DEVELOPING & TESTING POVERTY ASSESSMENT TOOLS

RESULTS FROM ACCURACY TESTS IN KAZAKHSTAN

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AUTHORS

At the time of this writing, Dr, Manfred Zeller was a professor for Socioeconomics of Rural Development at the Georg-August University of Göttingen's Institute of Rural Development in Germany. He is currently Professor for Rural Development Theory and Policy at the University of Hohenheim, Germany.

Gabriela Alcaraz V. is a Ph.D. candidate at the Institute of Rural Development, Georg-August University of Göttingen, Germany.

SERIES INFORMATION

This series presents a number of technical reports about USAID's program to develop Poverty Assessment Tools, implemented by the IRIS Center at the University of Maryland. These reports are made available to microenterprise practitioners, donor agency representatives, researchers and various stakeholders interested in the development of accurate and user-friendly tools to assess the poverty level of poor microenterprise clients in developing and transition economies.

CONTACT INFORMATION

IRIS Center
University of Maryland
Department of Economics
2105 Morrill Hall
College Park, MD 20742
USA

E-mail: info@iris.econ.umd.edu
Phone: +1.301.405.3110
Fax: +1.301.405.3020
Web: www.iris.umd.edu

ABSTRACT

This report presents the results of poverty assessment tool accuracy tests conducted by IRIS in Kazakhstan in 2004. The report first describes the design of the field research and the computation of the applicable poverty line, followed by an overview of the analytical methods chosen. A number of increasingly complex econometric methods are used to increase the accuracy of the estimation. This analysis results in the identification of groups of indicators that identify the poverty status of the 800 households included in the sample.
For more information on the project, please visit *www.povertytools.org.*

For more information on AMAP and related publications, please visit *www.microLINKS.org*.

For more information about the IRIS Center, visit *www.iris.umd.edu*.

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Chapter One: Introduction

USAID commissioned the IRIS Center to develop, test, and disseminate poverty assessment tools which will meet Congressional requirements for accuracy and cost of implementation. IRIS has implemented poverty indicator accuracy tests in Bangladesh, Peru, Uganda, and Kazakhstan. Comprehensive information on the project is available at www.povertytools.org, and will not be summarized in this report.

The purpose of this report is to present the results of the accuracy tests in Kazakhstan.[1] Chapter 1 provides an overview of the design of the field research for the accuracy test and the computation of the applicable poverty line. Chapter 2 provides an overview of the analysis presented in this report.

In Chapter 3, we present the results on selected poverty indicators from nine regression models (known as Ordinary Least Squares, or OLS, regression models). Each of these models potentially represents a newly designed poverty assessment tool, calibrated for Kazakhstan using a nationally representative sample. The regression models are run in SAS, using the MAXR function that seeks to maximize the explained variance of the dependent variable (per-capita daily expenditure) by a set of best 5, best 10, and best 15 regressors. Any set of five, ten, or fifteen poverty indicators can be considered a poverty assessment tool for purposes of identifying the poverty status of a household. The first six regression models differ with respect to the set of poverty indicators allowed in the model, starting from a model with a full set of potential regressors and gradually restricting the set of regressors on the basis of ease of implementation (referred to in this report as "practicality"). A seventh model is run as an example of a tool that considers only those poverty indicators that were rated as "highly verifiable" by SANGE Research Center, the survey firm in Kazakhstan.[2] A subsequent model compiles these indicators with powerful subjective and monetary indicators. Finally, the last model makes use of poverty indicators usually available in the World Bank Living Standards Measurement (LSMS) surveys. Thus, the first eight models can be considered alternative best combinations of poverty indicators (mainly derived from existing practitioner tools for poverty assessment), while the ninth model is a tool derived from poverty indicators usually available in LSMS surveys. The final section of this chapter presents results from the use of three other regression techniques: Probit, Quantile, and Linear Probability Model.

Chapter 4 presents results from an alternative estimation approach, the so-called "two-step" models — again estimated with the OLS regression technique. Compared to the models presented in Chapter 3, the models detailed in Chapter 4 perform better. At very low poverty headcount rates, as in Kazakhstan, the OLS models presented in Chapter 3 are clearly inferior compared to the two-step models. In addition to OLS, we also test Quantile, Probit, and the Linear Probability Model. Chapter 5 summarizes the results.

1.1 Field survey for accuracy tests in Kazakhstan

SANGE Research Center, in Almaty, Kazakhstan, carried out the survey and completed double entry of data using SPSS software. The survey covered all four zones of Kazakhstan, and seven of its fourteen oblasts. The interviewers carried out 840 interviews with the composite questionnaire, followed two weeks later by the benchmark questionnaire (N=817). Training of the interviewers began in August, 2004, and was carried out by Dr. Jean-Luc Dubois. The survey was carried out from early September until end of October, and double entry of all data was completed by mid-December, 2004.

Both the composite and benchmark questionnaires were adaptated to the Kazakhi context. In the case of the composite questionnaire, this entailed the inclusion of poverty indicators, such as the number of horses owned, or the inclusion of certain inferior foods in Section E (see questions E151 thru 159). Useful sources for the identification of country- and region-specific poverty indicators include various publications by the National Statistical Agency of Kazakhstan, as well as the experience SANGE's interviewers and researchers, who were intensively involved in the questionnaire adaptation. The adaptation of the benchmark questionnaire mainly involved the selection of major food items.

The adaptation and processing of the two questionnaires benefited greatly from the extensive expertise of the SANGE Research Center's personnel — including Janar Jandosova, Director General; Fatima Jandosova, Project Director; and Natalia Baitugelova, Senior Researcher; as well as their supervisors and interviewers — in conducting economic, social, and market studies in Kazakhstan's diverse cultural and socioeconomic settings.

1.2 Sampling frame

Requirements for sampling. For the general population sample, we chose a sample size of 800 households. The sample was required to be nationally representative. Given the regional diversity in terms of agro-climatic, cultural, and socioeconomic conditions, sampling had to include all four of Kazakhstan's administrative zones to be representative at the national level.

~~The size of the household sample for the survey was set at 800 households. I~~n order to have a buffer for incomplete cases, we decided to interview one extra household per cluster.[3] Hence, the total sample size is 842 households. The household selection process consisted of four steps, using a random selection procedure proportional to population size.

Kazakhstan is administratively divided into four zones: North, South, East, and West. Concurrently, the country is also divided into 14 *oblasts* (best translated as "province"). Each oblast is further divided into *rayons* — equivalent to districts. For logistical reasons, we determined that the survey could only be carried out in seven of the 14 oblasts. Based on population figures obtained from the National Statistics Agency (from the last census in 2000),

seven out of the 14 oblasts were selected with a probability proportional to the size of the oblast in the national population.

The second step was to distribute the 842 households into 40 clusters of 20 households each. This was an arbitrary decision, based on the fact that clusters are useful in decreasing logistical costs and travel time. In such a huge country (2,717,300 square kilometers, or about four times the size of Texas), the distances between two survey points may be very large. The use of clusters increases the overall sampling error by introducing a specific "cluster error." The level of such an error, however, decreases as the number of clusters increases. Therefore, the choice of 40 clusters can be considered as a pragmatic one — 40 clusters allowed the team to gather a geographically diverse sample (in terms of a good distribution among the regions selected), while minimizing cluster errors and keeping logistical costs at an affordable level. The third step consisted of distributing these clusters throughout the seven oblasts on a random basis. The probability that a certain area received a cluster was proportional to its population size. Stratification between urban areas (cities, large towns, and small towns) and rural areas (large villages, average villages, and small villages) was also considered. Each cluster corresponds to a rural rayon or city district.

During the forth step, 842 households were selected within these urban districts and rural rayons:

(i) In urban areas and towns, households were selected using geographical maps, by selecting random squares on the map and then using a random path method within each square.

(ii) For rural areas, one or two villages were randomly selected within a rayon, taking into account their sizes. Households were then allocated following random path methods, under the supervision of the coordinator and supervisors.

1.2.1 Selection of the seven oblasts

The 14 oblasts in Kazakhstan are: Almaty, Aktobe, Astana, Atyrau, North Kazakhstan, East Kazakhstan, Jambyl, Karaganda, Kzylorda, Kostanai, Mangystau, Pavlodar, South Kazakhstan, and West Kazakhstan.

We aggregated these oblasts into four cultural zones, according to their cultural features — the South, North, West, and East. We then determined the population of each zone, based National Agency of Statistics data (Table 1.2.1).

Table 1.2.1. Distribution of population by cultural zones

Cultural zone	Population
1. South	6,489,701
2. North	4,923,560
3. West	2,082,527
4. East	1,455,412
Kazakhstan	*14,951,200*

Seven oblasts were then selected. The four cultural zones were used as stratification criteria and the number of oblasts selected in each strata was proportional to the population. The selected oblasts are: Aktobe, Almaty, East Kazakhstan, Jambyl, Karaganda, Kostanai, and South Kazakhstan (Table 1.2.2).

Table 1.2.2. Distribution of population by oblasts

Oblast	**Cultural zone**	**Population**	**Cumulative Population**	**Selection**
Almaty	1. South	2,746,402	2,746,402	Selected
South Kazakhstan	1. South	2,150,256	4,896,658	Selected
Jambyl	1. South	985,552	5,882,210	Selected
Kzylorda	1. South	607,491	6,489,701	-
Karaganda	2. North	1,330,927	7,820,628	Selected
Astana	2. North	1,259,463	9,080,091	-
Kostanai	2. North	913,435	9,993,526	Selected
Pavlodar	2. North	745,238	10,738,764	-
North Kazakhstan	2. North	674,497	11,413,261	-
Aktobe	3. West	671,812	12,085,073	Selected
West Kazakhstan	3. West	603,832	12,688,905	-
Atyrau	3. West	457,215	13,146,120	-
Mangystau	3. West	349,668	13,495,788	-
East Kazakhstan	4. East	1,455,412	14,951,200	Selected
Kazakhstan		*14,951,200*		

1.2.2 Allocation of the 40 clusters within the seven oblasts

The 40 clusters were allocated across the seven regions according to each region's population, taking into account the relative share of population in urban and rural areas.

A cluster of 20 households was allocated for each 256,345 people (i.e., the total population of the seven oblasts divided by 40). The distribution between urban and rural clusters was based on the urban rating of each oblast (Table 1.2.3).

Table 1.2.3. Distribution of urban and rural clusters by oblast

Oblast	Population	Number of clusters	Urban rating	Urban+Rural
Aktobe	671,812	3	0.56	2 urban + 1 rural
Almaty	2,746,402	11	0.58	6 urban + 5 rural
East Kz	1,455,412	6	0.59	3 urban + 3 rural
Jambyl	985,552	4	0.45	2 urban + 2 rural
Karaganda	1,330,927	5	0.83	4 urban + 1 rural
Kostanai	913,435	3	0.53	2 urban + 1 rural
South Kz	2,150,256	8	0.36	3 urban + 5 rural
Kazakhstan	**14,951,200**	**40**	**0.56**	**22 urban+18 rural**

1.2.3 Selection of 40 rayons and cities within the oblasts

Once the 40 clusters were distributed over the seven oblasts (in proportion to their size and urban rating), specific rayons and cities were selected to receive these clusters.

This was done by using the database provided by the National Agency of Statistics, which gives detailed population information for cities; large and small towns; and large, average, and small villages (and their rayon). Through a systematic drawing (random function, selection step, alternative sampling), rayons and cities were selected in proportion to their size.

1.2.4 Selection of clusters within the cities

Several cities were selected using the procedure described above. The majority of small cities received one cluster. This is the case for Aktobe, Taraz, Faraganda, Ust Kamenogorsk, Semi Palatinsk, Ayagoz, Taraz, Karatau, Jezkazgan, Saran, Kostanay, and Saryagash. For these cities, there was no need to take sub-districts into account.

For the city of Shimkent, two clusters were selected. In this case, therefore, districts had to be taken into account. Each cluster was placed in a different district, one with high population density and one with low density.

In Almaty city there are six different districts, among which five clusters were distributed. A systematic selection was made (random function, selection step), in order to capture the distribution of the population within the district. This resulted in the following districts: Auezov, Bostandyk, Almaly, Turksyb, and Medeu (Table 1.2.4). Annex A-1 lists all 40 clusters selected for the survey.

Table 1.2.4. Distribution of the clusters among the Almaty districts

Districts	Population	Cumulates	Selection
Auezov	286.7	286.7	Selected
Bostandyk	241.8	528.5	Selected
Almaly	177.2	705.7	Selected
Turksib	156.8	862.5	Selected
Jetysu	144.2	1006.7	-
Medeu	129.4	1136.1	Selected
Total Almaty	*1136.1*		

In each of the rayons selected in rural areas, we chose a cluster or village of 20 households using the random walk method. This technique entailed taking a random walk from the center of a village in each of the four directions and selecting every N^{th} household. The number N was pre-specified in view of the size of the sample and the size of the population in the village.

For cities, such as Almaty, the map was divided geographically into squares. Then, one square was randomly selected from the total number of squares covering the district. This determined the center from which to begin the random walk. In Shymkent, the selection of the squares within these districts was done in the same way. For all other cities and towns (where only one cluster was selected) one square randomly chosen on the map gave the center of the cluster and a walk was made from this center in the four directions.

1.3 Poverty line

The legal text by U.S. Congress refers to two alternative poverty lines in defining the "very poor." The term "very poor" refers to individuals: (A) blonging to the bottom 50 percent below the poverty line established by the national government; *or* (B) living on the equivalent of less than one U.S. dollar per day.

By using the term "or," the legislation implies that a person could be considered very poor if he/she was *either* living on less than a dollar a day, *or* was in the bottom half of the distribution of those below the national poverty line. The legislation thus identifies two alternative measures of extreme poverty, which correspond to two commonly used poverty lines:

National Poverty Line (A) — *The bottom 50 percent* of those classified as poor by any national poverty line. In Kazakhstan, the national poverty line is expressed in *tenge*, the local currency.

International Poverty Line (B) — Income of one dollar income per day per capita (equal to $1.08 per day in purchasing power parity (PPP) dollars at 1993 prices).

In the following, we evaluate the level of these poverty lines in local currency for the survey month (October 2004).

International Poverty Line. The 1993 international poverty line of one dollar per capita and per day corresponds to 55.87 tenge in March 2003.[4] To estimate the nominal value of the international poverty line for October 2004 (the month of the IRIS benchmark survey), we used the evolution of the consumer price index between March 2003 and October 2004. According to data published by the Government of Kazakhstan's National Statistical Agency (NSA), the inflation rate in 2003 was seven percent (Government of Kazakhstan Statistical Yearbook, 2003). From January to October 2004, the NSA estimated an average inflation rate of five percent for all regions (*source*: data provided by the NSA to SANGE Research Center in January 2005). Using these inflation rates, the international poverty line of one dollar is 61.74 tenge (=55.87 * (1+0.07/4*3) * (1+0.05)). Accordingly, the two-dollar poverty line for the month of October is 123.49 tenge.

At the market exchange rate, one U.S. dollar was worth 136 tenge in fall of 2004. Using this market exchange rate, the one-dollar poverty line corresponds to 45 U.S. cents and the two-dollar line is equivalent to 90 U.S. cents.

National poverty line: The NSA regularly publishes a *subsistence minimum*, expressed in tenge per capita per month. The subsistence minimum is used by the Government as the official poverty line. The computation of this poverty line is based on a basket of necessity goods and services, including 70 percent food products and 30 percent non-food products and services. It is calculated for 16 regions, because of regional differences in living costs. The NSA adjusts the subsistence minimum on a monthly basis, in line with the changes in the consumer price index (CPI) for each of the 16 regions.[5]

At the time we conducted our data analysis, the most-recent data available on the subsistence minimum refers to the month of December 2003.[6] The average subsistence minimum for all regions of the country was 5692 tenge per capita per month in December 2003 (see Table 1.3.1, column one). The NSA first determines the subsistence minimum for an adult person living alone in a one-member household. This minimum, which can be viewed as an "adult equivalent value," is then converted into different per-capita values depending on the size of the household. The NSA reduces the subsistence minimum per capita for persons living in larger households, in order to account for differences in subsistence needs across different age groups, as well as for economies of scale and scope in household subsistence activities. Thus, the NSA uses fixed equivalence scale coefficients to calculate the per-capita subsistence minimum for five different

sizes of households, ranging from households with one member to households with five or more members. These coefficients are shown in Table 1.3.1. The per-capita subsistence minimums are obtained by multiplying the subsistence minimum per capita in the one-member household (i.e., the subsistence minimum per adult equivalent) by the respective scale coefficients for each of the five types of households.

Table 1.3.1: Subsistence minimum (SM) per capita per month in tenge, by region and household size (for December 2003)

Region/Oblast	**SM per capita for household with 1 member (equal to SM per adult equivalent)**	**SM per capita for household with 2 members**	**SM per capita for household with 3 members**	**SM per capita for household with 4 members**	**SM per capita for household with 5 or more members**	**CPI index for period Dec 03 thru Oct 04**
Equivalence escales coefficient	1	0.845	0.72	0.7025	0.625	
Akmola	5,669	4,79	4,082	3,982	3,543	1,049
Aktobe	6,063	5,123	4,365	4,259	3,789	1,058
Almaty rural	5,453	4,608	3,926	3,831	3,408	1,037
Atyrau	6,916	5,844	4,98	4,858	4,323	1,041
East Kazakhstan	5,547	4,687	3,994	3,897	3,467	1,051
Jambyl	4,894	4,135	3,524	3,438	3,059	1,039
West Kazakhstan	5,307	4,484	3,821	3,728	3,317	1,036
Karaganda	5,5	4,648	3,96	3,864	3,438	1,054
Kostanai	5,367	4,535	3,864	3,77	3,354	1,04
Kyzylorda	5,49	4,639	3,953	3,857	3,431	1,039
Mangistau	7,406	6,258	5,332	5,203	4,629	1,043
Pavlodar	5,313	4,489	3,825	3,732	3,321	1,045
North Kazakhstan	5,373	4,54	3,869	3,775	3,358	1,054
South Kazakhstan	4,88	4,124	3,514	3,428	3,05	1,033
Astana	5,676	4,796	4,087	3,987	3,548	1,054
Almaty urban	6,214	5,251	4,474	4,365	3,884	1,063
Kazakhstan Simple average	5,692	4,81	4,098	3,998	3,557	

Source: Data provided by National Statistical Agency in January 2005 to SANGE Research Center

The NSA provided the data on the regional CPI for the period from December 2003 to October 2004 (the month in which most of the benchmark surveys were carried out). These regional CPI indices are also listed in Table 1.3.1. Using the CPIs, and assuming 30 days per month, Table 1.3.2. shows the subsistence minimum per day and per capita, differentiated again by region and household size, for October 2004. On average, the poverty line for Kazakhstan (expressed in per-capita daily expenditures) ranges from 124 tenge in households with five or more members to 199 tenge in single households. On a per-adult equivalent basis, the subsistence minimums range from 171 tenge in the Jambyl and South Kazakhstan oblasts to 259 tenge in the Mangistau oblast, with a mean of 199 tenge (not weighted by oblast population).

Table 1.3.2: Subsistence minimum (SM) per capita per day in tenge, by region and household size (for October 2004)

Region/oblast	**SM per capita for household with 1 member (= SM per adult equivalent)**	**SM per capita for household with 2 members**	**SM per capita for household with 3 members**	**SM per capita for household with 4 members**	**SM per capita for household with 5 or more members**
	Tenge	Tenge	Tenge	Tenge	Tenge
Akmola	198	168	143	139	124
Aktobe	214	181	154	150	134
Almaty rural	188	159	136	132	118
Atyrau	240	203	173	169	150
East Kazakhstan	194	164	140	137	121
Jambyl	169	143	122	119	106
West Kazakhstan	183	155	132	129	115
Karaganda	193	163	139	136	121
Kostanai	186	157	134	131	116
Kyzylorda	190	161	137	134	119
Mangistau	257	218	185	181	161
Pavlodar	185	156	133	130	116
North Kazakhstan	189	160	136	133	118
South Kazakhstan	168	142	121	118	105
Astana	199	169	144	140	125
Almaty urban	220	186	159	155	138
Kazakhstan Simple average	199	168	143	139	124

Source: Own computation using data provided by SANGE research center, as shown in Table 1.3.1.

Each year, the NSA carries out a national household survey with a sample size of about 12,000 households. During the course of the year, households self-record their expenditures. The most recently published NSA poverty headcount index based on this survey is for 2002 (Statistical Yearbook of Kazakhstan, 2003). For 2002, the NSA estimated that 24.2 percent of the

population fell below the national poverty line. For 2003, the headcount index dropped to 19.8 percent (Source: Information directly obtained from the NSA by SANGE).[7]

According to U.S. Congressional legislation, only half (i.e., the bottom 50 percent) of these 19.8 percent of the population can be considered very poor. In absolute terms, if one took the bottom 50 percent below the national poverty line for defining the very poor, an absolute 9.9 percent of the population would thus be counted as very poor. On the other hand, according to data published by the World Bank, *less than two percent of the population in Kazakhstan in 2001 had expenditures below the international poverty line of 1 dollar a day*.[8] Hence, the bottom 50 percent below the national poverty line (concept B) defines a higher percentage as very poor as the international poverty line (concept A). The "or" term in the Congressional legislation suggests using the poverty line that yields a higher headcount index of "very poor." Thus, the applicable poverty line for the accuracy tests in Kazakhstan is the national poverty line.

Similar to the IRIS accuracy test carried out in Peru (see Zeller, Johannsen, and Alcatraz, 2005), we sought to identify the bottom 50 percent cutoff point below the national poverty line by using nationally representative expenditure distributions provided by the NSA to the SANGE Research Center. For purposes of clarity, we label this bottom 50 percent cutoff point as the poverty median line (PML). NSA kindly provided data on per-capita expenditure distributions for 2003 for each of the seven sample regions, as well as the poverty headcount indices for each of the 16 regions for the same year. However, the data on the cumulative expenditure distribution were not further differentiated by the five types of households. Therefore, it was not possible to determine the bottom 50 percent cutoff point from the official data provided by NSA as this would have required data on expenditures per per-adult equivalent (for each of the 16 regions). This experience highlights the fact that the bottom 50 percent cutoff below the national poverty line may not always be an easy measure to implement. This conclusion is similar to our experience in Peru, where substantial work was required to obtain the data on regional expenditure distributions and to process that data with poverty lines differentiated by region.

