0
Whether uses electricity for dwelling	0.278***	-0.249***	0.134***	-0.082***	0.130***	-0.075***
Constant	5.926***	1.267***	9.084***	0.498***	8.571***	0.467***
Number of observations	2742	2794	2869	2869	2869	2869
R squared	0.2287	0.03216	0.4278	0.03065	0.4141	0.03011

*Note: * indicates the coefficient is significant. at 10%, ** at 5%, *** at 1% levels*

Table 2: Determinants of vulnerability in Kyrgyzstan — restricted estimation

	log hh income		log hh total expenditure		log hh food expenditure	
	per capita		per capita		per capita	
	expectation	variance	expectation	variance	expectation	variance
Areas						
North Urban	0.143***	-0.042	0.188***	0.082***	0.124***	0.112***
North Rural	-0.062	0.180***	0.009	0.114***	-0.079***	0.135***
South Urban	-0.226***	0.045	0.190***	-0.007	0.129***	-0.029
Household characteristics						
Household size	0.283***	0.021	-0.179***	-0.018	-0.184***	-0.009
Household size squared	-0.012***	-0.002	0.006***	0.001	0.006***	0
Age household head	0.008***	-0.006***	0.001	-0.001	0.002**	-0.001
Whether hh head is male	0.144***	-0.059	0.094***	-0.028	0.098***	-0.028
Ethnic of household head						
Kyrgyz	-0.008	0.130	-0.254***	-0.104**	-0.287***	-0.075
Russian	0.307	-0.205	0.058	-0.148***	0.017	-0.155**
Ukrainian	0.105	-0.084	0.075	-0.172**	0.013	-0.198**
Uzbek	-0.249**	0.139	-0.437***	-0.078*	-0.428***	-0.051
Kazakh	-0.077	-0.183	0.020	-0.099	0.111	-0.028
Beylorussian	0.612**	-0.274	0.320	-0.278	0.146	-0.332
Tadjik	-0.711***	-0.187	-0.436***	-0.207**	-0.284*	-0.130
Tatar	0.207	-0.227	-0.002	-0.013	-0.010	-0.010
Dungan	-0.031	-0.142	0.286**	-0.118	0.071	-0.095
Highest certification of hh head	0.050***	-0.046***	0.059***	0.004	0.042***	-0.005
Prop. of members age 0-14	-0.608***	-0.666***	-0.394***	-0.029	-0.289***	-0.030
Prop. of members age > 60	-0.300***	-0.442**	-0.327***	-0.073	-0.289***	-0.030
Constant	6.078***	1.192***	9.141***	0.455***	8.638***	0.428***
Number of observations	2808	2855	2931	2931	2931	2931
R squared	0.213	0.02741	0.4244	0.02637	0.4108	0.02743

Note: * indicates the coefficient is significant. at 10%, ** at 5%, *** at 1% levels.