This leaves us with the option to identify the bottom 50 percent poorest (and hence the PML) directly with the nationally representative data collected for this accuracy test. We do this by first determining the number of households that have per-capita expenditures below the national poverty line, accounting for differences across regions and household sizes as shown in Table 1.3.2. Hence, we convert per-capita daily expenditures into daily per adult-equivalent expenditures using the equivalence coefficients of Table 1.3.1, and then identify the households below the regional poverty line in each of the seven sample oblasts. Based on this method, 74 out of 817 households (9.1%) have expenditures below the respective regional poverty line, expressed in daily per-adult equivalent as shown in Table 1.3.2.[9] Using this information, for each sampled region we examined the distribution of expenditures among those households living under that region's poverty line, allowing us to identify the bottom 50 percent poorest having expenditures below the region-specific poverty median line. These "regional poverty median lines" (RPMLs) are then used as the basis for all further empirical work, which boils down to a

search for tools that allow households whose monthly expenditures fall below the RPML to be identified.[10] Note that applying this approach to all of Kazakhstan would require following a similar procedure to find the RPML for each of the country's other 11 regions. A similar problem would apparently need to be faced in any country that sets different poverty lines for different regions.

The economic situation in Kazakhstan has continued to improve in 2004. With annual growth rates averaging around 11 percent since 2000, Kazakhstan has demonstrated impressive economic resilience in recent years. Poverty rates have declined by about four percentage points per year from a headcount index of 39 percent in 1998 to 19.8 percent in 2003. For the average of 2004, the NSA estimates a poverty rate of 16.1 percent (Source: NSA website, accessed in May 2005), which represents decrease of 3.7 percentage points. Kazakhstan is relatively well-off compared to the other three countries where IRIS conducted accuracy field tests.

Table 1.3.3: Poverty headcount indices in Kazakhstan, by year

Year	Poverty headcount index (in %) with income below subsistence minimum (SM)
1996	34.6
1997	38.3
1998	39.0
1999	34.5
2000	31.8
2001	28.4
2002	24.2
2003	19.8
2004	16.1
Fourth quarter of 2004	12.2

Source: National Statistical Agency, Government of Kazakhstan.

According to the NSA, poverty continuously decreased throughout 2004. In the fourth quarter — the period that coincides with the benchmark survey period of the IRIS accuracy survey — the NSA estimated a poverty rate of only 12.2 percent.[11] Our estimated headcount index of 9.7 percent in the sample population is 2.5 percentage points lower. This relatively small deviation exists despite the fact that IRIS's accuracy test sample had only 817 sample households in seven out of 14 oblasts, whereas the annual household survey of the NSA contains 12,000 households in all oblasts. The validity of the expenditure data in the IRIS sample is also shown through a comparison of the per-capita monthly expenditure distributions in NSA's sample survey for the fourth quarter of 2004 (Table 1.3.4) with those of the IRIS sample data set (Table 1.3.5).

Table 1.3.4: Distribution of monthly per-capita expenditures, based on nationally representative sample of NSA for the fourth quarter 2004

Decile of population, ordered from poorest to wealthiest	Monthly per-capita income, in tenge	Number of population in decile	Total monthly income of decile, in tenge	Share of income out of total sample income, %	Average monthly income per capita in decile, in tenge
1	0-3,799	4,008	12,184,869	3.24	3,040
2	3,800-4,730	4,008	17,172,167	4.57	4,284
3	4,731-5,594	4,008	20,689,091	5.51	5,162
4	5,595-6,569	4,008	24,373,522	6.48	6,081
5	6,570-7,674	4,008	28,529,332	7.59	7,118
6	7,675-8,956	4,008	33,200,768	8.84	8,284
7	8,957-10,555	4,008	38,945,533	10.36	9,717
8	10,556-12,681	4,008	46,335,685	12.34	11,561
9	12,682-16,771	4,008	58,166,154	15.48	14,513
10	> 16,771	4,011	96,165,196	25.59	23,975
Total, all deciles		40,083	375,762,317	100	9,375

Note: The headcount rate is 12.2 percent. NSA defines a measure of income inequality that is computed as the average income of the top decile divided by the average income of the lowest decile. Thus, the coefficient of income inequality is 7.9 (23975 / 3040).
Source: National Statistical Agency (NSA, 2004), provided by the World Bank office in Kazakhstan on April 8, 2005.

Table 1.3.5: Distribution of monthly per-capita expenditures, based on nationally representative sample of IRIS accuracy test, October 2004

Decile of population, ordered from poorest to wealthiest	Monthly per-capita income, in tenge	Number of population in decile	Total monthly income of decile, in tenge	Share of income out of total sample income, %	Average monthly income per capita in decile, in tenge
1	0-3,753	326	922,188	3.10	2,829
2	3,754-4,802	328	1,404,604	4.72	4,282
3	4,803-5,785	329	1,734,771	5.83	5,273
4	5,786-6,673	324	2,002,718	6.72	6,181
5	6,674-7,704	326	2,341,501	7.86	7,183
6	7,705-9,033	324	2,724,093	9.15	8,408
7	9,034-10,363	332	3,194,812	10.73	9,623
8	10,364-12,890	326	3,706,942	12.45	11,371
9	12,891-16,981	328	4,775,066	16.03	14,558
10	> 16,981	325	6,974,187	23.42	21,459
Total, all deciles		3,268	29,780,883	100	9,113

Note: The headcount rate is 9.7 percent. The coefficient of income inequality is 7.6 (21459 / 2829).
Source: Own calculations from IRIS sample of 817 households with 3268 persons.

Based on a poverty rate of 9.1 percent of the sample households living below the national poverty line in IRIS's accuracy test the sample, 4.5 percent of households (or 37 sample households) are defined as very poor (i.e., the bottom 50 percent of households below the national poverty line).

The following table gives an overview of the calculated percentage of poor households in the IRIS sample for alternative definitions of poverty.

Table 1.3.6: Percentage of poor households, by definition of poverty

Definition of poverty	Number of households below poverty line	Headcount index (in percent of households)
Below national poverty line, by region (in tenge, as defined in Table 1.3.2)	74	9.06
Very poor (VP): Belonging to the bottom 50 percent poorest living below the national poverty line, by region	37	4.53
Below 1 dollar per day per capita (=61.74 tenge at purchasing power parity rate)	8	0.98
Below 2 dollar per day per capita (=123.49 tenge at purchasing power parity rate)	59	7.22

Source: Own calculations from data of IRIS benchmark survey

Only 9.1 percent of its households are defined as being poor by the national poverty line and all other definitions of poverty yield lower headcounts. The applicable measure of poverty in the context of the U.S. legislation is the one described by the words "very poor." Here, the headcount in the sample is 4.53 percent.

To stay true to the language of the legislation, throughout this report we will use the term "very poor" or "VP" for those households having an expenditure falling below the bottom 50 percent cutoff below the national poverty line. We will use the term "not very-poor" or "NVP" for those having an expenditure equal to or above this bottom 50 percent cutoff. Readers should bear in mind that ANY such binomial, "either-or" labels tend to distort the underlying reality, which is continuous. The standard of living of a household and its members just above the line is not that much different than that of a household just below the line. It is also important to note that even above the national poverty line there are many households that are vulnerable to poverty. This means that losing one's employment, an illness of a family member, or a social obligation may easily drive these households into poverty. Given these considerations, some readers may find it interesting to see accuracy levels of the estimated models for the national poverty line as well. We provide this information with the denotation NP (below national poverty line) and NNP (not national poor).

Table 1.3.7 shows daily expenditures, expressed per capita and per adult-equivalent, in tenge. These figures are further differentiated for each of the eight regions for which the NSA has defined distinct poverty lines. The third column lists the percentage of households that have expenditures below the subsistence minimum (i.e., NP), as shown in Table 3.1.2. The fourth column shows the distribution of the very-poor (VP) by region and in the total sample of 817 households.

Table 1.3.7.: Daily expenditures (per capita and per adult-equivalent), and percentage of households below national poverty line and below bottom 50 percent cutoff below national poverty line, by region

Region	**Per-capita daily expenditures, in tenge**	**Per adult-equivalent daily expenditures, in tenge**	**Percentage of households below national poverty line (NP)**	**Percentage of very-poor (VP)**
Aktobe oblast (N=61)	313	452	8.20	4.92
Almaty city (N=99)	431	590	9.09	4.04
Almaty rural (N=124)	302	429	12.10	6.45
East Kazakhstan (N=122)	399	520	4.10	1.64
Jambyl (N=82)	252	359	14.63	7.32
Karaganda (N=101)	341	451	5.94	2.97
Kostonay (N=62)	341	432	3.23	1.61
South Kazakhstan (N=166)	246	371	12.05	6.02
Total sample (N=817)	324	448	9.06	4.53

The results indicate that the rural part of Almaty oblast, Jambyl, and South Kazakhstan belong to the regions with a higher incidence of poverty, whereas Eastern Kazakhstan and Kostonay are above-average oblasts.[12]

Chapter Two: Overview of Regression Analysis

2.1 Introduction

In Chapter 3, we will analyze the accuracy of newly designed tools, using nine original regression models developed for generating tools. These models consider all the poverty indicators that were compiled in the composite questionnaire, based on submissions of practitioner tools to IRIS in late 2003 (as reviewed by Zeller 2003, see *www.povertytools.org*). Additional indicators have been adapted from recent poverty assessment studies published in academic literature. Thus — with the exception of Model 9, based on LSMS type indicators — the newly designed tools considered in Chapter 3 seek the *best combinations* of poverty indicators drawn from existing practitioner tools.

2.2 Composite Questionnaire

The structure of the composite questionnaire is as follows (see *www.povertytools.org*):

A. Identification of household (location, client status, etc.)
B. Household roster/demography, including individual as well as household-level indicators (derived from all practitioner tools)
C. Household expenditures by category (adapted from the FINCA and ACCION tools)
D. Housing indicators (generic questions adapted from tools by AIM, ASA, CASHPOR, CIMS-OI, PRIZMA, and TUP), plus poverty indicators concerning minimum wage levels acceptable to respondents
E. Food consumption/Food Security Scales (adapted from tools by CGAP, Freedom from Hunger, and World Food Program Food Security and Hunger Questionnaire)
F. Asset-based indicators (adapted from the GRAMEEN Network and most other tools)
G. Social capital, voice, and vulnerability (adapted from recent advancements in social science research)
H. Estimates of objective and subjective poverty (adapted from recent advancements in social science research)
I. Information on client status of individual household members in programs and institutions supporting microfinance or business development services (including information on size of loans and outstanding debt)
K. Monetary voluntary savings by individual household members (adapted from WOCCU)

The pretest of the composite questionnaire revealed that it was not possible to ask the questions on section K without jeopardizing the willingness of the respondents to cooperate for the subsequent benchmark visit. Questions on monetary savings and informal debt are highly

sensitive in Kazakhstan, possibly because of the relatively high level of crime. It was therefore decided to ask section K at the end of the second interview, scheduled for fourteen days after the first interview.

2.3 Selection of indicators

In chapter 3, we present results from nine models that were run with OLS using SAS software. The models differ by the type of regressors used. While Model 1 includes 250 regressors, Model 7 has the most restrictive list of 104 potential poverty indicators.

For Model 1, presented in Chapter 3, the set of best poverty indicators is dominated by various expenditure and asset categories, apart from household demographic characteristics, with only a few poverty indicators from other dimensions and sections of the composite questionnaire.[13] Starting with Model 2, we gradually reduce the number of regressors to allow indicators from other dimensions and sections of the questionnaire to enter the set of best poverty indicators.

This approach principally aims to develop a variety of tools that capture different dimensions of poverty. A secondary objective of the approach is to address the practicality issue, by basing the series of models on selected indicators that are increasingly *simple* and *verifiable*.

Difficulty of indicator. Information on some indicators is easy to obtain, while for others it is not. Difficulty can be expressed in terms of time, money, and social costs expended for obtaining information. Social costs are especially important when addressing culturally sensitive questions. The difficulty of an indicator will therefore vary with the socio-economic and cultural context. It will also depend on the skill level and quality of training of interviewers. Furthermore, difficulty is strongly affected by the educational level and intellectual skills of the respondent, as well as by the interview situation (whether in private at home, or among peers and/or strangers in public, where the respondent may incur high social costs for answering certain types of questions). For example, the value of total assets is very difficult and tedious to obtain, and therefore is not suitable for an operational poverty assessment tool. Another example is question C2 in the composite questionnaire regarding the value of food that is home-produced and consumed by the household in an average week, as well as several other expenditure indicators.

Verifiability of indicator. Another useful characteristic of an indicator for its operational use is its ease of verification (in terms of time, monetary, and social costs). Here, we distinguish between objective and subjective indicators. Subjective indicators include any self-assessment (perception, feeling, attitudes) by the respondent (e.g., Section E9 onwards and Section H, regarding perceived adequacy of livelihood); or any assessment done by the interviewer (e.g., rating the poverty status of a household on a scale from 1 to 5, as in Section A). While some subjective indicators are among the more powerful poverty indicators, as will be shown later, they are hardly verifiable, as the scales used are subjective and not disclosed to others. Objective indicators are characterized by using scales for measurement that can be — at least in principle

— verified by consistent standards of measurement metrics. Examples of objective indicators include the age of a person (in years), the size of the rooms (in square meters), or whether the roof is made of natural fibers — these indicators are directly measurable through conventional and universally comparable scales. Measurability using comparable scales is a prerequisite for direct verifiability. Objective indicators, however, may also vary in their degree of verifiability. An example of an objective but unverifiable indicator is the number of luxury foods eaten in the past seven days, or the money received from migrant relatives, or how many days a child was sick in the past 12 months. Common to this group of unverifiable objective indicators is the fact that actions or states occurred in the past.

Because the difficulty and verifiability of an indicator cannot be generalized across different socio-economic and cultural contexts, it is somewhat arbitrary to classify a particular indicator (or group of indicators) as being more or less difficult to ask, or more or less verifiable. Therefore, the selection of progressively smaller subsets of regressors for defining Models 1 through 6 inevitably reflects some arbitrary assumptions and choices.

In Models 7 and 8, we used SANGE's subjective assessment of verifiability as an alternative way to address the practicality issue. To get more information on the practicality of poverty indicators, IRIS also conducted practicality tests via microfinance and business development services organizations.

Our sequence of regression models using progressively fewer poverty indicators (from Model 1 to 6) aims to generate a series of poverty assessment tools that gradually become less accurate (because each is less comprehensive) while at the same time becoming more practical, less costly, and less prone to falsification by respondents or survey intermediaries.

For each model presented in Chapter 3, we present a set of BEST 5, BEST10, and BEST15 poverty indicators. Each of these three sets can be considered a poverty assessment tool in itself. For each tool we document the level of Total Accuracy, Poverty Accuracy for the very-poor, and Non-Poverty Accuracy for the not very-poor, as well as the degree of Undercoverage and Leakage. From an operational point of view — and everything else being the same — a tool derived only from the five best indicators presents an easier, more practical poverty assessment tool than one that uses the best 15 (or even more) poverty indicators.[14] The reason for this is obvious — with a BEST5 tool there are fewer questions to ask and analyze. However, fewer poverty indicators in a tool usually implies a lower degree of accuracy.

This highlights the important trade-off between accuracy (and residual errors) and practicality. Achieving the right balance requires careful consideration — which will ultimately determine the selection and certification of certain poverty assessment tools.

2.4 Specification of regression models

The following nine model types were run as ordinary least squares in SAS. In all regressions, the sample size is 817. The dependent variable is the natural logarithm of per-capita daily expenditures in tenge.

Table 2.2.1 Dependent variable per-capita daily expenditures

Variable	N	Minimum	Maximum	Mean	Standard deviation
Per-capita daily expenditures	817	36.24	1676.60	324.20	188.13
Ln expenditures per capita (natural logarithm)	817	3.59	7.42	5.62	0.56

In all regressions, an INCLUDE statement always includes the following nine regressors as control variables:

Table 2.2.2. Description of the ten control variables

Variable	N	Minimum	Maximum	Mean	Standard. deviation
Household size	817	1	14	4.00	2.02
Household size squared	817	1.00	196.00	20.11	20.40
Age of household head	817	19.00	91.00	50.08	14.57
Aktobe oblast	817	0	1	0.07	0.26
Almaty oblast	817	0	1	0.27	0.44
East Kazakhstan	817	0	1	0.14	0.35
Jambyl oblast	817	0	1	0.10	0.30
Karaganda oblast	817	0	1	0.12	0.32
Kostanay oblast	817	0	1	0.07	0.26
Is this community urban or rural?	817	0	1	0.52	0.50

The first three control variables take into account the influence of important demographic factors that, in previous research, have emerged as powerful variables in explaining per-capita expenditures at the household level. The seven dummy variables seek to capture regional agro-ecological, cultural, and socioeconomic differences between the different oblasts, as well as differences between rural and urban locations. The inclusion of these seven dummy variables ensures that the estimated regression coefficients are controlled for regional differences.

All variables that are defined in monetary values, such as expenditures and assets, are converted into natural logarithms, since the dependent variable is also expressed in a natural logarithm.[15] All ordinal variables (e.g., type of roof, where a lower values indicates construction with inferior materials and a higher value indicates construction with superior materials) have been converted into dummy variables that reflect the different subtypes. For example, if the database has three types of roof (1=natural material; 2=metal; and 3=superior, such as tile), then

dummy variables for two of the three types of roof were formulated and tested in the statistical analysis for their potential of being a significant poverty indicator.

The nine different models were run in SAS using the MAXR technique that seeks to obtain a model with a high R-square (R^2). The R^2 is the ratio of the variance in the dependent variable that is explained by the model and its regressors, divided by the overall observed variance of the dependent variable. The coefficient ranges between 0 and 1. R^2 takes on the value of 1 when predicted values for the dependent variable for all households are the same as the observed values. A coefficient of 0.6 for R^2 implies that 60 percent of the observed variance in the dependent variable is explained by the model and its regressors.

A model with high explanatory power is a prerequisite for good predictions of the dependent variable per-capita daily expenditures (and thereby poverty status). The maximum R^2 improvement technique (MAXR) is a subcommand for regressions in SAS. The MAXR technique seeks to maximize explained variance (i.e., R^2), and considers all combinations among pairs of regressors to move from one step to the next.

In the first step, the MAXR method begins by finding the one-variable model producing the highest R^2. In the second step, another variable is added — the one that yields the greatest increase in R^2. Once the two-variable model is obtained, each of the variables in the model is compared to each of the variables *not* in the model. For each comparison of single pairs of variables, MAXR tests whether removing one variable and replacing it with the other one increases the R^2. After comparing all possible switches, MAXR determines the switch that produces the largest increase in R^2. Comparisons then begin again in the third step and so forth, and the process continues until MAXR finds that no switch can increase R^2. This limit may not be reached at 15 variables, but may require many more regressors. Thus, the MAXR technique allows us to identify the best model in each category — with only one regressor, or with only 5 (in this paper called the BEST5 model), 10 (BEST10 model), or 15 (BEST15 model) regressors.

2.5 Differences between the models

From the composite questionnaire, we computed 1141 poverty indicators and related variables~~ for their computation~~. Prior to using SAS software with the MAXR function, we eliminated almost half of the indicators: all of the original monetary variables that had been replaced by their natural logarithms, the original ordinal and nominal variables that had been converted into dummies, and all of the variables necessary for computation and comparison that do not serve as direct poverty indicators.

The remaining 598 poverty indicators were used as the basic regression file to analyze each variable for its potential as a regressor. Similar to the subsequent analysis of the nine models, the SAS MAXR routine (as explained in section 2.4) was used to select the best 250 potential regressors (in addition to the ten control variables) for Models 1 through 9. All of the dimensions of poverty (as well as all poverty indicators submitted from practitioner tools) from

the composite questionnaire sections were represented in the initial 598 indicators. These dimensions were also included in the final regression file of the best 250 indicators and hence in the generation of tools. Special care was given to the generation and testing of gender-specific poverty indicators. Annex C lists the gender-specific indicators (a subset of the 250 regressors) that were selected for the final regression analysis.

Next, we describe the differences between the models (see also Figure 2.5.1).

Model 1: This model includes all 260 regressors considered in the regression analysis using SAS software (this includes the ten control variables contained in every model). As discussed below, this model selects mainly regressors that are derived from indicators of expenditures or value of assets.

Model 2: In this model, we drop all expenditure-related variables except two: *weekly expenditures on food* and *other expenditures (social events, leisure) during the past 12 months* (see section C of the composite questionnaire). These variables were the two best expenditure categories among 16 tested using the MAXR technique.[16] Reducing the number of expenditure variables is a first step towards a more operational set of poverty indicators — self-reported expenditures by respondents, for any length of recall period, are impossible to verify directly. The variables *weekly expenditures on food* and other *expenditures (social events, leisure) during the past 12 months* are two of the easier expenditure items to recall.

In general, questions contained in section C, relating to expenditures (questions C1 to C12), are prone to high measurement error and require relatively intensive interviewer training. The interviewer needs to facilitate the interview by asking prompting questions on major elements of the different expenditure categories. For example, a particularly difficult expenditure category is home-produced food. This is category is difficult for interviewers who are unfamiliar with traditional or metric measures used for crop yields in agriculture and food subsistence production (see question C2). Furthermore, the interviewer needs to provide special assistance to respondents with no or low school education for even simple calculations (such as adding up expenses), especially since some elements of a certain expenditure category are recalled by the respondent on a monthly basis, and others are best remembered on a weekly basis (one bag of potatoes per month, but a basket of rice per week). While these questions did not pose any significant difficulties for SANGE's experienced interviewers, they may pose difficulties for less-experienced interviewers.

In total, Model 2 has 246 regressors that were retained from Model 1 (see Annex B).

Model 3: The set of regressors for this model is similar to that in Model 2. The only difference is the exclusion of the variable *total value of household assets* as a regressor. This variable is the natural logarithm of the total value of all assets possessed by the household. The total asset value is a powerful poverty indicator, and its exclusion allows other variables for single assets (or subgroups) to enter among the best regressors. Calculated from the value of all

assets (from section D and F of the composite questionnaire), this variable is considered a costly poverty indicator — and therefore less practical — since it would require asking many of the questions from section D and F.

Model 4: The set of regressors for this model is similar to that in Model 3. The only difference is the exclusion of the variables *weekly expenditures on food* and *other expenditures (social events, leisure) in the past 12 months*. As these were the most powerful poverty indicators among the expenditure group, their exclusion allows other poverty indicators to enter into the set of best regressors.

Model 5: This is similar to Model 4, but all *subjective* poverty indicators are excluded. Such indicators include all ordinal rankings done by the interviewer (such as those at the beginning of the interview in Section A, or the assessment of the structure of the house), as well as all ordinal rankings concerning the respondent's feelings or self-assessment (for example, the ladder questions in Section H). While these subjective indicators can be powerful poverty indicators, they can hardly be verified, at least not in a direct way. Thus, subjective indicators allow strategic answers by the respondent based on his or her perceptions of the interview and expectations of the use of the results. For example, if a respondent believes that making herself appear poorer than she actually is will increase her chance of being accepted into a program or recievng a loan, then she may strategically alter her responses to get what she wants.[17]

The subjective poverty indicators that were excluded in Model 5 (compared to Model 4) are presented in Annex B. Model 5 includes 189 variables.

Model 6: This model is similar to Model 5, but excludes all *monetary* variables from the remaining subset of regressors. With this approach, we now base the model solely on demographic characteristics and the number and type of assets possessed. There are 163 variables in this model.

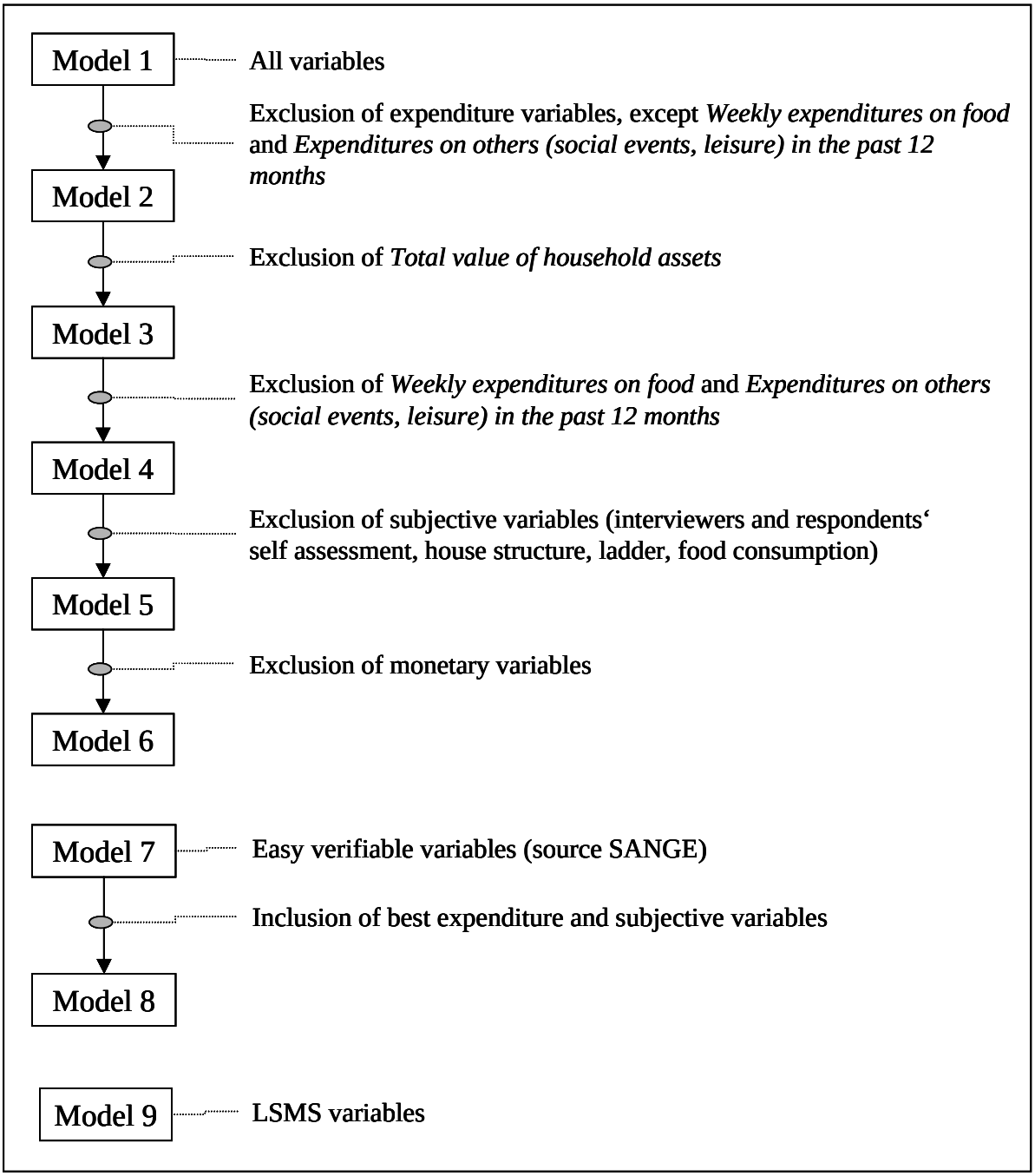
Model 7: Compared to Model 6, this model is more restrictive with respect to the verifiability criterion. It incorporates the 85 indicators rated as "easily verifiable" by SANGE (see Annex D).[18] Model 7 contains many poverty indicators that are used in the housing index, as well as variables on asset ownership and other observable indicators.

Model 8: Model 8 is similar to Model 7, but includes the two best expenditure variables, as well as five powerful subjective variables:

- Number of meals served to the household members in the past two days
- Days in past seven days with main meal based on cheese and/or sausages
- Kilograms of flour bought in a single purchase
- In the last 12 months, were you and your household members worried that your food would run out before you had money to buy more?

- Number of steps above step identified as respective national poverty line

Figure 2.5.1 . Schematic representation of the models' construction process.



Model 8 is an example of a combination of indicators — some were deemed easily verifiable by survey experts in Kazakhstan (including some that are directly observable), whereas other powerful subjective and objective indicators are not directly verifiable. This model may allow indirect verifiability of food (and other) expenditures and subjective indicators by internal comparison with readily verifiable indicators.

Model 9. This model incorporates variables that are usually available in World Bank LSMS surveys. It includes 141 regressors related to demographic, asset, expenditure, housing, and credit and financial asset information.

Annex B presents a description of the 260 regressors entered into the different models. For each model, the corresponding column (M*) indicates the specific regressors included in the model type. Figure 2.5.1 presents an overview of the nine regression models tested.

In summary, the models differ in the particular sets of poverty indicators submitted to regression analysis. The nine models differ in the number and type of regressors that are considered, and Models 1 to 7 represent increasingly simple tools that appear progressively less prone to the risk of strategic answers and verification problems. The result of the regression analysis (i.e., the identified set of 5, 10, or 15 best regressors) could potentially be used as a tool in nationally representative surveys in Kazakhstan for assessing whether a household is below or above the poverty line.

Chapter Three: Results from Regression Models

In this chapter, the results of the regressions are presented for the OLS regression models, by reporting

- The regressors that were among the BEST5, BEST10, and BEST15 models
- The adjusted R-square achieved (e.g., an R-square of 0.6 indicates that 60 percent of the observed variance in the dependent variable is explained by the regressors)

In order to assess the prediction power of each regression model (or tool) for poverty assessment, we used the following seven measures of accuracy performance (IRIS, 2005):

- **Total Accuracy —** the percentage of the total sample of 788 households whose poverty status is correctly predicted by the regression model.
- **Poverty Accuracy —** the accuracy among the very-poor, which refers to the households correctly predicted as very-poor, expressed as a percentage of the total very-poor.
- **Non-Poverty Accuracy —** the accuracy among the not very-poor, which refers to the households correctly predicted as not very-poor, expressed as percentage of the total number of not very-poor.
- **Undercoverage — t**he error of predicting very-poor households as being not very-poor, expressed as a percentage of the total number of very-poor.
- **Leakage —** the error of predicting not very-poor households as very-poor, expressed as a percentage of the total number of very-poor.
- **Poverty Incidence Error** (PIE) — the difference between the predicted and the actual (observed) poverty incidence, measured in percentage points.
- **Balanced Poverty Accuracy Criterion** (BPAC) — Poverty Accuracy minus the absolute difference between Undercoverage and Leakage, each expressed as a percentage of the total number of very-poor. When Undercoverage and Leakage are equal, the BPAC is equal to the Poverty Accuracy. BPAC is measured in percentage points. The application of the BPAC criteria is based on three assumptions about the valuation of errors concerning the predictions of the very-poor and the not very-poor (see IRIS, 2005).

In section 3.1 to 3.9, we present results from models using the OLS regression technique, using the different sets of regressors identified as Model 1 through 9. In section 3.10, we use three alternative regression techniques. For each of the regression models presented in Chapter 3, we provide the above performance measures for predicting the very-poor and not very-poor.

The Leakage and Undercoverage measures are often used in the literature to assess the poverty targeting performance of development and safety net policies, institutions, or projects. The PIE measure indicates the precision of a model (or poverty assessment tool) in correctly predicting the poverty incidence. Ideally, the value of PIE should be zero, implying that the predicted poverty rate equals the observed poverty rate. Positive PIE values indicate an underestimation of the poverty incidence, whereas negative values imply an overestimation of the poverty headcount index. PIE is useful if the objective of the poverty assessment is to measure the poverty outreach of an entire institution that provides microfinance or business development services. Hence, the evaluation question is: "What percentage of institution X's clients are very-poor?" Note that a satisfactory PIE value may be reached through a combination of a low Poverty Accuracy and a low Non-Poverty Accuracy. This is because errors in predicting the very-poor may cancel out with errors made in predicting the not very-poor, which will result in a satisfactory PIE value. Thus, a good PIE value (close to zero) may be achieved by a model that has a low Poverty Accuracy and a low Non-Poverty Accuracy and a high Leakage and Undercoverage. Hence, selecting a model on the basis of PIE entails the risk of choosing a model with a low Poverty Accuracy and high Undercoverage and Leakage. The balanced poverty assessment criterion BPAC considers these three accuracy measures, and models with a higher positive BPAC value indicate a higher Poverty Accuracy, adjusted by the absolute difference between Leakage and Undercoverage. There may exist trade-offs between PIE and BPAC in the selection of models. A perfect prediction model would have a value of zero for PIE and a value of 100 for BPAC. In such a perfect model, Leakage and Undercoverage would have a value of zero, and Total Accuracy, Poverty Accuracy, and Non-Poverty Accuracy a value of 100.

It is interesting to test the sensitivity of the tools' accuracy to a change in the definition of poverty. For this purpose, we computed the accuracy performance of models with respect to the national poverty line. Here, we distinguished two groups: (1) households with expenditures below the national poverty line (the national poor, abbreviated NP) and (2) households with expenditures above the national poverty line (the not-national poor, abbreviated as NNP). In total, we present twenty-seven regression models, derived from nine types of models each with a set of best five, ten and fifteen regressors. We calculate the accuracy levels both for the very-poor (VP) and the national poor (NP).

We note that the set of BEST regressors is statistically determined by SAS's MAXR technique, which searches for the best model fit. The term BEST regressors should not be misunderstood as certifying the Total Accuracy of a regression model or its superiority in any of the other measures of performance listed above. The set of BEST 5, BEST 10, or BEST 15 regressors simply refers to the *best model fit*, given the constraints on the set of available regressors and on the maximum number of regressors for inclusion (for example, five regressors in a BEST 5 model).

Model 1

Model 1 includes all 250 regressors available for the regression analysis, in addition to the ten control variables. Table 3.1.1 presents the number of households classified as very-poor and not very-poor by the bottom 50 percent poverty line, as well as the predicted poverty status of the households within both groups.

Table 3.1.1 Observed vs. Predicted poverty status for the BEST 5 regressors set.

Poverty status (as measured by benchmark questionnaire in survey)	**Predicted poverty status**		
	Not very-poor	**Very-poor**	**Total**
Not very-poor	777	3	780
Very-poor	32	5	37
Total	809	8	817

Observed poverty status:

- Percentage of very-poor = (37 / 817) * 100 = 4.53%
- Percentage of not very-poor = (780 / 817) * 100 = 95.47 %

Predicted poverty status:

- Percentage of predicted very-poor = (8 / 817) * 100 = 0.98%
- Percentage of predicted not very-poor = (809 / 817) * 100 = 99.02 %

Model performance:

- Total Accuracy = (777 + 5) / 817) * 100 = 95.71 %
- Poverty Accuracy for the very-poor (VP)= (5 / 37) * 100 = 13.51 %
- Non-Poverty Accuracy for the not very-poor (NVP) = (777 / 780) * 100 = 99.61 %
- Undercoverage = (33 / 37) * 100 = 86.48 %
- Leakage = (4 / 37) * 100 = 8.10 %
- Difference between predicted and observed poverty status (PIE) = -3.54 % points.
- Balanced Poverty Accuracy Criterion (BPAC) = 13.51 % - 78.38 % = -64.87 % points.

From Table 3.1.2, we observe that the highest performance in terms of Total Accuracy of Model 1 is actually achieved in the BEST5 set (95.71%). Monetary variables (either expenditures or asset values) account for approximately half of the indicators incorporated in each set.

Table 3.1.2 Summary of accuracy results for Model 1

Variables	Model performance (%, %pt)			
Best 5 indicators: R^2 adjusted = 0.567	**National Poor (NP)**		**Very-poor (VP)**	
• Squared age of household head • Number of steps above the step identified as respective nat. poverty line (if minus below) • Other expenditures (social events, leisure), last 12 months • Annualized total household expenditures • Total value of household assets	Total Accuracy: Poverty Accuracy (NP): Non-Poverty Accuracy (NNP): Undercoverage: Leakage: Pop. predicted as NP: PIE: BPAC:	91.79 24.32 98.52 75.67 14.86 3.54 -5.50 -14:87	Total Accuracy: Poverty Accuracy (VP): Non-Poverty Accuracy (NVP): Undercoverage: Leakage: Pop. predicted as VP: PIE: BPAC:	95.71 13.51 99.61 86.48 8.10 0.98 -3.54 -64:87
Best 10 indicators: R^2 adjusted = 0.594				
Next best five indicators: • Autorickshaw ownership • Household often didn't have enough food to eat • Percentage of dependents younger than 18 and older than 60 years (in relation to household size) • Household belongs to traders association • Expenditures in school/education, last 12 months • Expenditures on health, last 12 months Removed indicators: • Squared age of household head	Total Accuracy: Poverty Accuracy (NP): Non-Poverty Accuracy (NNP): Undercoverage: Leakage: Pop. predicted as NP: PIE: BPAC:	92.28 32.43 98.25 67.56 17.56 4.52 -4.53 -17.57	Total Accuracy: Poverty Accuracy (VP): Non-Poverty Accuracy (NVP): Undercoverage: Leakage: Pop. predicted as VP: PIE: BPAC:	95.22 10.81 99.23 89.18 16.21 1.22 -3.30 -62.16
Best 15 indicators: R^2 adjusted =0.619				
Next best five indicators: • Head of household sleeps on floor or thin sleeping mat • Share of food expenditures from total household expenditures • Annualized food expenditures, recall 1	Total Accuracy: Poverty Accuracy (NP): Non-Poverty Accuracy (NNP):	92.41 33.78 98.25	Total Accuracy: Poverty Accuracy (VP): Non-Poverty Accuracy (NVP):	95.47 10.81 99.48

week • Value of color TVs • Number of horses owned • Household has piped water in house • Household head is salaried-production worker Removed indicators: • Annualized total household expenditures • Expenditures on health, last 12 months	Undercoverage: Leakage: Pop. predicted as NP: PIE: BPAC:	66.21 17.56 4.65 -4.40 -14.87	Undercoverage: Leakage: Pop. predicted as VP: PIE: BPAC:	89.18 10.81 0.97 -3.55 -67.56

Performance in predicting the very-poor (VP — the bottom 50 percent cutoff below the national poverty line) is problematic for Model 1. While it achieves a high Total Accuracy of about 95 percent, depending on the number of regressors, and even higher accuracy in predicting the not very-poor, these achievements are offset by a very low Poverty Accuracy for the very-poor, resulting in high Undercoverage levels. This pattern of results occurs in all three versions of the model (i.e., with five, ten, or fifteen regressors). Model 1 underestimates the headcount index of the very-poor by about 3.5 percentage points — a significant error considering that the observed headcount index is only 4.57 percent.

Other models (discussed below) achieve somewhat better Total Accuracy results than Model 1. At first, this result is surprising, as Model 1 allows the selection of all possible indicators from the composite questionnaire and is therefore expected to present the most powerful set of regressors. If we remember, however, that the term "powerful" here refers to the highest R^2 and not necessarily to the highest Total Accuracy, the results are consistent. Model 1 has the highest R^2 of all models. However, note that all OLS models performed relatively poorly in correctly predicting the very-poor. This is mainly because of the low very-poor headcount index in the sample, as well as the low national-poor headcount index. Because the OLS model is not suited for delivering accurate predictions at the lower range of the expenditure distribution scale, the accuracy of the predictions among the very-poor is low. Significant improvements in Total Accuracy can only be achieved by using two-step models, as shown in Chapter 4.

With respect to the national poverty line, Model 1 presents the best Total Accuracy results of all the tools presented in this chapter. In addition, the BEST15 set achieved the highest level of Poverty Accuracy for the national poor and the lowest Undercoverage figures. As we see later, Models 6 and 9 registered the highest Non-Poverty Accuracy for the non-national poor, with 99.32 percent on the corresponding BEST15 sets, and consequently the lowest Leakage levels, at 6.75 percent.

Irrespective of the poverty line considered, this model presented the lowest (best) PIE.

In general, some of the selected indicators of Model 1 may not be optimal in terms of difficulty of obtaining information and verifying the indicators. For example, the indicators *total value of household assets, share of food expenditures from total household expenditures*, or o*ther expenditures in last 12 months* would require intensive and detailed questioning about the household's assets (and their valuation) and about their expenditure level in the last 12 months. In addition, this type of information is difficult to verify.

3.2 Model 2

Model 2 excludes all expenditure or expenditure-derived variables (section C of the composite questionnaire), with the exception of *weekly expenditures on food* and other *expenditures (social events, leisure) in the past 12 months*.

The highest R^2 and accuracy levels as well as the lowest Undercoverage and Leakage measures were achieved by the BEST15 regressor set. This holds for the very-poor and the national poor. For the predictions about the national poor, the accuracy performance figures improve from the BEST5 to the BEST15 set.

Using the definition for very-poor, Model 2 performed better than Model 1. This model registered the highest level of Poverty Accuracy (on averate, 15.31 percent for the VP) and the lowest Undercoverage figures (84.68 percent, on average) among all models. Total Accuracy was 95.83 percent for the BEST15 set, and Non-Poverty Accuracy (NVP) reached levels above 99.61 percent. On average, the predicted poverty headcount was 1.01 percent.

Compared to Model 1 — and now considering the national poverty line — Model 2 demonstrates a lower Total Accuracy in each of the three sets and a slightly higher Non-Poverty Accuracy (NNP) in the BEST10 and BEST15 sets. The Poverty Accuracy (NP) decreased by 6.76 percent from the level achieved by the BEST15 set in Model 1, causing a similar incremental increase for the Undercoverage measure. On average, the predicted poverty headcount was 3.66 percent which yields a PIE measure of -5.5 percentage points. Like Model 1, the poverty headcount index of the NP (as well as the VP) is underestimated by about three to five percentage points.

In terms of poverty dimensions, this model incorporates variables related to the household's housing and demographic characteristics, while reducing the number of expenditure indicators, which results in a more multidimensional set of indicators than in Model 1.

Table 3.2.1 Summary of the accuracy results for Model 2

Variables	Model performance (%, %pt)			
Best 5 indicators: R^2 adjusted = 0.558	**National Poor**		**Very-poor**	
• Squared age of household head • Number of steps above the step identified as respective nat. poverty line (if minus below) • Weekly expenditures on food • Other expenditures (social events, leisure), last 12 months • Total value of household assets	Total Accuracy: Poverty Accuracy (NP): Non-Poverty Accuracy (NNP): Undercoverage: Leakage: Pop. predicted as NP: PIE: BPAC:	90.94 21.62 97.84 78.37 21.62 3.91 -5.14 -35.13	Total Accuracy: Poverty Accuracy (VP): Non-Poverty Accuracy (NVP): Undercoverage: Leakage: Pop. predicted as VP: PIE: BPAC:	95.83 16.21 99.61 83.78 8.10 1.10 -3.42 -59.47
Best 10 indicators: R^2 adjusted = 0.583				
Next best five indicators: • Autorickshaw ownership • Percentage of dependents younger than 14 and older 60 years (in relation to household size) • Metal frame with padlock as lock in main entrance door • Exterior walls material is wireframed reed or clay • Household belongs to traders association • Number of sheep and goats owned Removed indicators: • Squared age of household head	Total Accuracy: Poverty Accuracy (NP): Non-Poverty Accuracy (NNP): Undercoverage: Leakage: Pop. predicted as NP: PIE: BPAC:	91.79 24.32 98.52 75.67 14.86 3.54 -5.51 -36.49	Total Accuracy: Poverty Accuracy (VP): Non-Poverty Accuracy (NVP): Undercoverage: Leakage: Pop. predicted as VP: PIE: BPAC:	95.83 13.51 99.74 86.48 5.40 0.85 -3.67 -67.57
Best 15 indicators: R^2 adjusted =0.601				
Next best five indicators: • Squared age of household head • Days in the last seven days with main meal based on butter • Number of adult household members who read/write	Total Accuracy: Poverty Accuracy (NP): Non-Poverty Accuracy (NNP):	92.28 27.02 98.78	Total Accuracy: Poverty Accuracy (VP): Non-Poverty Accuracy (NVP):	95.83 16.21 99.61

• Number of milk cows owned • Household has piped water in house • Household head is salaried-production worker Removed indicators: • Percentage of dependents younger than 14 and older 60 years (in relation to household size)	Undercoverage: Leakage: Pop. predicted as NP: PIE: BPAC:	72.97 12.16 3.54 -5.51 -33.79	Undercoverage: Leakage: Pop. predicted as VP: PIE: BPAC:	83.78 8.10 1.10 -3.42 -59.47

3.3 Model 3

Model 3 is based on Model 2, but excludes the variable *value of total household assets*.

With regard to predicting the percentage of very-poor, all accuracy measures slightly decrease in performance from the BEST5 to the BEST15 set. The best performance was achieved by the BEST5 set, with 95.47 percent Total Accuracy. However, Model 3 only achieves Poverty Accuracy (VP) of 8.10 percent. Total Accuracy dropped by 0.49 percentage points for the BEST15 set. On the other hand, the BEST15 set showed some marginal improvement in the poverty incidence criterion (PIE). Here, the predicted poverty headcount was 0.97 percent. This, combined with the observed headcount index for the VP of 4.57 percent, resulted in an overall underestimation of the headcount index for the VP by 3.55 percentage points (the PIE was 3.55 percentage points).

When considering the predictions for the percentage of the national poor (NP), most performance indicators improve from the BEST5 to the BEST15 set, especially regarding Poverty Accuracy (NP). In contrast, Non-Poverty Accuracy (NNP) decreased by 0.68 percentage points, while Leakage increased by 6.76 percentage points. The highest Total Accuracy was obtained by the BEST10 set (91.43%), while the highest Poverty Accuracy (NP) was achieved by the BEST15 set (24.32%).

Compared to Models 1 and 2, Model 3 presents similar figures on Total Accuracy, Non-Poverty Accuracy (NNP), and Leakage. With regard to Poverty Accuracy (NP), Model 3 presents slightly lower figures. In contrast, at the VP cutoff, Poverty Accuracy (VP) declined by more than half, and Undercoverage increased more than 10 percentage points.

Asset and expenditure variables together still represent half of the BEST10 indicator set. Their relative importance drops to one third in the BEST15 option, which also includes indicators related to food security and subjective poverty assessment that appear somewhat more difficult to verify.

Table 3.3.1 Summary of the accuracy results Model 3

Variables	Model performance (%, %pt)			
Best 5 indicators: R^2 adjusted = 0.509	**National Poor**		**Very-poor**	
• Autorickshaw ownership • Number of steps above the step identified as respective nat. poverty line (if minus below) • Weekly expenditures on food • Other expenditures (social events, leisure), last 12 months • Rickshaw ownership	Total Accuracy: Poverty Accuracy (NP): Non-Poverty Accuracy (NNP): Undercoverage: Leakage: Pop. predicted as NP: PIE: BPAC:	90.82 13.51 98.52 86.48 14.86 2.57 -6.48 -58.11	Total Accuracy: Poverty Accuracy (VP): Non-Poverty Accuracy (NVP): Undercoverage: Leakage: Pop. predicted as VP: PIE: BPAC:	95.47 8.10 99.61 91.89 8.10 0.73 -3.79 -75.69
Best 10 indicators: R^2 adjusted = 0.563				
Next best five indicators: • Squared age of household head • Household often didn't have enough food • Maximum education level of any household member • Number of horses owned • Household has piped water in house	Total Accuracy: Poverty Accuracy (NP): Non-Poverty Accuracy (NNP): Undercoverage: Leakage: Pop. predicted as NP: PIE: BPAC:	91.43 22.97 98.25 77.02 17.56 3.67 -5.38 -36.49	Total Accuracy: Poverty Accuracy (VP): Non-Poverty Accuracy (NVP): Undercoverage: Leakage: Pop. predicted as VP: PIE: BPAC:	95.10 5.40 99.35 94.59 13.51 0.85 -3.67 -75.68
Best 15 indicators: R^2 adjusted =0.591				
Next best five indicators: • Household has mobile (cell phone) • Number of meals served to the household members during the last 2 days • Kilograms of flour usually bought in a single purchase • Household belongs to traders association • Value of dishes	Total Accuracy: Poverty Accuracy (NP): Non-Poverty Accuracy (NNP): Undercoverage: Leakage: Pop. predicted as NP: PIE: BPAC:	91.18 24.32 97.84 75.67 21.62 4.16 -4.89 -29.73	Total Accuracy: Poverty Accuracy (VP): Non-Poverty Accuracy (NVP): Undercoverage: Leakage: Pop. predicted as VP: PIE: BPAC:	94.98 5.40 99.23 94.59 16.21 0.97 -3.55 -72.98

3.4 Model 4

Model 4 is similar to Model 3, but excludes the variables *weekly expenditures on food* and *other expenditures (social events, leisure) in the past 12 months*. Adjusted R^2 levels are again lower than for the previous model, with a high value of 0.556 (in the BEST15 set).

At the VP cutoff, this model's BEST5 set has the highest Total Accuracy, highest Non-Poverty Accuracy (NVP), and lowest Leakage. However, Poverty Accuracy (VP) is highest in the BEST10 set — the predicted poverty headcount was 0.73 percent on average, and 1.10 at the highest, for the BEST10 set.

At the NP cutoff, Total Accuracy and Non-Poverty Accuracy (NNP) were similar to levels in the previous models. The BEST15 set achieved the highest Total Accuracy (91.67%) and the highest Poverty Accuracy for the NP (25.67%), as well as the lowest Undercoverage figures. Within this cutoff, Non-Poverty Accuracy (NNP) and Leakage declined from the BEST5 to the BEST15 sets. The predicted poverty headcount was 2.89 percent on average and 3.91 percent at the highest (in the BEST15 set).

With respect to the indicators selected for the model, asset variables continue to play a predominant role (accounting for half of the variables included in each set), followed by food security variables. Demographic and educational attainment variables play a minor role in all models up to this stage. This model still includes some subjective and not easily verifiable indicators.

Table 3.4.1 Summary of the accuracy results Model 4

Variables	Model performance (%, %pt)			
Best 5 indicators: R^2 adjusted = 0.463	**National Poor**		**Very-poor**	
• Autorickshaw ownership • Maximum education level of any household member • Number of steps above the step identified as respective nat. poverty line (if minus below) • Value of dishes • Rickshaw ownership	Total Accuracy: Poverty Accuracy (NP): Non-Poverty Accuracy (NNP): Undercoverage: Leakage: Pop. predicted as NP: PIE: BPAC:	90.69 8.10 98.92 91.89 10.81 1.71 -7.34 -72.98	Total Accuracy: Poverty Accuracy (VP): Non-Poverty Accuracy (NVP): Undercoverage: Leakage: Pop. predicted as VP: PIE: BPAC:	95.34 2.70 99.74 97.29 5.40 0.36 -4.16 -89.19
Best 10 indicators: R^2 adjusted = 0.525				
Next best five indicators: • Household has mobile (cell phone) • Household often didn't have enough food • Number of meals served to the household members during the last 2 days • Household belongs to traders association • Number of horses owned	Total Accuracy: Poverty Accuracy (NP): Non-Poverty Accuracy (NNP): Undercoverage: Leakage: Pop. predicted as NP: PIE: BPAC:	91.06 17.56 98.38 82.43 16.21 3.06 -5.99 -48.66	Total Accuracy: Poverty Accuracy (VP): Non-Poverty Accuracy (NVP): Undercoverage: Leakage: Pop. predicted as VP: PIE: BPAC:	95.10 8.10 99.23 91.89 16.21 1.10 -3.42 -67.58
Best 15 indicators: R^2 adjusted =0.556				
Next best five indicators: • Squared age of household head • Head of household sleeps on floor or thin sleeping mat • Days in the last seven days with the main meal based on cheese and/or sausages • Kilograms of flour usually bought in a single purchase • Musical instrument ownership	Total Accuracy: Poverty Accuracy (NP): Non-Poverty Accuracy (NNP): Undercoverage: Leakage: Pop. predicted as NP: PIE: BPAC:	91.67 25.67 98.25 74.32 17.56 3.91 -5.14 -31.09	Total Accuracy: Poverty Accuracy (VP): Non-Poverty Accuracy (NVP): Undercoverage: Leakage: Pop. predicted as VP: PIE: BPAC:	95.22 5.40 99.48 94.59 10.81 0.73 -3.79 -78.38

3.5 Model 5

Model 5 is based on Model 4, but excludes all subjective variables, thus leaving out some important dimensions. Excluded variables are: subjective self-assessment of the adequacy of food consumption (i.e. Food Security Scale variables from Freedom from Hunger), vulnerability, the respondents' own poverty assessment, and the interviewers' assessment of poverty and of the condition of the house.

This model shows a more pronounced decrease in the adjusted R^2 and a slight drop in Total Accuracy levels.

At the VP cutoff, Total Accuracy increased slightly in comparison to Model 4, in spite of lower adjusted R^2 levels. A striking result is the abysmal level of Poverty Accuracy (VP) registered by this model, which was 0 pecent in all sets. Non-Poverty Accuracy (NVP) was 100 percent in the BEST5 and BEST 10 sets and 99.87 percent in the BEST 15 set. Undercoverage for all cases was 100 percent. This result makes clear the inadequacy of Model 5 to identify the poor at the lowest poverty line. Not surprisingly, the predicted poverty headcount, on average, was 0.04 percent.

At the NP cutoff, the best performance, with 91.18 percent accuracy, was achieved by the BEST15 set. Poverty Accuracy for the NP (10.81%) is sharply lower than the level achieved by the BEST15 set in Model 4 (25.67%). Non-Poverty Accuracy (NNP) showed levels above 99 percent, with a maximum of 99.59 percent achieved in the BEST5 set. Undercoverage considerably improved from the BEST5 to the BEST15 model, while Leakage worsened. The headcount index of NP is severely underestimated by all models. The predicted poverty headcount was 1.09 percent on average.

The exclusion of subjective variables allowed housing and education-related variables to enter into the best combinations for the first time. However, the best sets are still mainly composed of asset variables.

Table 3.5.1 Summary of the accuracy results Model 5

Variables	Model performance (%, %pt)			
Best 5 indicators: R^2 adjusted = 0.404	**National Poor**		**Very-poor**	
• Autorickshaw ownership • Household has mobile (cell phone) • Maximum education level of any household member • Value of dishes • Rickshaw ownership	Total Accuracy: Poverty Accuracy (NP): Non-Poverty Accuracy (NNP): Undercoverage: Leakage: Pop. predicted as NP: PIE: BPAC:	90.82 2.70 99.59 97.29 4.05 0.61 -8.44 -90.54	Total Accuracy: Poverty Accuracy (VP): Non-Poverty Accuracy (NVP): Undercoverage: Leakage: Pop. predicted as VP: PIE: BPAC:	95.47 0 100 100 0 0 -4.52 -100
Best 10 indicators: R^2 adjusted = 0.468				
Next best five indicators: • House structure: dilapidated • Household belongs to traders association • Value of washing machines • Head is salaried worker – employee • Number of horses owned	Total Accuracy: Poverty Accuracy (NP): Non-Poverty Accuracy (NNP): Undercoverage: Leakage: Pop. predicted as NP: PIE: BPAC:	90.94 5.40 99.46 94.59 5.40 0.97 -8.08 -83.79	Total Accuracy: Poverty Accuracy (VP): Non-Poverty Accuracy (NVP): Undercoverage: Leakage: Pop. predicted as VP: PIE: BPAC:	95.47 0 100 100 0 0 -4.52 -100
Best 15 indicators: R^2 adjusted =0.497				
Next best five indicators: • Household's water source is dam/pond/river/spring • Number of adult household members who can read and write • Number of carpets owned • Number of sheep and goats owned • Household has piped water in house	Total Accuracy: Poverty Accuracy (NP): Non-Poverty Accuracy (NNP): Undercoverage: Leakage: Pop. predicted as NP: PIE: BPAC:	91.18 10.81 99.19 89.18 8.10 1.71 -7.34 -70.27	Total Accuracy: Poverty Accuracy (VP): Non-Poverty Accuracy (NVP): Undercoverage: Leakage: Pop. predicted as VP: PIE: BPAC:	95.34 0 99.87 100 2.70 0.12 -4.40 -97.3

3.6 Model 6

This model excludes all monetary variables. The adjusted R^2 dropped further, achieving the lowest levels of all models (range: 0.389 to 0.486).

In general, Model 6 performed similarly to Model 5 at both cutoffs, for all performance measures.

At the VP cutoff, we found results similar to Model 5. Therefore, like Model 5, Model 6 should not be used to identify the poor at the lower poverty line.

At the NP cutoff, the highest Total Accuracy (91.67%) was achieved by the BEST15 set, 0.49 percent higher than in Model 5. All measures performed better than the BEST15 set from Model 5. The predicted poverty headcount was 1.34 percent on average.

As in the previous models, most of the variables incorporated into the best sets refer to assets and housing variables.

Table 3.6.1 Summary of the accuracy results Model 6

Variables	Model performance (%, %pt)			
Best 5 indicators: R^2 adjusted = 0.389	**National Poor**		**Very-poor**	
• Autorickshaw ownership • Household has mobile (cell phone) • Ownership of dishes • Maximum education level of any household member • Rickshaw ownership	Total Accuracy: Poverty Accuracy (NP): Non-Poverty Accuracy (NNP): Undercoverage: Leakage: Pop. predicted as NP: PIE: BPAC:	90.82 2.70 99.59 97.29 4.05 0.61 -8.44 -90.54	Total Accuracy: Poverty Accuracy (VP): Non-Poverty Accuracy (NVP): Undercoverage: Leakage: Pop. predicted as VP: PIE: BPAC:	95.47 0 100 100 0 0 -4.52 -100
Best 10 indicators: R^2 adjusted = 0.454				
Next best five indicators: • Recent home improvements done in the last three years (yes/no) • Exterior wall material is wireframed reed or clay • Number of sheep and goats owned • Refrigerator ownership • Head is salaried worker - employee	Total Accuracy: Poverty Accuracy (NP): Non-Poverty Accuracy (NNP): Undercoverage: Leakage: Pop. predicted as NP: PIE: BPAC:	90.69 5.40 99.19 94.59 8.10 1.22 -7.83 -81.09	Total Accuracy: Poverty Accuracy (VP): Non-Poverty Accuracy (NVP): Undercoverage: Leakage: Pop. predicted as VP: PIE: BPAC:	95.47 0 100 100 0 0 -4.52 -100
Best 15 indicators: R^2 adjusted =0.486				
Next best five indicators: • Head of household sleeps on floor or thin sleeping mat • Household belongs to traders association • Number of adult household members who can read and write • Number of carpets owned • Number of milk cows owned	Total Accuracy: Poverty Accuracy (NP): Non-Poverty Accuracy (NNP): Undercoverage: Leakage: Pop. predicted as NP: PIE: BPAC:	91.67 16.21 99.19 83.78 8.10 2.20 -6.85 -59.47	Total Accuracy: Poverty Accuracy (VP): Non-Poverty Accuracy (NVP): Undercoverage: Leakage: Pop. predicted as VP: PIE: BPAC:	95.34 0 99.87 100 2.70 0.12 -4.40 -97.3

3.7 Model 7

This model incorporates 75 poverty indicators that have been rated by SANGE as easily verifiable (score 4 or 5), based on their experience in conducting field research and surveys in Kazakhstan. (Annex G provides the ratings for all 250 regressors.)

In terms of adjusted R^2, Model 7 performed better than Model 6, achieving a level between Models 4 and 5.

At the VP cutoff, Model 7 performed better than the two previous models. The best performance (95.83%) was achieved by the BEST15 set, with 10.81 percent Poverty Accuracy (VP). Non-Poverty Accuracy (NVP) was 99.87 percent — the highest level achieved for this measure among all models. The predicted poverty headcount was 0.44 percent on average.

Compared to the NP cutoff in Model 6, Total Accuracy increased slightly in the BEST5 and BEST10 and decreased in the BEST15 set. The BEST10 sets presented the best performance, with an Total Accuracy of 91.43 percent. Poverty Accuracy (NP) and Non-Poverty Accuracy (NNP) were 14.86 and 99.05 percent, respectively. The average predicted poverty headcount was 2.44 percent.

The indicators incorporated in the best sets are more multidimensional than the selected indicators from previous models. Asset variables continue to play an important role, but other variables — housing, expenditures, demography, and position on the ladder — appeared with more frequency.

This model represents a more practical and operational approach than the previous models (in terms of indicator verifiability). However, its accuracy in identifying the very-poor is lower than for Models 1 to 4, undermining its usefulness.

Table 3.7.1 Summary of the accuracy results Model 7

Variables	Model performance (%, %pt)			
Best 5 indicators: R^2 adjusted = 0.472	**National Poor**		**Very-poor**	
• Household has mobile (cell phone) • Horse ownership • Annualized total household expenditures • Refrigerator ownership • Remittances sent / total household expenditures	Total Accuracy: Poverty Accuracy (NP): Non-Poverty Accuracy (NNP): Undercoverage: Leakage: Pop. predicted as NP: PIE: BPAC:	91.06 12.16 98.92 87.83 10.81 2.08 -6.97 -64.86	Total Accuracy: Poverty Accuracy (VP): Non-Poverty Accuracy (NVP): Undercoverage: Leakage: Pop. predicted as VP: PIE: BPAC:	95.34 2.70 99.74 97.29 5.40 0.36 -4.16 -89.19
Best 10 indicators: R^2 adjusted = 0.509				
Next best five indicators: • Percentage of dependents younger than 18 and older than 60 years (in relation to household size) • Floor material is linoleum, dutch tile or parquet • Expenditures on home, in last 12 months • Musical instrument ownership • Rickshaw ownership	Total Accuracy: Poverty Accuracy (NP): Non-Poverty Accuracy (NNP): Undercoverage: Leakage: Pop. predicted as NP: PIE: BPAC:	91.43 14.86 99.05 85.13 9.45 2.20 -6.85 -60.82	Total Accuracy: Poverty Accuracy (VP): Non-Poverty Accuracy (NVP): Undercoverage: Leakage: Pop. predicted as VP: PIE: BPAC:	95.34 2.70 99.74 97.29 5.40 0.36 -4.16 -89.19
Best 15 indicators: R^2 adjusted =0.533				
Next best five indicators: • Exterior wall material is wireframed reed or clay • Household's water source is dam/ pond /river /spring • Position on the ladder of a household with an income of 15000 tenge/month • Change in living standards in last 8 years • Value of color TV's	Total Accuracy: Poverty Accuracy (NP): Non-Poverty Accuracy (NNP): Undercoverage: Leakage: Pop. predicted as NP: PIE: BPAC:	91.18 14.86 98.78 85.13 12.16 2.44 -6.61 -58.11	Total Accuracy: Poverty Accuracy (VP): Non-Poverty Accuracy (NVP): Undercoverage: Leakage: Pop. predicted as VP: PIE: BPAC:	95.83 10.81 99.87 89.18 2.70 0.61 -3.91 -75.67

3.8 Model 8

Model 8 is similar to Model 7, with the addition of the best expenditure variables plus five powerful subjective variables:[19]

- Number of meals served to household members in the past two days
- Days in past seven days with main meal based on cheese and/or sausages
- Kilograms of flour bought in a single purchase
- In last 12 months, were you and your household members worried that your food would run out before you had money to buy more?
- Number of steps above step identified as respective national poverty line

Compared to Model 7, the incorporation of these variables decreased the model's performance slightly for the BEST5 and BEST10 sets, but registered an improvement in the BEST15 set. In terms of adjusted R^2, this model showed improved performance, reaching values similar to those for Model 3.

At the VP cutoff, the BEST15 set registered the highest Total Accuracy figures, but slightly lower than the BEST15 set from Model 7. The predicted poverty headcount was 0.6 percent on average.

At the NP cutoff, the BEST15 set had the best performance, with 17.56 percent Poverty Accuracy (NP) and 91.43 percent Total Accuracy. Non-Poverty Accuracy (NNP) was 98.78 percent, while Leakage and Undercoverage were 12.16 and 82.43 percent, respectively. On average, the predicted poverty headcount was 2.52 percent.

Out of the seven variables added to the model, five were selected into the best combinations. This reflects the importance of incorporating subjective variables, especially those related to food security, to maximize accuracy performance for poverty assessment in Kazakhstan. However, actual accuracy may in fact be lower with subjective variables, as they tend to be more difficult to ask and are especially difficult to verify (see Annex D).

This set of variables still includes many asset variables, but their relative importance in comparison to other variables is diminished, so that variables on demographic characteristics and household expenditures now enter into the best sets.

Table 3.8.1 Summary of the accuracy results Model 8

Variables	Model performance (%, %pt)			
Best 5 indicators: R^2 adjusted = 0.526	**National Poor**		**Very-poor**	
• Other expenditures (social events, leisure), last 12 months • Number of steps above the step identified as respective nat. poverty line (if minus below) • Squared age of household head • Annualized total household expenditures • Rickshaw ownership	Total Accuracy: Poverty Accuracy (NP): Non-Poverty Accuracy (NNP): Undercoverage: Leakage: Pop. predicted as NP: PIE: BPAC:	90.69 14.86 98.25 85.13 17.56 2.93 -6.12 -52.71	Total Accuracy: Poverty Accuracy (VP): Non-Poverty Accuracy (NVP): Undercoverage: Leakage: Pop. predicted as VP: PIE: BPAC:	95.34 5.40 99.61 94.59 8.10 0.61 -3.91 -81.09
Best 10 indicators: R^2 adjusted = 0.561				
Next best five indicators: • Number of meals served to the household members during the last 2 days • Days in the last seven days with the main meal based on cheese and/or sausages • Household has mobile (cell phone) • Exterior walls material is wireframed reed or clay • Horse ownership	Total Accuracy: Poverty Accuracy (NP): Non-Poverty Accuracy (NNP): Undercoverage: Leakage: Pop. predicted as NP: PIE: BPAC:	90.82 13.51 98.52 86.48 14.86 2.57 -6.48 -58.11	Total Accuracy: Poverty Accuracy (VP): Non-Poverty Accuracy (NVP): Undercoverage: Leakage: Pop. predicted as VP: PIE: BPAC:	95.47 5.40 99.74 94.59 5.40 0.48 -4.04 -83.79
Best 15 indicators: R^2 adjusted =0.578				
Next best five indicators: • Kilograms of flour usually bought in a single purchase • Percentage of dependents younger than 18 and older than 60 years (in relation to household size) • Musical instrument ownership • Refrigerator ownership • Remittances sent / total household expenditures	Total Accuracy: Poverty Accuracy (NP): Non-Poverty Accuracy (NNP): Undercoverage: Leakage: Pop. predicted as NP: PIE: BPAC:	91.43 17.56 98.78 82.43 12.16 2.69 -6.36 -52.71	Total Accuracy: Poverty Accuracy (VP): Non-Poverty Accuracy (NVP): Undercoverage: Leakage: Pop. predicted as VP: PIE: BPAC:	95.71 10.81 99.74 89.18 5.40 0.73 -3.79 -72.97

3.9 Model 9

Model 9 uses a set of 141 regressors that are typically included in the World Bank LSMS surveys. Model 9 shows similar adjusted R^2 levels as Model 8.

At the VP cutoff, the highest Total Accuracy was achieved by the BEST15 set. The BEST5 and Best10 sets yielded similar levels of Poverty Accuracy (VP). The BEST5 version yielded a slightly higher predicted headcount index. The BEST 15 set showed 100 percent Non-Poverty Accuracy (NVP). Interestingly, the three sets achieved the same level of Poverty Accuracy (VP, 13.51%) On average, the predicted poverty headcount was 0.73 percent — far below the level of the observed headcount index in the sample.

At the NP cutoff, the BEST15 sets demonstrated the highest accuracy, reaching 21.62 percent Poverty Accuracy (NP) and 99.06 percent Non-Poverty Accuracy (NNP). The predicted poverty headcount was 2.61 percent on average.

In terms of the variables that made up the best sets, asset-related variables regained their importance and constituted almost half of the variables included in the three sets, followed by expenditure, housing, and demographic variables.

In terms of verifiability of the indicators, Model 9 contains complicated indicators, such as the total value of household assets.

Table 3.9.1 Summary of the accuracy results Model 9

Variables	Model performance (%, %pt)			
Best 5 indicators: R^2 adjusted = 0.513	**National Poor**		**Very-poor**	
• Household has mobile (cell phone) • Remittances sent to relatives in last 12 months • Sum of household clothing expenditures in past 12 months • Total value of household assets • Household has piped water in house	Total Accuracy: Poverty Accuracy (NP): Non-Poverty Accuracy (NNP): Undercoverage: Leakage: Pop. predicted as NP: PIE: BPAC:	91.31 16.21 98.79 83.78 12.16 2.57 -6.48 -55.41	Total Accuracy: Poverty Accuracy (VP): Non-Poverty Accuracy (NVP): Undercoverage: Leakage: Pop. predicted as VP: PIE: BPAC:	95.83 13.51 99.74 86.49 5.41 0.86 -3.67 -67.57
Best 10 indicators: R^2 adjusted = 0.535				
Next best five indicators: • Squared age of household head • Exterior wall material is wireframed reed or clay • Musical instrument ownership • Number of milk cows owned by the household • Number of sheep and goats owned by the household	Total Accuracy: Poverty Accuracy (NP): Non-Poverty Accuracy (NNP): Undercoverage: Leakage: Pop. predicted as NP: PIE: BPAC:	91.67 17.57 99.06 82.43 9.46 2.45 -6.61 -55.41	Total Accuracy: Poverty Accuracy (VP): Non-Poverty Accuracy (NVP): Undercoverage: Leakage: Pop. predicted as VP: PIE: BPAC:	95.96 13.51 99.87 86.49 2.7 0.73 -3.79 -70.27
Best 15 indicators: R^2 adjusted =0.550				
Next best five indicators: • Household head is craftsman • Toilet: shared or own latrine • Household head is salaried worker-employee • Number of household members with incomplete primary education • Number of household members with incomplete secondary education	Total Accuracy: Poverty Accuracy (NP): Non-Poverty Accuracy (NNP): Undercoverage: Leakage: Pop. predicted as NP: PIE: BPAC:	92.04 21.62 99.06 78.38 9.46 2.82 -6.24 -47.30	Total Accuracy: Poverty Accuracy (VP): Non-Poverty Accuracy (NVP): Undercoverage: Leakage: Pop. predicted as VP: PIE: BPAC:	96.08 13.51 100 86.49 0 0.61 -3.92 -72.97

3.10 Results from other single-step regression techniques: Quantile, Probit, and Linear Probability Model

In contrast to the two-step models presented in the next chapter, which consist of two regression runs, in this chapter we present single-step regressions.

The previous nine sections have presented models that were estimated in a single regression run (i.e., with a single step) using the OLS regression technique with the continuous dependent variable logarithm of daily per-capita expenditures. Annex E.1 summarizes their results, whereas Annex F.1 shows the BEST15 regressors for each of the nine models.

Alternative single-step regression techniques include Probit, Quantile, and the Linear Probability Model (LPM). The LPM and the Probit techniques use a dummy as a dependent variable, which is coded one if the household is very-poor and zero otherwise. The LPM model is also estimated with OLS using the SAS package, and the selection of BEST15 regressors is done using the MAXR procedure.

With the Probit and the Quantile regressions, it is not feasible to use the MAXR procedure to select the set of BEST15 regressors. In order to test the accuracy performance of the Quantile regression model (which uses the log of daily per-capita expenditures as the dependent variable), the BEST15 regressors set (as it was determined by the OLS-MAXR regression) is used. The Quantile regression models are estimated with the STATA package, whereas the Probit model is estimated with SAS. For the Probit model, where the dependent variable is a dummy variable similar to the LPM, we use the BEST15 regressors that were identified in the LPM model with the SAS MAXR procedure. The Probit model (like the LPM model) estimates the probability of a household being below the poverty line.

Annex E.3 presents the accuracy performance for these alternative single-step regression techniques. We restrict the testing of these alternative techniques to four sets of regressors — Models 1, 4, 7, and 9 — and only estimate the models with a set of fifteen regressors.

For Model 1, we show the complete results for accuracy performance in the following table.

Table 3.10.1 Summary of the accuracy results from the single-step regression techniques for Model 1

Model 1 Poverty rate: 4.52%	**Adj. R^2**	**Total Accuracy (%)**	**Poverty Accuracy (%)**	**Under-coverage (%)**	**Leakage (%)**	**PIE (% point)**	**BPAC (% point)**
Single-step methods -MAXR variable selection							
OLS	0.619	95.47	10.81	89.19	10.81	-3.55	-67.57
Quantile regression (estimation point: 26)		95.23	48.65	51.35	54.05	0.12	**45.95**
Linear Probability	0.253	95.96	10.81	89.19	0	-4.04	-78.37
Probit		96.45	40.54	59.46	18.92	-1.84	0

For the set of regressors as identified by Model 1, quantile regression is the best single-step technique in terms of maximizing the Balanced Poverty Accuracy Criterion (BPAC). Through an iterative procedure involving a series of regressions with the given set of BEST15 regressors, alternative percentile points of estimation for the Quantile model are tested in order to maximize the BPAC. With an optimal point of estimation set at the 26th percentile, the Quantile regression achieves a PIE of 0.12 percentage points. In other words, this model almost perfectly predicts the observed poverty rate. Moreover, the value for poverty accuracy is 48.65 percent, and for the BPAC it is 45.95 percentage points. In comparison with the single-step OLS regression technique, the gains in Poverty Accuracy and BPAC from using the Quantile regression technique are considerable.

Similar results concerning the differences in accuracy performance between the four alternative single-step regression techniques are shown next. Tables 3.10.2, 3.10.3, and 3.10.4 present the results for the sets of regressors termed Model 4, 7, and 9, respectively.

Table 3.10.2 Summary of the accuracy results from the single-step regression techniques for Model 4

Model 4 Poverty rate: 4.52%	**Adj. R^2**	**Total Accuracy (%)**	**Poverty Accuracy (%)**	**Under-coverage (%)**	**Leakage (%)**	**PIE (% point)**	**BPAC (% point)**
Single-step methods -MAXR variable selection							
OLS	0.557	95.23	5.41	94.59	10.81	-3.79	-78.38
Quantile regression (estimation point: 27)		93.64	29.73	70.27	70.27	0.00	**29.72**
Linear Probability	0.229	95.59	5.41	94.59	2.7	-4.16	-86.48
Probit		96.21	29.73	70.27	13.51	-2.57	-27.03

Model 4 represents the set of regressors that excludes the total value of household assets and all expenditure variables. It includes all subjective poverty indicators and most indicators from the practitioner tools. Table 3.10.2 compares the accuracy performance of four single-step regression techniques for the set of regressors termed Model 4. The best regression technique is the single-step Quantile. This technique achieves a BPAC value of 29.72 and a PIE value of 0.00 percentage points. Compared to the OLS regression technique, this result is a considerable improvement.

Table 3.10.3 Summary of the accuracy results from the single-step regression techniques for Model 7

Model 7 Poverty rate: 4.52%	**Adj. R^2**	**Total Accuracy (%)**	**Poverty Accuracy (%)**	**Under-coverage (%)**	**Leakage (%)**	**PIE (% point)**	**BPAC (% point)**
Single-step methods -MAXR variable selection							
OLS	0.533	95.84	10.81	89.19	2.70	-3.92	-75.68
Quantile regression (estimation point: 18)		92.66	21.62	78.38	83.78	0.24	**16.22**
Linear Probability	0.160	95.59	5.4	94.59	2.7	-4.16	-86.49
Probit		95.96	24.32	75.68	13.51	-2.82	-37.84

Model 7 represents the set of regressors that only includes poverty indicators that have been rated as “easily verifiable” (score 4 or 5) by the survey firm. Annex D provides the ratings for all 250 regressors. Table 3.10.3 compares the accuracy performance of four single-step regression techniques for the set of regressors termed Model 7. The best regression technique in terms of BPAC is the Quantile model. This technique achieves a BPAC value of 16.22 percentage points and a PIE value of 0.22 percentage points. Compared to the OLS regression technique, this again constitutes a considerable improvement with respect to BPAC.

Table 3.10.4 Summary of the accuracy results from the single-step regression techniques for Model 9

Model 9 Poverty rate: 4.52%	**Adj. R^2**	**Total Accuracy (%)**	**Poverty Accuracy (%)**	**Under-coverage (%)**	**Leakage (%)**	**PIE (% point)**	**BPAC (% point)**
Single-step methods -MAXR variable selection							
OLS	0.550	96.08	13.51	86.49	0	-3.92	-72.97
Quantile regression (estimation point: 23)		94.74	45.95	54.05	62.16	0.37	**37.84**
Linear Probability	0.166	95.59	5.4	94.59	2.7	-4.16	-86.49
Probit		96.20	32.43	67.57	16.22	-2.33	-18.92

Model 9 represents the set of regressors that is usually contained in LSMS surveys. Table 3.10.4 compares the accuracy performance of four single-step regression techniques for the set of regressors termed Model 9. The best regression technique in terms of BPAC is the Quantile model. This technique achieves a BPAC value of 37.84 percentage points and a PIE value of 0.37 percentage ponts. Compared to the OLS regression technique, this result again constitutes a considerable improvement with respect to BPAC.

In conclusion, the use of Quantile regression techniques allows us to considerably improve the accuracy performance compared to single-step OLS, Probit, or LPM. This result holds true for all four sets of regressors (i.e., Models 1, 4, 7, and 9) that were tested in this section. In the next chapter, we explore the accuracy of the two-step methods.

Chapter Four: Two-step models

4.1 Introduction to two-step OLS regression technique

The accuracy measures presented in the single-step Models 1 through 9 (Chapter 3) relate to the average accuracy of the models in predicting the poverty status using the full sample. However, they do not take into account the differences in accuracy observed at different levels of expenditure (benchmark indicator "daily expenditures per capita"). The models presented in Chapter 3 exhibited a high Total Accuracy, but a very low accuracy among the very-poor (or the national poor). They also underestimated the poverty headcount index by a wide margin. The weak performance of the OLS models in Chapter 3 — as compared to the analysis of Bangladesh and Peru, for example — is entirely driven by the very low level of observed headcount index for the very-poor (at 4.5%). At such low poverty rates, models estimated in a single step with ordinary OLS regression will generally show weak performance, irrespective of the country and data set.

In order to further improve the poverty status estimation, we used a two-step approach (see Grootaert et al., 1998), which breaks down the differences in the accuracy measures by deciles of the benchmark indicator. The original model is evaluated by the level of accuracy obtained in the different deciles of the full sample (step one). In step two, the model is estimated using a subsample that only includes those deciles with low accuracy levels, in order to identify the best regressor set for that subsample. The estimation in step two is repeated with OLS, using SAS's MAXR routine. Finally, the combined accuracy level of the two models is calculated by considering the predicted status from step one for the high-accuracy deciles and the predicted status from step two for the subsample of low-accuracy deciles.

In the remaining part of section 4.1, we present in detail first the results of the two-step OLS approach for Model 1's BEST15 regressor set. Sections 4.2 to 4.4 present the results for similar two-step OLS approaches but using alternative sets of regressors, as defined by Models 4, 7, and 9. Overall, the two-step OLS models have a much better performance in predicting the very-poor than the single-step OLS models presented in Chapter 3. The models lead to an improvement in Poverty Accuracy and a reduction of the Poverty Incidence Error (PIE). Also, the Balanced Poverty Accuracy Criterion (BPAC) increases noticeably (see Annex E.2). However, while Poverty Accuracy is improved and the PIE is reduced, the models do still achieve a relatively low BPAC values for the very-poor (see Annex E.2). In comparison with the other three IRIS country field tests, these weak results seem to be driven by the low very-poor headcount index in Kazakhstan.

Section 4.5 combines the two-step approach with the three alternative regression techniques — Quantile, Probit, and Linear Probability Model. With all three sets of regressors tested (Models 1, 7, and 9), the two-step Quantile technique achieves the highest BPAC of over 50 percentage points and a PIE of 0.00 percentage points. These results show that, in the case of

Kazakhstan with a very low poverty rate, the Quantile regression technique performs the best and can actually still achieve a relatively good accuracy performance.

4.1.1 First step: Model 1 — Best 15 set on full sample

We first evaluate the accuracy of model 1 with the BEST15 regressors set. Table 4.1.1.1 presents the results at the VP cut off, which correspond to the results already shown in Table 3.1.2.

Table 4.1.1.1 Accuracy level for the BEST 15 regressor set.

Measure	Level
Total Accuracy	95.47%
Poverty Accuracy	10.81%
Non poverty Accuracy	99.48%
Undercoverage	89.18%
Leakage	10.81%
PIE	-3.55 %points
BPAC	-67.56 %points

Table 4.1.1.2 presents a comparison of the predicted per-capita daily expenditures with the actual expenditures, both expressed in tenge. From the table, it can be observed that while the model overestimated the expenditures in the lowest part of the distribution, it underestimated them around the mean and in the higher expenditure levels.

Table 4.1.1.2 Comparison of predicted and actual expenditures in the single-step OLS regression (Model 1)

Variable	Minimum	Maximum	Mean	Std. Deviation
Actual daily expenditures per capita, tenge. (benchmark)	36.24	1 676.60	447.92	257.4
Predicted daily expenditures per capita, tenge.	49.57	1 656.89	423.87	200.19

4.1.2 Second step and combined accuracy of the two-step model

By testing the set of variables from Model 1 on the different subsamples (e.g., all percentiles above the fifth percentile of daily per-capita expenditures), the new BEST15 regressor sets were identified. Afterwards, the combined accuracy measures for all possible subsamples were determined and the optimal cutoff point for the subsample was identified. The evaluation criterion was the maximization of the BPAC.

Following this approach, the highest BPAC level was found with the subsample cutoff set at the 22nd percentile. The combined accuracy measures from the two step model is presented in Table 4.1.2.1.

It can be observed, for the subsample, that while the adjusted R^2 value was lower than in the BEST15 set from the first step (0.619), the accuracy results improved. Total Accuracy increased slightly from 95.47 percent to 96.45 percent in the two-step approach. Poverty Accuracy registered a major increase from 10.81 to 40.54 percent, an absolute increase of 29.73 percentage points. While Undercoverage decreased, Leakage increased by 8.1 percentage points. The predicted poverty incidence increased, causing a 1.72 percentage-point reduction in the PIE. BPAC increased from -67.56 percentage points to 0.00 percentage points in the single-step model.

Table 4.1.2.1. Combined accuracy from two-step estimation — Model 1 at the VP cut off

Measure	Percentile 22nd
Number of observations in the subsample	139
Adjusted R^2 for the subsample	0.486
Total Accuracy (%)	96.45
Poverty Accuracy (%)	40.54
Undercoverage (%)	59.45
Leakage (%)	18.91
PIE (% points)	-1.83
BPAC (% points)	0

Table 4.1.2.2 presents the BEST15 regressor set obtained for the subsample at the 22nd percentile. The BEST15 set from the first step (corresponding to BEST15 in Table 3.1.2) is presented for comparison. Three variables (shaded in gray) appear to be important in both steps of the model. These were:

- Household often didn't have enough food to eat
- Annualised food expenditures, recall at one week
- Number of horses owned by the household

None of these three variables were rated as easily verifiable by SANGE.

Table 4.1.2.2 Best 15 regressor sets derived from the second step

Variable	Full sample	Percentile 22nd
Autorickshaw ownership	X	
Household head sleeps on floor or thin sleeping mat	X	
Household often didn´t have enough food to eat	X	X
Proportion of dependents younger than 18 or older than 60 years (in relation to household size)	X	
Share of food expenditures from total household expenditures	X	
Household belongs to traders association	X	
Number of steps above step identified as poverty line	X	
Annualised food expenditures, recall at one week	X	X
Expenditures on school/education past 12 months	X	
Expenditures on other expenditures (social events, leisure), past 12 months	X	
Value of colour TV's	X	
Total value of household assets	X	
Number of horses owned by the household	X	X
Household has piped water in house	X	
Household head is salaried-production worker	X	
Head is craftsman		X
Contribution to school committee		X
Do you have Mobile (cell phone) in the house?		X
Metal frame with padlock as main entrance's lock		X
Household ate sometimes rice and cereals because other food was scarce		X
Exterior walls material is wireframed reed or clay		X
Kilograms of flour usually bought in a single purchase		X
Maximum education level of any household member		X
Number of literate male adults in the household		X
Expenditures on health in last 12 months		X
Sum of household clothing expenditures in past 12 months		X
Rooms per person		X
Total number of new regressors		12

The last row in Table 4.1.2.2 shows the number of new regressors that substitute for some of the original regressors used in step one. It can be seen that the BEST15 variable set for the full sample includes several monetary variables (expenditure or asset-related variables), while the BEST15 set for the subsample relies more on other types of variables, such as housing, demographic, and food-security variables that are more relevant as predictors for the poorest quintile of the population.

A practitioner tool based on a two-step model would require information on the original BEST15 regressors of step one, plus information about the 12 new additional poverty indicators that are included among the BEST15 regressors of step two (see Table 4.1.2.2).

In practice, all questions related to the first and second step (15 plus 12 indicators) can be integrated into a single interview with each household. The interviewer could begin with the best 15 indicators of the first step, and then compute an estimated per-capita daily expenditure. If the estimated expenditure falls above the cutoff value for the 22nd percentile, the household is rated as not very-poor, and the interview can be terminated. If, however, the predicted per-capita expenditure value falls below this cut off, the interview needs to be continued by asking questions related to the 12 additional regressors of the second step. Based on the values obtained for these regressors (plus the original regressors from the first step), a second value for predicted per-capita daily expenditures is computed. If this second value is below the applicable poverty line, the household is rated as very-poor. In practice, however, it is recommended not to interrupt the interview for the calculation based on the first 15 indicators, but to continue with the questions for the remaining 12 poverty indicators. In this case, the calculations of one (or two) expenditure values are done after the interview.

4.2 Two-step model 4

As mentioned in section 2.5, Model 4 excluded the variable *total value of household assets* as well as all expenditure variables. With this, it was possible to create a set of regressors that contained all of the subjective poverty indicators and most indicators from the practitioners' tools. Table 4.2.1 presents the performance of the two-step approach for this set of regressors. The first column shows the results of a single-step model, whereas the second column shows the results for the combined accuracy of the two-step model.

Table 4.2.1 Accuracy results for Model 4

Measure	Model 4	Percentile 18th
Number of observations	817	89
Adjusted R^2 for the sample/subsample	0.557	0.471
Total Accuracy (%)	95.23	96.7
Poverty Accuracy (%)	5.41	43.24
Undercoverage (%)	94.59	56.76
Leakage (%)	10.81	16.22
PIE (% points)	-3.79	-1.84
BPAC (% points)	-78.38	2.70

Among the subsamples, the highest combined BPAC was found at the 18th percentile. While Total Accuracy increased only by 1.47 percentage points, Poverty Accuracy registered a considerable increase of 37.83 percentage points (meaning a similar reduction in Undercoverage). Leakage increased by 5.41 percentage points.

The two-step approach predicted a higher incidence of poverty than that predicted by the single-step model. The PIE decreased from -3.79 to -1.84 percentage points, reducing the difference between predicted and observed poverty headcount. The gains in BPAC derived from this approach reached 81.08 percentage points, from an initial level of -78.38 to 2.70 percentage points in the second step.

4.3 Two-step model 7

As explained in Chapter 2, Model 7 was constructed using the variables that SANGE rated as easily verifiable. Table 4.3.1 presents the performance of the two-step approach in predicting the very-poor.

Table 4.3.1. Accuracy results for the two-step Model 7 at the bottom 50 percent cutoff

Measure	Model 7	Percentile 20th
Number of observations	817	98
Adjusted R^2 for the sample/subsample	0.533	0.421
Total Accuracy (%)	95.83	95.96
Poverty Accuracy (%)	10.81	21.62
Undercoverage (%)	89.19	78.38
Leakage (%)	2.70	10.81
PIE (% points)	-3.92	-3.06
BPAC (% points)	-75.68	-45.95

It can be observed that in spite of achieving a minor improvement in Total Accuracy (0.13 percentage points), Poverty Accuracy increased noticeably from 10.81 to 21.62 percent. While the level of Undercoverage decreased, the Leakage error increased by 8.11 percentage points compared to the single-step model (shown in the left column of Table 4.3.1). The two-step model still underestimated the number of very poor households, yielding a PIE of -3.06 percentage points.

The BPAC improved by 29.73 percentage points. Despite these improvements, it should be noted that even with the use of two-step OLS models, Poverty Accuracy remains low. This finding highlights the challenge of finding simple tools capable of accurately identifying very-poor households in an environment where extreme poverty is relatively rare.

4.4 Two-step model 9

Model 9 incorporated 141 variables commonly used in World Bank LSMS datasets. Table 4.4.1 presents the accuracy results from the two-step approach for predicting the very-poor.

Table 4.4.1. Accuracy results for the two-step Model 9 at the bottom 50 percent cutoff

Measure	Model 9	Percentile 20th
Number of observations	817	108
Adjusted R^2 for the sample/subsample	0.550	0.433
Total Accuracy (%)	96.08	95.84
Poverty Accuracy (%)	13.51	32.43
Undercoverage (%)	86.49	67.57
Leakage (%)	0	24.32
PIE (% points)	-3.92	-1.96
BPAC (% points)	-72.97	-10.81

From the table it can be observed that Total Accuracy slightly decreased (by 0.24 percentage points) as a result of the two-step approach. However, a considerable gain was achieved in Poverty Accuracy, which increased from 13.51 to 32.43 percent. As a result, the level of Undercoverage decreased, while Leakage increased by 24.32 percentage points.

The predicted poverty incidence increased, yielding a PIE of -1.96. This model still underestimates the poverty headcount, but the results are closer to the actual headcount than the results for the single-step model shown in the left column of Table 4.4.1. The BPAC measure improved noticeably, increasing by 62.16 percentage points.

4.5 Results from other two-step regression techniques: Quantile, Probit, and Linear Probability Model

The previous sections have presented two-step models that were estimated with the OLS regression technique using the continuous dependent variable logarithm of daily per-capita expenditures. Annex E.2 summarizes their results, whereas Annex F.2 shows the BEST15 regressors for each of the three regressions using different sets of regressors (i.e. Models 1, 4, 7, and 9).

Similar to single-step regression techniques, alternative formulations of the two-step approach again consist of using the Probit, Quantile, and Linear Probability Model as alternative regression techniques. For example, in a two-step modeling framework, a two-step Probit model consists of running two Probit regressions. Similar to the above OLS models, the first run includes the full sample, whereas the second subsample includes a subset of poorer households.

As already mentioned in section 3.10, the LPM and Probit techniques use as a dependent variable a dummy variable that is coded one if the household is very-poor and zero otherwise. Similar to the OLS regression technique presented in sections 4.1 to 4.4, the Quantile regression model uses the log of daily per-capita expenditures as the dependent variable. Similar to the single-step models, the regressors used in the two-step Quantile regressions are the same as those identified by SAS MAXR for the two-step OLS regressions. In addition, the percentile cutoff point for the second-step subsample in Quantile regressions is the same as the one determined in the two-step OLS model. Moreover, the point of estimation for the first step quantile regression is similar to the one found to be optimal for the single-step Quantile model presented in Chapter 3. To identify the optimal second point of estimation for the second-step Quantile regression, we again employ an iterative procedure that runs a series of regressions with the given set of BEST15 regressors (as determined by the second-step OLS regression). Also similar to the single-step models, the regressors used in the two-step Probit regressions are the same as those identified by SAS MAXR for the two-step LPM regressions, and the cutoff point for the subsample in the two-step Probit is the same as with the LPM model.

We restrict the testing of the three alternative two-step regression techniques to four sets of regressors — Models 1, 4, 7, and 9. Again, the models are estimated with a set of BEST15 regressors.

For Model 1, the accuracy performance results for the four two-step regression techniques are shown in Table 4.5.1.

Table 4.5.1 Summary of the accuracy results of two-step regression techniques for Model 1

Model 1 Poverty rate: 4.52%	**Adj. R^2**	**Total Accuracy (%)**	**Poverty Accuracy (%)**	**Under-coverage (%)**	**Leakage (%)**	**PIE (% point)**	**BPAC (% point)**
Two-step methods -MAXR variable selection							
OLS Percentile 22th	0.486 subsample	96.45	40.54	59.45	18.91	-1.83	0
Quantile regression (estimation points 26, 5) –22th perc. Cut off		96.08	56.76	43.24	43.24	0	**56.76**
Linear Probability Percentile 23rd	0.375 subsample	97.06	48.65	51.35	13.51	-1.71	10.81
Probit Percentile 23rd	N/A						

Table 4.5.1 shows the accuracy performance of the three alternative two-step regression techniques. The OLS model is the same than the one presented in section 4.1. The SAS package

did not yield a result for the two-step Probit model, probably because of the very small size of the second subsample. Thus, results for this technique are not available for Model 1, and also not for Models 4, 7, 9.

For the set of regressors as identified by Model 1, the above table shows that Quantile regression is best two-step technique in terms of maximizing BPAC. With points of estimation set at the 26th percentile for the first step and at the 5th percentile for the second step, the Quantile regression achieves a PIE of 0.00 percentage points. In other words, this model perfectly predicts the observed poverty rate. The value for Poverty Accuracy, and hence also for BPAC, is 56.76 percentage points. Compared to the two-step OLS regression technique, the gains in Poverty Accuracy and BPAC achieved from using Quantile regression technique are considerable. The two-step Quantile regression technique also outperforms the best single-step regression technique, as illustrated in Annex E.3. This annex shows results from all four single-step and two-step models in one table.

For Model 4, the accuracy performance results of the four two-step regression techniques are shown in Table 4.5.2.

Table 4.5.2 Summary of the accuracy results of two-step regression techniques for Model 4

Model 4 Poverty rate: 4.52%	**Adj. R^2**	**Total Accuracy (%)**	**Poverty Accuracy (%)**	**Under-coverage (%)**	**Leakage (%)**	**PIE (% point)**	**BPAC (% point)**
Two-step methods -MAXR variable selection							
OLS Percentile 18th	0.471 subsample	96.7	43.24	56.76	16.22	-1.84	2.70
Quantile regression (estimation points 27, 5) – 18 perc. Cut off		94.61	40.54	59.46	59.46	0.00	**40.54**
Linear Probability Percentile 23rd	0.389 subsample	98.04	62.16	37.84	5.41	-1.47	29.73
Probit Percentile 23rd	N/A						

For the set of regressors termed Model 4, Table 4.5.2 shows that the best two-step regression technique in terms of maximizing BPAC is the two-step Quantile. With points of estimation set at the 27th percentile for the first step and at the 5th percentile for the second step, this model achieves a PIE of 0.00 percentage points. Again, this model perfectly predicts the observed poverty rate. Moreover, the value for Poverty Accuracy, and hence also for BPAC, is 40.54 percentage points. Compared to the two-step OLS regression technique, the gains in Poverty Accuracy and BPAC achieved from using the two-step Quantile regression technique are considerable.

For Model 7, the accuracy performance results of the four two-step regression techniques are shown in Table 4.5.3.

Table 4.5.3 Summary of the accuracy results of two-step regression techniques for Model 7

Model 7 Poverty rate: 4.52%	**Adj. R^2**	**Total Accuracy (%)**	**Poverty Accuracy (%)**	**Under-coverage (%)**	**Leakage (%)**	**PIE (% point)**	**BPAC (% point)**
Two-step methods -MAXR variable selection							
OLS Percentile 20th	0.421 subsample	95.96	21.62	78.38	10.81	-3.06	-45.95
Quantile regression (estimation points 18, 4) – 20 perc. Cut off		94.61	43.24	56.76	62.16	0.24	**37.84**
Linear Probability Percentile 20th	0.241 subsample	97.18	48.65	51.35	10.81	-1.84	8.10
Probit Percentile 20th	N/A						

For the set of regressors termed Model 7, Table 4.5.3 shows that Quantile regression is best two-step technique in terms of maximizing BPAC. With points of estimation set at the 18th percentile for the first step and at the 4th percentile for the second step and using the poorest 20 percent (similar to the two-step OLS) as the subsample for the second step, the Quantile regression achieves a PIE of 0.24 percentage points. In other words, this model almost perfectly predicts the observed poverty rate. Moreover, the BPAC value is 37.84 percentage points. Compared to the two-step OLS regression technique, the gains in Poverty Accuracy and BPAC achieved from using the two-step Quantile regression technique are considerable.

For Model 9, the accuracy performance results of the four two-step regression techniques are shown in Table 4.5.4.

Table 4.5.4 Summary of the accuracy results of two-step regression techniques for Model 9

Model 9 Poverty rate: 4.52%	**Adj. R^2**	**Total Accuracy (%)**	**Poverty Accuracy (%)**	**Under-coverage (%)**	**Leakage (%)**	**PIE (% point)**	**BPAC (% point)**
Two-step methods -MAXR variable selection							
OLS Percentile 20th	0.433 subsample	95.84	32.43	67.57	24.32	-1.96	-10.81
Quantile regression (estimation points 23, 5) – 20 perc. cutoff		94.61	40.54	59.46	59.46	0	**40.54**
Linear Probability Percentile 22nd	0.463 subsample	96.94	43.24	56.76	10.81	-2.08	-2.7
Probit Percentile 22nd		N/A					

For the set of regressors termed Model 9 (i.e. the regressors usually contained in LSMS data sets), Table 4.5.4 shows that Quantile regression is best two-step technique in terms of maximizing BPAC. With points of estimation set at the 23rd percentile for the first step and at the 5th percentile for the second step and using the poorest 20 percent (similar to the two-step OLS) as the subsample for the second step, the Quantile technique achieves a PIE of 0.00 percentage points — a perfect prediction. The value for Poverty Accuracy and BPAC is 40.54 percentage points. Compared to the two-step OLS regression technique, the gains in Poverty Accuracy and BPAC achieved from using the two-step Quantile regression technique are again considerable. The reader should note that this model achieved exactly the same performance as the two-step Quantile Model 4.

Annex E.3 presents the accuracy performance for these alternative two-step regression techniques and shows the results for the four single-step regression techniques already presented in section 3.10. The four summary tables in Annex E.3 show that the two-step Quantile regression technique achieves the highest BPAC for all four sets of regressors (i.e., Models 1, 4, 7, and 9). Annex F.3. shows the set of regressors that were used by these best two-step quantile regression techniques.

Chapter Five: Summary

This report first presented nine single-step regression models, each with a set of best 5, best 10, and best 15 regressors. These models were estimatedwith the Ordinary Least Squares (OLS) regression technique. Because of the very low poverty headcount index for the very-poor (around 5%) and the national poor (around 10%) in the Kazakhstan sample, the OLS models proved inadequate to predict the percentage of very-poor households, in spite of a Total Accuracy measure exceeding 90 percent. Whereas tests of the single-step OLS regression technique are performed for nine different sets of regressors, termed Model 1 through 9, the alternative single-step and two-step regression techniques are limited to four sets of regressors — Models 1, 4, 7, and 9. As in the other three IRIS test countries, Model 1 includes all poverty indicators enumerated in the field countries. Compared to Model 1, Model 4 excludes all expenditure categories and the total value of household assets but still contains most poverty indicators from practitioners' tools, as well as subjective poverty indicators. Model 7 includes only indicators that are deemed by experienced survey-firm staff as being highly verifiable and easy to ask — it is thus the most practical model. Model 9 uses indicators similar to those found in World Bank LSMS data sets.

The report also contains tests of three alternative single-step regression techniques, namely the Probit, Quantile, and Linear Probability Model (LPM) techniques. Among those, the single-step Quantile regression technique yielded the highest value for BPAC for all sets of regressors. In addition, we tested two-step models using the four different regression techniques.

The nine single-step OLS models show very satisfactory levels of Total Accuracy — they accurately predicted the percentage of households which actually fall into a given category. However, all nine models show very low accuracy among the very-poor (or the national poor), and all consistently underestimate the poverty headcount. Moreover, these models tend to underestimate poverty rates that are indicated by a negative PIE value. The BPAC values are negative in each of the nine models, indicating very weak accuracy performance. The results clearly show that single-step models estimated with OLS are ill-suited for use in Kazakhstan, with an observed headcount index ranging from 5 to 10 percent, respectively, for the very-poor and the national poor in the sample. Annex E.1 provides a summary of accuracy results for all nine single-step OLS models. Annex F.1 summarizes the variables used as best 15 regressors in the different models.

Considerable improvements could be achieved by using Quantile regression techniques in a single-step framework. For Models 1, 4, 7, and 9, positive BPAC values of over 30 percentage points could be achieved, with a PIE value close to zero — indicating an almost perfect prediction of observed poverty rate. These results constitute large improvements compared to the results obtained with single-step OLS techniques.

We observed that all models estimated via single-step using OLS were less accurate for the very-poor than for the not very-poor. This implies that the inaccuracies in prediction are not equally distributed over all expenditure percentiles but are systematically higher for the very-poor. This resulted in negative BPAC values for all nine models. This problem of unbalanced accuracies can be potentially reduced by the use of two-step models, following a method pioneered by Grootaert et al. (1998). The computational costs of these models, however, are higher than those for the single-step models.

The results of the two-step OLS models presented in Chapter 4 compare favorably with the single-step OLS models presented in Chapter 3. While the Total Accuracy of the two-step models is only marginally higher than for the OLS models, the two-step models have a clear advantage in estimating the proportion of the population that is very-poor and thereby somewhat better estimating the headcount indices, given that headcount indices are low in Kazakhstan.

We further explored alternative regression techniques in a two-step regression framework for the four different sets of regressors. Again, these are:

- Model 1 — full set of regressors
- Model 4 — all regressors except total value of assets and expenditure categories
- Model 7 — the model thought to be most practical
- Model 9 — with a set of regressors usually contained in LSMS data sets

The alternative regression techniques used were Quantile, Probit, and LPM. When considering all eight different regression techniques tested (i.e. the four single-step and the four two-step techniques), the two-step Quantile achieved the highest BPAC for all four sets of regressors. The results obtained with the two-step quantile model appear fairly satisfying. For example, for the set of regressors termed Model 1, the two-step Quantile regression technique achieved a perfect prediction of the observed poverty rate (PIE = 0.00 percentage points) and a fairly high BPAC value of 56.76 percentage points. For the set of regressors with the highest practicality (Model 7), the two-step Quantile regression technique yielded a PIE of 0.24 percentage points and a BPAC of 37.84 percentage points. Annex F.3 lists the set of best regressors that were used in the model achieving the highest BPAC value.

In conjunction with tests in Bangladesh, Peru, and Uganda, the accuracy tests in Kazakhstan show that the choice of a suitable regression technique is an empirical issue. The choice is influenced by the level of poverty rate. In countries with a low poverty rate, two-step techniques and/or Quantile regression appear to yield better results in terms of the BPAC. Overall, the results for Kazakhstan highlight that the challenge of finding tools capable of accurately identifying very-poor households in an environment where extreme poverty is relatively rare can only be satisfyingly addressed with the use of more complex regression techniques.

Bibliography

Dubois, Jean-Luc. 2004. Report on the sample design for the IRIS accuracy test in Kazakhstan. Mimeograph prepared for the IRIS center. Paris, August 2004.

Grootaert, Christiaan, and Jeanine Braithwaite. 1998. Poverty correlates and indicator-based targeting in Eastern Europe and the Former Soviet Union. Poverty Reduction and Economic Management Network, Environmentally and Socially Sustainable Development Network. Washington D.C.: The World Bank.

IRIS. 2005. Note on Assessment and Improvement of Tool Accuracy. Mimeograph, Revised version from June 2, 2005. IRIS center, University of Maryland.

Zeller, Manfred. 2004. Review of Poverty Assessment Tools. Report submitted to IRIS and USAID as part of the Developing Poverty Assessment Tools Project. January 2004. (PDF-File at http://www.povertytools.org).

Zeller, Manfred, Gabriela V. Alcaraz, and Julia Johannsen. 2005. Developing and testing poverty assessment tools: Results from accuracy tests in Bangladesh. IRIS Center, University of Maryland, College Park. First report in November 2004. Final report in September 2005 (Available [online] at http://www.povertytools.org).

Zeller, Manfred, Julia Johannsen, and Gabriela V. Alcaraz. 2005. Developing and testing poverty assessment tools: Results from accuracy tests in Peru. IRIS Center, University of Maryland, College Park. First report in February 2005. Final report in September 2005 (Available [online] at http://www.povertytools.org).

Zeller, Manfred, and Gabriela V. Alcaraz. 2005. Developing and testing poverty assessment tools: Results from accuracy tests in Uganda. IRIS Center, University of Maryland, College Park. First report in May 2005, and final report in September 2005. (Available [online] at http://www.povertytools.org).

Annexes

Annex A: Characteristics of sample

Table A.1 List of selected clusters, rayons and cities, villages, and districts

Regions and cluster number	Rayons and cities	Name of village, city, district	Urban or rural
1. Aktobe	**3 clusters**		**2 urban, 1 rural**
1.01	Aktobe	Aktobe city	Urban
1.02	Hobbin	Kobda aul town	Urban
1.03	Martuk	Pervomaika	Rural
2. Almaty	**11 clusters**		**6 urban, 5 rural**
2.04	Almaty city	Auezov district	Urban
2.05	Almaty city	Bostandyk district	Urban
2.06	Almaty city	Almaly district	Urban
2.07	Almaty city	Medeo district	Urban
2.08	Almaty city	Turksib district	Urban
2.09	Karasai	Kaskelen town	Urban
2.10	Iliy	Otegen Batyr	Rural
2.11	Enbeskshikazakh	Boltabai, Enbek	Rural
2.12	Talgar	Belbulak, KyzylKairat	Rural
2.13	Iliy	Janatalap	Rural
2.14	Eskeldin	Zarya Kommunizma, Enbek	Rural
3 East Kazakhstan	**6 clusters**		**3 urban, 3 rural**
3.15	Ust Kamenogorsk	Ust Kamenogorsk city	Urban
3.16	Semi Palatinsk	Semi Palatinsk city	Urban
3.17	Ayagoz	Ayagoz city	Urban
3.18	Jarmin	Auezov town	Rural
3.19	Glubokov	Belokamenka	Rural
3.20	Shemonaiha	Konevka	Rural
4. Jambyl	**4 clusters**		**2 urban, 2 rural**
4.21	Taraz	Taraz city	Urban
4.22	Talas	Karatau city	Urban
4.23	Jambyl	Ilich, Assa	Rural

4.24	Jualyn	Ryspek Batyr, Boraldai	Rural
5. Karaganda	**5 clusters**		**4 urban, 1 rural**
5.25	Karaganda	Karaganda city	Urban
5.26	Jezkazgan	Jezkazgan city	Urban
5.27	Saran	Saran city	Urban
5.28	Bukhar-Jyrau	Kushoky town	Urban
5.29	Abai	Kurminka	Rural
6. Kostanay	**3 clusters**		**2 urban, 1 rural**
6.30	Kostanay	Kostanay city	Urban
6.31	Taranov	Tobol town	Urban
6.32	Denisovskii	Grishenka	Rural
7. South Kazakhstan	**8 clusters**		**3 urban, 5 rural**
7.33	Shymkent	Shymkent city	Urban
7.34	Shymkent	Shymkent city	Urban
7.35	Ordybasy	Spataevo, Tortkol	Rural
7.36	Turkestan c.a	Yulgili, Babaikurgan	Rural
7.37	Saryagash	Saryagash city	Urban
7.38	Shymkent c.a.	Aktas	Rural
7.39	Sairam	Kyzyl Kazakhstan, Kyzylkishlak	Rural
7.40	Saryagash	Janatalap	Rural

Source: Dubois, Jean-Luc. 2004. Report on the sample design for the IRIS accuracy test in Kazakhstan. Paris, August 2004.

Annex B: Descriptives of all regressors (N= 260), by type of model (N = 817)

Variable Label	Min.	Max.	Mean	St. Dev.	M1	M2	M3	M4	M5	M6	M7	M8	M9
Household size	1.00	14.00	4.00	2.03	X	X	X	X	X	X	X	X	X
Household size squared	1.00	196.00	20.11	20.40	X	X	X	X	X	X	X	X	X
Age of household head	19.00	91.00	50.08	14.58	X	X	X	X	X	X	X	X	X
Aktobe oblast	0.00	1.00	0.07	0.26	X	X	X	X	X	X	X	X	X
Almaty oblast	0.00	1.00	0.27	0.45	X	X	X	X	X	X	X	X	X
Est Kazakhstan	0.00	1.00	0.15	0.36	X	X	X	X	X	X	X	X	X
Jambyl oblast	0.00	1.00	0.10	0.30	X	X	X	X	X	X	X	X	X
Karaganda oblast	0.00	1.00	0.12	0.33	X	X	X	X	X	X	X	X	X
Kostanay oblast	0.00	1.00	0.08	0.26	X	X	X	X	X	X	X	X	X
Is this community urban or rural?	0.00	1.00	0.52	0.50	X	X	X	X	X	X	X	X	X
If head and spouse have a joint account	0.00	1.00	0.02	0.13	X	X	X	X	X	X			X
If spouse has any account	0.00	1.00	0.08	0.27	X	X	X	X	X	X			X
Total agricultural assets owned (out of 5)	0.00	3.00	0.20	0.47	X	X	X	X	X	X			X
Average age of all household members	9.43	83.50	36.33	16.94	X	X	X	X	X	X			
Squared age of household head	361.00	8281.00	2720.44	1541.21	X	X	X	X	X	X	X	X	X
Age of youngest household member	0.00	82.00	20.75	22.65	X	X	X	X	X	X			
Area of major buildings and additional structures f1a+f1b	0.00	300.90	1.68	13.40	X	X	X	X	X	X	X	X	
Area of agricultural land under irrigation f2a+f2b	0.03	15000.00	32.43	530.81	X	X	X	X	X	X			X
Is the majority of streets asphalted in this community?	0.00	1.00	0.60	0.49	X	X	X	X	X	X	X	X	
Autorickshaw ownership	0.00	1.00	0.09	0.28	X	X	X	X	X	X			X
Bed ownership	0.00	1.00	0.87	0.34	X	X	X	X	X	X	X	X	X
Blanket ownership	0.00	1.00	0.07	0.26	X	X	X	X	X	X	X	X	X
Do you have bus station?	0.00	1.00	0.37	0.48	X	X	X	X	X	X	X	X	
Carpet ownership	0.00	1.00	0.93	0.26	X	X	X	X	X	X	X	X	X
Contribution cooperatives	0.00	1.00	0.08	0.27	X	X	X	X	X	X			
CD player ownership	0.00	1.00	0.31	0.46	X	X	X	X	X	X			X
Do you have access to a cellular communication station?	0.00	1.00	0.65	0.48	X	X	X	X	X	X	X	X	
How far away the access to cellular communication station (km)?	0.00	100.00	18.47	32.38	X	X	X	X	X	X	X	X	
Household head is chronically ill	0.00	1.00	0.39	0.49	X	X	X	X	X	X			X
Percentage of chronically ill adults (in relation to household size)	0.00	100.00	27.64	34.61	X	X	X	X	X	X			X
Number of females with some chronic illness	0.00	5.00	0.56	0.76	X	X	X	X	X	X			X
Do you have cinema?	0.00	1.00	0.25	0.43	X	X	X	X	X	X	X	X	
Contribution neighbors group	0.00	1.00	0.00	0.03	X	X	X	X	X	X			
Other value cooling or heating equipment	0.00	1.00	0.01	0.09	X	X	X	X	X	X			X

Variable Label	Min.	Max.	Mean	St. Dev.	M1	M2	M3	M4	M5	M6	M7	M8	M9
Contribution political group	0.00	1.00	0.06	0.24	X	X	X	X	X	X			
Do you have cabinet of a private doctor?	0.00	1.00	0.49	0.50	X	X	X	X	X	X			
Head is craftsman	0.00	1.00	0.00	0.06	X	X	X	X	X	X	X	X	X
Contribution school committee	0.00	1.00	0.02	0.15	X	X	X	X	X	X			
How far away the cultural center (km)?	0.00	200.00	11.69	35.15	X	X	X	X	X	X	X	X	
How many rooms does the dwelling have?	1.00	9.00	3.28	1.38	X	X	X	X	X	X			X
Have you made a recent home improvement in the last three years?	0.00	1.00	0.60	0.49	X	X	X	X	X	X			
Do you have Mobile (cell phone) in the house?	0.00	1.00	0.18	0.38	X	X	X	X	X	X	X	X	X
Head of household sleeps on floor or thin sleeping mat	0.00	1.00	0.05	0.21	X	X	X	X	X	X			
Head of household sleeps on thick mattress	0.00	1.00	0.08	0.27	X	X	X	X	X	X			
Head of household sleeps on self made bed	0.00	1.00	0.09	0.28	X	X	X	X	X	X			
Household ate sometimes self cooked bread/flat cakes bec. food scarce	0.00	1.00	0.06	0.23	X	X	X	X					
Cooking fuel is Gas rom public grid	0.00	1.00	0.28	0.45	X	X	X	X	X	X	X	X	X
Household ate rarely crackers bec. food scarce	0.00	1.00	0.08	0.27	X	X	X	X					
Household ate sometimes crackers bec. food scarce	0.00	1.00	0.03	0.18	X	X	X	X					
Community was affected by any natural disaster during past 5 years	0.00	1.00	0.45	0.50	X	X	X	X	X	X	X	X	
Household sometimes didn't have enough food	0.00	1.00	0.22	0.41	X	X	X	X					
Household often didn't have enough food	0.00	1.00	0.05	0.22	X	X	X	X					
Percentage of dependents younger than 14 and older 60 years (in relation to household size)	0.00	100.00	38.30	31.15	X	X	X	X	X	X	X	X	
Percentage of dependents younger than 15 and older than 64 years (in relation to household size)	0.00	100.00	35.92	29.81	X	X	X	X	X	X	X	X	
Percentage of dependents younger than 18 and older than 60 years (in relation to household size)	0.00	100.00	46.00	29.29	X	X	X	X	X	X	X	X	
Floor is ground	0.00	1.00	0.02	0.15	X	X	X	X	X	X	X	X	X
Floor is cement simple or covered (such as tiles)	0.00	1.00	0.06	0.24	X	X	X	X	X	X	X	X	X
Floor is linoleum, Dutch tile or parquet	0.00	1.00	0.24	0.43	X	X	X	X	X	X	X	X	X
Household usually purchases flour more than twice a week	0.00	1.00	0.04	0.19	X	X	X	X					
Household usually purchases flour once every 2 weeks	0.00	1.00	0.07	0.26	X	X	X	X					
Household usually purchases flour monthly	0.00	1.00	0.39	0.49	X	X	X	X					
Agree that you feel accepted as a member of this village/neighborhood?	0.00	1.00	0.91	0.29	X	X	X	X					

Variable Label	Min.	Max.	Mean	St. Dev.	M1	M2	M3	M4	M5	M6	M7	M8	M9
Household feels that clothing expenses are above need	0.00	1.00	0.08	0.27	X	X	X	X					
Household feels that health care expenses are above need	0.00	1.00	0.09	0.29	X	X	X	X					
Household feels that child educ expenses are above need	0.00	1.00	0.06	0.23	X	X	X	X					
Household feels that housing expenses are below need	0.00	1.00	0.46	0.50	X	X	X	X					
Household feels that housing expenses are above need	0.00	1.00	0.07	0.25	X	X	X	X					
Household feels living standard improved significantly compared to 1996	0.00	1.00	0.11	0.31	X	X	X	X					
Household feels living standard same as compared to 1996	0.00	1.00	0.47	0.50	X	X	X	X					
Household feels living standards worse compared to 1996	0.00	1.00	0.32	0.47	X	X	X	X					
House structure: dilapidated	0.00	1.00	0.12	0.32	X	X	X	X	X	X			
Number of females with some disability	0.00	2.00	0.09	0.30	X	X	X	X	X	X			X
Household head has any disability	0.00	1.00	0.09	0.28	X	X	X	X	X	X			X
Dishes ownership	0.00	1.00	0.69	0.46	X	X	X	X	X	X			X
Number of males with some disability	0.00	2.00	0.09	0.29	X	X	X	X	X	X			X
Distance to oblast center?	0.00	600.00	114.47	133.11	X	X	X	X	X	X	X	X	
Household head is divorced	0.00	1.00	0.08	0.26	X	X	X	X	X	X			X
Household cooks in one of the rooms in the house	0.00	1.00	0.15	0.36	X	X	X	X	X	X	X	X	
Household speaks Kazakh or other (minority)	0.00	1.00	0.47	0.50	X	X	X	X	X	X	X	X	
Household ate sometimes lenten soup bec. food scarce	0.00	1.00	0.13	0.33	X	X	X	X					
Metal frame with padlock in main entrance door	0.00	1.00	0.14	0.34	X	X	X	X	X	X			
Household ate sometimes macaroni bec. food scarce	0.00	1.00	0.13	0.34	X	X	X	X					
Household ate often macaroni bec. food scarce	0.00	1.00	0.21	0.41	X	X	X	X					
Quality of walls: poor	0.00	1.00	0.15	0.36	X	X	X	X	X	X			
Household ate rarely rice and cereals bec. food scarce	0.00	1.00	0.12	0.32	X	X	X	X					
Household ate sometimes rice and cereals bec. food scarce	0.00	1.00	0.08	0.27	X	X	X	X					
Household ate often rice and cereals bec. food scarce	0.00	1.00	0.07	0.26	X	X	X	X					
Household ate mostly rice and cereals bec. food scarce	0.00	1.00	0.06	0.23	X	X	X	X					
Roof with straw or wood	0.00	1.00	0.05	0.21	X	X	X	X	X	X			X
Roof with ruberoid	0.00	1.00	0.11	0.31	X	X	X	X	X	X			X
Household had to skip meals less than 10 days during past 12 months	0.00	1.00	0.02	0.13	X	X	X	X					
Toilet: bush, field, no facility or shared pit toilet	0.00	1.00	0.02	0.15	X	X	X	X	X	X			X
Toilet: shared or own latrine	0.00	1.00	0.02	0.15	X	X	X	X	X	X			X
Toilet: shared or own flush toilet	0.00	1.00	0.33	0.47	X	X	X	X	X	X			X

Variable Label	Min.	Max.	Mean	St. Dev.	M1	M2	M3	M4	M5	M6	M7	M8	M9
Exterior walls: wireframed reed or clay walls	0.00	1.00	0.30	0.46	X	X	X	X	X	X	X	X	X
Source of water is: Dam/pond/river/spring	0.00	1.00	0.01	0.12	X	X	X	X	X	X	X	X	X
Source of water is: Well in residence yard	0.00	1.00	0.22	0.42	X	X	X	X	X	X	X	X	X
How many meals were served to the household members during the last 2 days?	1.00	32.00	6.10	2.00	X	X	X	X				X	
In the last seven days, how many days Chicken served by the household in a main meal eaten?	0.00	7.00	1.34	1.87	X	X	X	X					
In the last seven days, how many days Butter served by the household in a main meal eaten?	0.00	7.00	4.54	3.12	X	X	X	X					
In the last seven days, how many days Cheese, Sausage served by the household in a main meal eaten?	0.00	7.00	1.59	2.42	X	X	X	X				X	
How many kilograms of flour do you usually buy in a single purchase?	0.00	500.00	31.11	33.37	X	X	X	X				X	
During last 30 days, for how many days did your household not have enough food to eat?	0.00	30.00	2.52	6.28	X	X	X	X					
For how many days will your stock of flour last?	0.00	720.00	30.49	66.85	X	X	X	X					
In last 12 months were you and your household members worried that your food would run out before you had money to buy more?	0.00	1.00	0.59	0.49	X	X	X	X				X	
In last 12 months did you or any other adult in your household skip meals because you did not have enough money to buy?	0.00	1.00	0.10	0.30	X	X	X	X					
In last 12 months did you or any other adult in your household stop eating for an entire day because you did not have enough money to buy?	0.00	1.00	0.06	0.24	X	X	X	X					
Education level of household head	0.00	15.00	12.01	2.99	X	X	X	X	X	X			X
Maximum education level of any household member	1.00	15.00	13.06	2.05	X	X	X	X	X	X			X
Minimum education level of any household member	0.00	15.00	5.44	5.26	X	X	X	X	X	X			X
Electric or gas cooker ownership	0.00	1.00	0.44	0.50	X	X	X	X	X	X	X	X	X
Electric heater ownership	0.00	1.00	0.09	0.29	X	X	X	X	X	X	X	X	X
Head of household is farmer (1=Yes, 0=no)	0.00	1.00	0.02	0.15	X	X	X	X	X	X			X
During the past 5 years, did you have fire	0.00	1.00	0.20	0.40	X	X	X	X	X	X			
Share of food expenditures from total expenditures	0.18	1.93	1.07	0.34	X								
Number of members, relatives working abroad and sending money	0.00	2.00	0.05	0.25	X	X	X	X	X	X			
Birth of own child in last 3 years?	0.00	6.00	0.25	0.57	X	X	X	X	X	X	X	X	
Adoption of a child in last 3 years?	0.00	4.00	0.02	0.22	X	X	X	X	X	X			

Variable Label	Min.	Max.	Mean	St. Dev.	M1	M2	M3	M4	M5	M6	M7	M8	M9
We received dowry/kali/bride-money Or some important valuable gift in last 3 years?	0.00	1.00	0.00	0.06	X	X	X	X	X	X			
Relocation of residence/household because of other reasons such as natural disasters In last 3 years	0.00	1.00	0.02	0.14	X	X	X	X	X	X	X	X	
Did your household have a very serious problem or failure in your own crop production In last 3 years?	0.00	1.00	0.12	0.33	X	X	X	X					
Did your household have a very serious problem or failure in your own micro-enterprise In last 3 years?	0.00	1.00	0.03	0.18	X	X	X	X					
Total household members in civic group	0.00	2.00	0.00	0.09	X	X	X	X	X	X			
Household in NGO for entrepreneurial services	0.00	1.00	0.00	0.05	X	X	X	X	X	X			
Total household members in other groups	0.00	1.00	0.00	0.07	X	X	X	X	X	X			
Total household members in other NGO	0.00	3.00	0.01	0.12	X	X	X	X	X	X			
Household in other NGO	0.00	1.00	0.00	0.07	X	X	X	X	X	X			
Total of household members in political group	0.00	6.00	0.17	0.59	X	X	X	X	X	X			
Household in political group	0.00	1.00	0.11	0.31	X	X	X	X	X	X			
Total of household members in religious group	0.00	2.00	0.01	0.11	X	X	X	X	X	X			
Total household members in school committee	0.00	1.00	0.03	0.17	X	X	X	X	X	X	X	X	
Total household members in Traders Association	0.00	7.00	0.08	0.57	X	X	X	X	X	X			
Household in Traders association	0.00	1.00	0.02	0.15	X	X	X	X	X	X			
Household in water/waste group	0.00	1.00	0.00	0.03	X	X	X	X	X	X	X	X	
Have you or members of household are denied service or only limited opportunity to water supply	0.00	1.00	0.15	0.36	X	X	X	X			X	X	
Have you or members of household are denied service or only limited opportunity to utilities services (sanitary technicians)	0.00	1.00	0.14	0.35	X	X	X	X					
Have you or members of household are denied service or only limited opportunity to social help	0.00	1.00	0.25	0.43	X	X	X	X					
Have you or members of household are denied service or only limited opportunity to healthcare services: hospital	0.00	1.00	0.21	0.41	X	X	X	X					
Have you or members of household are denied service or only limited opportunity to medical products and medical material	0.00	1.00	0.22	0.41	X	X	X	X					
Have you or members of household are denied service or only limited opportunity to labour registry office	0.00	1.00	0.13	0.34	X	X	X	X					
Number of memberships out of 22 institutions	0.00	3.00	0.35	0.58	X	X	X	X	X	X			
Household is NOT member of any institution	0.00	1.00	0.69	0.46	X	X	X	X	X	X			

Variable Label	Min.	Max.	Mean	St. Dev.	M1	M2	M3	M4	M5	M6	M7	M8	M9
On which step of this ladder are you located today?	1.00	9.00	3.79	1.40	X	X	X	X			X	X	
Where on the ladder would you locate a household, who has an income equal to 15000 tenge per month?	1.00	8.00	2.21	1.23	X	X	X	X			X	X	
Where on the ladder would you locate your household 8 years ago?	1.00	10.00	3.72	1.99	X	X	X	X			X	X	
Horses ownership	0.00	1.00	0.08	0.27	X	X	X	X	X	X	X	X	X
Head of household is occupied in housework (1=Yes, 0=no)	0.00	1.00	0.09	0.28	X	X	X	X	X	X			X
If household rates itself below the step reflecting the respective nat. pov. line	0.00	1.00	0.15	0.36	X	X	X	X					
Number of steps above the step identified as respective nat. poverty line (if minus below)	-7.00	8.00	1.58	1.75	X	X	X	X				X	
Subjective change in living standards in last 8 years, recoding H09	1.00	3.00	1.76	0.89	X	X	X	X			X	X	
Head of household chooses leisure (1=Yes, 0=no)	0.00	1.00	0.01	0.10	X	X	X	X	X	X			X
Value of agricultural land under irrigation f2a+f2b	4.56	16.43	7.87	3.28	X	X	X	X	X				X
Value of agricultural land under no irrigation f3a+f3b	2.26	14.31	3.03	2.33	X	X	X	X	X				X
Annualized food expenditures, recall 1 week	5.37	14.45	11.99	0.82	X								
Number of adult household members who can read and write	0.00	9.00	2.62	1.28	X	X	X	X	X	X			X
Number of literate females in household	0.00	8.00	1.91	1.08	X	X	X	X	X	X			X
Number of literate male adults in household	0.00	5.00	1.18	0.84	X	X	X	X	X	X			X
Number of literate males in household	0.00	5.00	1.59	1.10	X	X	X	X	X	X			X
Weekly expenditures on food	1.17	10.46	7.76	0.86	X	X	X					X	
Weekly value of food farm/garden-produced	-0.09	10.09	3.78	3.56	X								
Monthly expenditures on utilities	0.76	9.62	7.13	1.15	X						X	X	
Monthly expenditure on fuel	0.66	10.66	6.03	2.73	X						X	X	
Monthly value of other goods-cooking fuel produced on farm/garden	-0.69	11.00	0.59	2.94	X								
Expenditures in school/education, last 12 months	2.87	13.02	6.75	3.39	X						X	X	
Expenditures on health, last 12 months	2.83	13.21	8.56	1.91	X								
Expenditures on home, last 12 months	2.91	13.90	7.00	3.09	X						X	X	
Expenditures on furniture, last 12 months	2.08	14.12	4.38	3.33	X						X	X	
Remittances sent to relatives, last 12 months	0.69	13.21	3.51	3.15	X						X	X	X
Expenditures on other expenditures-social events, leisure, last 12 month	2.48	13.22	7.94	2.79	X	X	X					X	
Sum of household clothing expenditures in past 12 months	3.00	13.78	9.94	1.89	X								X

Variable Label	Min.	Max.	Mean	St. Dev.	M1	M2	M3	M4	M5	M6	M7	M8	M9
Value of total savings other household members	5.80	12.27	5.99	0.86	X	X	X	X	X				X
Value of total savings spouse	4.44	11.60	4.96	1.36	X	X	X	X	X				X
Total value of agricultural assets (motor tiller, plow, irrigation, huskmach)	0.15	12.21	1.44	2.90	X	X	X	X	X				X
Value of air conditioner	2.30	11.51	7.46	2.84	X	X	X	X	X				X
Value of bed	1.90	12.92	7.22	2.51	X	X	X	X	X				X
Value of blanket	0.23	11.13	0.90	2.42	X	X	X	X	X				X
Value of black/ white TVs	-1.14	10.31	-0.77	1.86	X	X	X	X	X		X	X	X
Value of carpets	2.47	13.21	8.23	2.16	X	X	X	X	X				X
Value of other cooling or heating equipment	-2.55	10.71	-2.46	0.98	X	X	X	X	X				X
Value of color TVs	-1.17	12.21	-0.84	1.65	X	X	X	X	X		X	X	X
Value of milk cows	1.20	13.82	1.67	2.04	X	X	X	X	X				X
Value of dishes	2.15	13.32	6.46	3.21	X	X	X	X	X				X
Value of electronic heaters	-1.12	9.90	-0.33	2.52	X	X	X	X	X				X
Value of home library	2.52	15.20	4.81	3.17	X	X	X	X	X				X
Value of horses	1.90	12.90	2.60	2.47	X	X	X	X	X				X
Value of motor tillers	-0.96	10.17	-0.34	2.30	X	X	X	X	X				X
Value of musical instruments	0.08	11.70	1.35	2.96	X	X	X	X	X				X
Value of wooden plows	-1.49	9.62	-0.51	2.78	X	X	X	X	X				X
Value of metal pots	0.81	11.00	3.42	3.61	X	X	X	X	X				X
Value of tractors	1.35	13.43	1.73	1.83	X	X	X	X	X				X
Value of tubes for irrigation	-0.66	12.21	-0.56	1.05	X	X	X	X	X				X
Value of washing machines	1.38	11.13	3.94	3.71	X	X	X	X	X				X
Annualized total household expenditures	9.25	14.69	12.64	0.72	X						X	X	
Total value of household assets	5.70	15.71	11.79	1.44	X	X							X
Number of male adults in household	0.00	5.00	1.20	0.84	X	X	X	X	X	X	X	X	X
Ratio of male to females	0.00	5.00	1.00	0.86	X	X	X	X	X	X	X	X	
Do you have market/ bazaar?	0.00	1.00	0.49	0.50	X	X	X	X	X	X	X	X	
How far away the market/ bazaar (km)?	0.00	97.00	9.98	19.35	X	X	X	X	X	X	X	X	
Motor cultivator ownership	0.00	1.00	0.00	0.03	X	X	X	X	X	X			X
Motorcycle ownership	0.00	1.00	0.33	0.47	X	X	X	X	X	X			X
Musical instrument ownership	0.00	1.00	0.16	0.37	X	X	X	X	X	X	X	X	X
Agricultural equipment number	0.00	15.00	0.27	1.47	X	X	X	X	X	X			X
Number of air conditioners	0.00	3.00	0.85	0.48	X	X	X	X	X	X			X

Variable Label	Min.	Max.	Mean	St. Dev.	M1	M2	M3	M4	M5	M6	M7	M8	M9
Autorick number	0.00	3.00	0.09	0.31	X	X	X	X	X	X			X
Beds number	0.00	50.00	2.41	3.56	X	X	X	X	X	X			X
Carpet number	0.00	25.00	4.28	3.14	X	X	X	X	X	X			X
Car number	0.00	20.00	0.02	0.70	X	X	X	X	X	X			X
Cd players number	0.00	2.00	0.31	0.47	X	X	X	X	X	X			X
Valuable cooling or heating equipment number	0.00	2.00	0.01	0.13	X	X	X	X	X	X			X
Colour TVs number	0.00	2.00	0.04	0.21	X	X	X	X	X	X			X
Dishes and plates number	0.00	300.00	20.99	40.41	X	X	X	X	X	X			X
Someone in household have a savings, checking, deposits or other type of account	0.00	1.00	0.23	0.42	X	X	X	X	X	X			
Home library number	0.00	2000.00	49.99	146.54	X	X	X	X	X	X			X
Horses number	0.00	6.00	0.11	0.45	X	X	X	X	X	X			X
Microwaves number	0.00	2.00	0.09	0.30	X	X	X	X	X	X			X
Milk cow number	0.00	200.00	0.35	7.04	X	X	X	X	X	X			X
Motorcycles number	0.00	200.00	5.06	12.01	X	X	X	X	X	X			X
Motor tillers number	0.00	6.00	0.11	0.47	X	X	X	X	X	X			X
Household declares to not be able to save anything	0.00	1.00	0.65	0.48	X	X	X	X	X	X			X
Pigs number	0.00	13.00	0.28	1.27	X	X	X	X	X	X			X
Sheep and goat number	0.00	150.00	1.91	9.23	X	X	X	X	X	X			X
Suits and valuable dresses number	0.00	15.00	0.20	1.01	X	X	X	X	X	X			X
Tractor number	0.00	3.00	0.06	0.28	X	X	X	X	X	X			X
Washing machines number	0.00	3.00	0.33	0.49	X	X	X	X	X	X			X
During the past 5 years, did you have other natural disaster	0.00	1.00	0.02	0.15	X	X	X	X	X	X	X	X	
Household lives in own house	0.00	1.00	0.93	0.26	X	X	X	X	X	X	X	X	X
Deg. Participation in farmers group	0.00	1.00	0.00	0.05	X	X	X	X			X	X	
Number of programs available in community (out of 4)	0.00	4.00	1.76	1.16	X	X	X	X					
Deg. participation school committee	0.00	1.00	0.01	0.12	X	X	X	X			X	X	
Deg. participation sports group	0.00	1.00	0.01	0.08	X	X	X	X			X	X	
Deg. Participation in traders associations	0.00	1.00	0.00	0.03	X	X	X	X			X	X	
Do you have shop for pesticides and/or fertilizer?	0.00	1.00	0.28	0.45	X	X	X	X	X	X	X	X	
How far away the phone station (km)?	0.00	47.00	4.79	11.94	X	X	X	X	X	X	X	X	
Pigs ownership	0.00	1.00	0.08	0.27	X	X	X	X	X	X			X
Household has piped water in house	0.00	1.00	0.54	0.50	X	X	X	X	X	X	X	X	X
Do you have post office?	0.00	1.00	0.75	0.44	X	X	X	X	X	X	X	X	

Variable Label	Min.	Max.	Mean	St. Dev.	M1	M2	M3	M4	M5	M6	M7	M8	M9
How far away the post office (km)?	0.00	47.00	4.17	10.45	X	X	X	X	X	X	X	X	
Do you have private polyclinic/hospital?	0.00	1.00	0.39	0.49	X	X	X	X	X	X	X	X	
Dependency ratio younger than 15 or older than 64 years	0.00	100.00	9.97	29.07	X	X	X	X	X	X			
Number of household members who can read only	0.00	4.00	0.05	0.25	X	X	X	X	X	X			X
Refrigerator ownership	0.00	1.00	0.73	0.45	X	X	X	X	X	X	X	X	X
Household head is Christian	0.00	1.00	0.37	0.48	X	X	X	X	X	X	X	X	
Remittances sent/ total household expenditures	0.06	0.95	0.28	0.24	X						X	X	X
Head of household is retired (1=Yes, 0=no)	0.00	1.00	0.27	0.44	X	X	X	X	X	X	X	X	X
Rickshaw ownership	0.00	1.00	0.16	0.37	X	X	X	X	X	X	X	X	X
Ratio of male adults to female adults	0.00	4.00	0.89	0.67	X	X	X	X	X	X	X	X	
Rooms per person	0.17	5.00	1.01	0.63	X	X	X	X	X	X			X
Head is salaried worker - employee	0.00	1.00	0.07	0.25	X	X	X	X	X	X			X
Head is salaried-production worker	0.00	1.00	0.22	0.41	X	X	X	X	X	X			X
Head is seller at the bazaar	0.00	1.00	0.02	0.15	X	X	X	X	X	X			X
Total number of days sick by females	0.00	1345.00	56.02	107.49	X	X	X	X	X	X			X
Average number of days sick by females	0.00	365.00	31.37	61.90	X	X	X	X	X	X			X
Head is state official - military	0.00	1.00	0.03	0.17	X	X	X	X	X	X			X
Do you have state polyclinic/hospital?	0.00	1.00	0.80	0.40	X	X	X	X	X	X	X	X	
Tractor ownership	0.00	1.00	0.05	0.21	X	X	X	X	X	X			X
Wardrobe in house	0.00	1.00	0.94	0.23	X	X	X	X	X	X			X
Household head is widow	0.00	1.00	0.16	0.36	X	X	X	X	X	X	X	X	X
Wooden plow ownership	0.00	1.00	0.11	0.32	X	X	X	X	X	X	X	X	X
Total amount borrowed from formal institutions	4.98	15.38	5.30	1.48	X	X	X	X	X				X
Total outstanding debt to formal institutions	5.43	15.72	5.80	1.53	X	X	X	X	X				
Household head completed only primary education	0	1	0.01	0.12									X
Household head: incomplete primary education	0	1	0.03	0.18									X
Household head has no schooling or did not complete gr.1	0	1	0.01	0.12									X
Household head completed only secondary/post primary education	0	1	0.64	0.48									X
Household head: incomplete secondary education	0	1	0.09	0.29									X
Household head completed superior education	0	1	0.19	0.40									X
Household head: incomplete superior education	0	1	0.01	0.11									X
Number of household members with no schooling or incomp gr. 1	0	4	0.50	0.78									X
Number of household members with incomplete primary education	0	4	0.32	0.60									X
Number of household members with complete primary education	0	1	0.07	0.25									X

Variable Label	Min.	Max.	Mean	St. Dev.	M1	M2	M3	M4	M5	M6	M7	M8	M9
Number of household members with incomplete secondary education	0	5	0.52	0.77									
Number of household members with complete secondary education	0	8	1.19	1.17									X
Number of household members with incomplete degree	0	3	0.13	0.39									X
Number of houehold members with complete degree	0	5	0.27	0.59									X

Annex C: Gender-specific variables used in regression analysis

Note: This list does not include gender-specific poverty indicators among the first set of 598 regressors that were submitted to the first MAXR analysis but to the set of the best 250 indicators that came out of that regression.

Variable Label	Min.	Max.	Mean	St. Dev.
If spouse has any account	0.00	1.00	0.08	0.27
Number of females with some chronic illness	0.00	5.00	0.56	0.76
Number of females with some disability	0.00	2.00	0.09	0.30
Number of males with some disability	0.00	2.00	0.09	0.29
Number of literate females in household	0.00	8.00	1.91	1.08
Number of literate male adults in household	0.00	5.00	1.18	0.84
Number of literate males in household	0.00	5.00	1.59	1.10
Value of total savings spouse	4.44	11.60	4.96	1.36
Ratio of male adults to female adults	0.00	4.00	0.89	0.67
Number of male adults in household	0.00	5.00	1.20	0.84
Ratio of male to females	0.00	5.00	1.00	0.86
Total number of days sick by females	0.00	1345.00	56.02	107.49
Average number of days sick by females	0.00	365.00	31.37	61.90

Note: N = 817 households

Annex D: Verifiability scores provided by SANGE

Variable assessment scale: 1 very hard – 5 easily verifiable
Note: The indicators with verifiability scores of 4 or 5 have been included in Model 7 and Model 8

Table D.1 Verifiability score of the variables

Source: Communication via email in February 2005 with SANGE, Kazakhstan (based on SANGE's own assessment)

Variable	Measurement	Verifiability	Difficulty to ask
Do head and spouse have a joint bank account?	Yes/No	2	3
Does the spouse have any bank account?	Yes/No	2	3
Number of agricultural assets owned	Number	2	5
Average age of all household members	Years	3	5
Age of household head	Years	5	5
Age of youngest household member	Years	3	5
Area of Major buildings and additional structures	100 sq. m.	5	5
Area of agricultural land under irrigation	100 sq. m.	1	5
Is the majority of streets asphalted in this community? Community variable	Yes/No	5	5
Autorickshaw ownership	Yes/No		
Bed ownership	Yes/No	5	3
Blanket ownership	Yes/No	5	3
Do you have bus station?	Yes/No	5	5
Carpet ownership	Yes/No	5	2
Contribution to cooperatives (in cash or in kind)	Contribution/No contribution	2	5
CD player ownership	Yes/No	2	5
Do you have access to a cellular communication station? Community variable	Yes/No	5	5
How far away the access to cellular communication station (km)?	Km	5	5

Variable	Measurement	Verifiability	Difficulty to ask
Household head is chronically ill	Yes/No	2	2
Percentage of chronically ill adults (in relation to household size)	Number	2	2
Number of females with some chronic illness	Number	2	2
Do you have cinema? Community variable	Yes/No	5	5
Contribution to neighbors group (in cash or in kind)	Contribution/No contribution	3	3
Ownership other cooling or heating equipment	Yes/No	3	5
Contribution political group	Contribution/No contribution	3	3
Do you have cabinet of a private doctor?	Yes/No	3	5
Head is craftsman	Yes/No	5	5
Contribution to school committee (in cash or in kind)	Contribution/No contribution	3	5
How far away the cultural center (km)? Community variable	Km	5	5
How many rooms does the dwelling have?	Number	3	3
Have you made a recent home improvement in the last three years?	Yes/No	4	5
Do you have Mobile (cell phone) in the house?	Yes/No	5	5
Head of household sleeps on floor or thin sleeping mat	Yes/No	3	2
Head of household sleeps on thick mattress	Yes/No	3	2
Household head sleeps on self made bed	Yes/No	2	2
Household ate sometimes self cooked bread/flat cakes because other food was scarce	Yes/No	2	2
Cooking fuel is Gas from public grid	Yes/No	5	5
Household rarely ate crackers because other food was scarce	Yes/No	1	2
Household ate sometimes crackers because other food was scarce	Yes/No	1	2
Community was affected by any natural disaster during past 5 years. Community variable	Yes/No	5	5
Household sometimes didn't have enough food	Yes/No	2	1
Household often didn't have enough food	Yes/No	2	1
Percentage of dependents lt 14 and gt 60 years (in rel. to household size)	Number	5	5

Variable	Measurement	Verifiability	Difficulty to ask
Percentage of dependents lt 15 and gt 64 years (in relation to household size)	Number	5	5
Percentage of dependents lt 18 and gt 60 years (in relation to household size)	Number	5	5
Floor is ground	Yes/No	5	5
Floor is cement simple or covered (such as tiles)	Yes/No	5	5
Floor is linoleum, dutch tile or parquet	Yes/No	5	5
Household usually purchases flour more than twice a week	Yes/No	3	5
Household usually purchases flour once every 2 weeks	Yes/No	3	5
Household usually purchases flour monthly	Yes/No	3	5
Household feels accepted as a member of this village/neighborhood?	Yes/No	2	3
Household feels that clothing expenses are above need	Yes/No	2	3
Household feels that health care expenses are above need	Yes/No	2	3
Household feels that child educ. expenses are above need	Yes/No	2	4
Household feels that housing expenses are below need	Yes/No	2	2
Household feels that housing expenses are above need	Yes/No	3	3
Household feels living standard improved significantly compared to 1996	Yes/No	1	4
Household feels living standard same as compared to 1996	Yes/No	1	4
Household feels living standards worse compared to 1996	Yes/No	1	4
House structure: dilapidated	Yes/No	3	3
Number of females with some disability	Number	1	1
Household head has any disability	Yes/No	1	1
Household owns Dishes	Yes/No	1	1
Number of males with some disability	Number	1	1
Distance to oblast center?	Km	5	5
Household head is divorced	Yes/No	3	3
Household cooks in one of the rooms in the house	Yes/No	5	5
Household speaks Kazakh or other (minority language)	Yes/No	5	5
Household ate sometimes lenten soup because other food was scarce	Yes/No	1	2
Metal frame with padlock in main entrance door	Yes/No	2	1

Variable	Measurement	Verifiability	Difficulty to ask
Household ate sometimes macaroni because other food was scarce	Yes/No	2	1
Household ate often macaroni because other food was scarce	Yes/No	2	1
Quality of walls: poor	Yes/No	4	2
Household ate rarely rice and cereals because other food was scarce	Yes/No	2	2
Household ate sometimes rice and cereals because other food was scarce	Yes/No	2	2
Household ate often rice and cereals because other food was scarce	Yes/No	2	2
Household ate mostly rice and cereals because other food was scarce	Yes/No	2	2
Roof material is straw or wood	Yes/No	3	3
Roof material is ruberoid	Yes/No	3	3
Household had to skip meals less than 10 days during past 12 months because not enough food available	Yes/No	1	1
Toilet: bush, field, no facility or shared pit toilet	Yes/No	1	3
Toilet: shared or own latrine	Yes/No	3	3
Toilet: shared or own flush toilet	Yes/No	3	3
Exterior walls: wireframed reed or clay walls	Yes/No	5	3
Water source is Dam/pond/river/spring	Yes/No	5	5
Water source is Well in residence yard	Yes/No	5	5
Number of meals served to the household members in the last 2 days	Number	2	3
In the last seven days, how many days a main meal was based on chicken?	Number	2	4
In the last seven days, how many days a main meal was based on Butter?	Number	2	4
In the last seven days, how many days a main meal was based on Cheese and/or Sausage?	Number	2	4
How many kilograms of flour do you usually buy in a single purchase?	Number	2	5
During last 30 days, how many days did household not have enough food to eat?	Number	2	2
For how many days will stock of flour last?	Number	3	5
In last 12 months were your household members worried that your food would run out before you had money to buy more?	Yes/No	2	3
In last 12 months did you or any other adult in your household skip meals	Yes/No	2	2

Variable	Measurement	Verifiability	Difficulty to ask
because you did not have enough money to buy?			
In last 12 months did you or any other adult in your household stop eating for an entire day because you did not have enough money to buy?	Yes/No	2	2
Education level of household head	Class completed	4	5
Maximum education level of any household member	Class completed	4	5
Minimum education level of any household member	Class completed	4	5
Electric or gas cooker ownership	Yes/No	5	5
Electric heater ownership	Yes/No	5	5
Head of household is farmer (1=Yes, 0=no)	Yes/No	4	5
During the past 5 years, did you have fire	Yes/No	3	5
Food expenditure as a share of total household expenditures	Number	3	5
Number of household members (or relatives) working abroad and sending money	Number	3	
Birth of own child in last 3 years?	Yes/No	5	5
Adoption of a child in last 3 years?	Yes/No	2	5
We received dowry/kalym/bride-money Or important valuable gift in last 3 years?	Yes/No	2	2
Relocation of residence/household because of other reasons such as natural disasters In last 3 years	Yes/No	5	2
Did your household have a very serious problem or failure in your own crop production In last 3 years?	Yes/No	4	5
Did your household have a very serious problem or failure in your own micro-enterprise In last 3 years?	Yes/No	4	4
Total household members in civic group	Number	3	4
Household in NGO for entrepreneurial services	Yes/No	3	5
Total household members in other groups	Number	3	5
Total household members in other NGO	Number	3	5
Household in other NGO	Yes/No	3	5
Total of household members in political group	Number	3	5
Household in political group	Yes/No	3	5

Variable	Measurement	Verifiability	Difficulty to ask
Total of household members in religious group	Number	3	5
Total household members in school committee	Number	5	5
Total household members in Traders Association	Number	3	5
Household in Traders association	Yes/No	3	5
Household in water/waste group	Yes/No	5	5
Have you or members of household are denied service or only limited opportunity to water supply	Yes/No	5	5
Have you or members of household are denied service or only limited opportunity to utilities services (sanitary technicians)	Yes/No	3	3
Were you or your household denied for service or limited for receiving social help	Yes/No	3	3
Have you or members of household are denied service or only limited opportunity to healthcare services: hospital	Yes/No	3	5
Have you or members of household are denied service or only limited opportunity to medical products and medical material	Yes/No	3	5
Have you or members of household are denied service or only limited opportunity to labor registry office	Yes/No	3	5
Total Number of memberships on different institutions/organizations		3	5
Household is NOT member of any institution	Yes/No	3	5
On which step of this ladder are you located today?	Step on ladder	5	5
Where on the ladder would you locate a household, who has an income equal to 15000 tenge per month?	Step on ladder	5	5
Where on the ladder would you locate your household 8 years ago?	Step on ladder	5	5
Horses ownership	Yes/No	5	5
Head of household is occupied in housework (1=Yes, 0=no)	Yes/No	4	5
Household rates itself below the step reflecting the respective nat. pov. Line	Yes/No	3	1
Number of steps above step identified as respective nat pov. line, if minus below	Step on ladder	4	5
Subjective change in living standards in last 8 years, recoding H09	Improved/Worsened	5	4

Variable	Measurement	Verifiability	Difficulty to ask
Head of household chooses leisure (1=Yes, 0=no)	Yes/No	2	2
Value of agricultural land under irrigation	Tenge	1	2
Value of agricultural land under no irrigation	Tenge	1	2
Annualized food expenditures, recall 1 week	Tenge	2	5
Number of adult household members who can read and write	Number	3	5
Number of literate females in household	Number	3	5
Number of literate male adults in household	Number	3	5
Number of literate males in household	Number	3	5
Weekly expenditures for buying food	Tenge	2	3
Weekly value of food farm/garden-produced	Tenge	2	1
Monthly expenditures on utilities	Tenge	5	5
Monthly expenditure on fuel	Tenge	5	5
Monthly value of other goods-cooking fuel produced on farm/garden	Tenge	5	5
Expenditures in school/education, last 12 months	Tenge	5	5
Expenditures on health, last 12 months	Tenge	2	2
Expenditures on home, last 12 months	Tenge	5	5
Expenditures on furniture, last 12 months	Tenge	5	5
Remittances sent to relatives, last 12 mo.	Tenge	5	5
Expenditures on other expenditures-social events, leisure, last 12mo	Tenge	2	2
Household clothing expenditures in past 12 months	Tenge	4	5
Value of total savings other household members (not head or spouse)	Tenge	1	1
Value of total savings spouse	Tenge	1	1
Total value of agricultural assets (motor tiller, plow, irrigation, uskmach)	Tenge	3	5
Value of air conditioner	Tenge	4	5
Value of bed	Tenge	2	2
Value of blanket	Tenge	2	2
Value of black/ white TVs	Tenge	5	5
Value of carpets	Tenge	3	3
Value of other cooling or heating equipment	Tenge	4	4
Value of color TVs	Tenge	5	5

Variable	Measurement	Verifiability	Difficulty to ask
Value of milk cows	Tenge	2	2
Value of dishes	Tenge	1	1
Value of electronic heaters	Tenge	2	4
Value of home library	Tenge	1	4
Value of horses	Tenge	1	4
Value of motor tillers	Tenge	3	3
Value of musical instruments	Tenge	1	4
Value of wooden plows	Tenge	2	3
Value of metal pots	Tenge	2	1
Value of tractors	Tenge	2	4
Value of tubes for irrigation	Tenge	2	4
Value of washing machines	Tenge	4	5
Annualized total household expenditures	Tenge	5	5
Total value of household assets	Tenge	2	2
Number of male adults in household	Number	5	5
Ratio of male to females	Number	5	5
Do you have market/ bazaar?	Yes/No	5	5
How far away the market/ bazaar (km)?	Km	5	5
Motor cultivator ownership	Yes/No	3	5
Motorcycle ownership	Yes/No	3	5
Musical instrument ownership	Yes/No	5	5
Agricultural equipment number	Number	4	5
Number of air conditioners	Number	4	5
Autorick number	Number	4	5
Beds number	Number	4	3
Carpet number	Number	4	3
Car number	Number	3	3
Cd players number	Number	3	3
Valuable cooling or heating equipment number	Number	3	3
Color TVs number	Number	3	3

Variable	Measurement	Verifiability	Difficulty to ask
Dishes and plates number	Number	1	2
Someone in household have a savings, checking, deposits or other type of account	Yes/No	1	1
Home library number	Number	3	4
Horses number	Number	3	5
Microwaves number	Number	3	2
Milk cow number	Number	3	4
Motorcycles number	Number	3	4
Motor tillers number	Number	3	4
Household declares to not be able to save anything	Yes/No	3	4
Pigs number	Number	3	4
Sheep and goat number	Number	3	4
Suits and valuable dresses number	Number	2	2
Tractor number	Number	2	4
Washing machines number	Number	2	4
During the past 5 years, did you have other natural disaster	Yes/No	5	5
Household lives in own house	Yes/No	5	5
Degree Participation in farmers group	Active participation / No participation	5	5
Number of programs available in community (out of 4)	Number	2	2
Degree participation school committee	Active participation / No participation	5	5
Degree participation sports group	Active participation / No participation	5	5
Degree Participation in traders associations	Active / No participation	5	5
Do you have shop for pesticides and/or fertilizer?	Yes/No	5	5
How far away the phone station (km)?	Km	5	5
Pigs ownership	Yes/No	3	4
Household has piped water in house	Yes/No	5	5

Variable	Measurement	Verifiability	Difficulty to ask
Do you have post office?	Yes/No	5	5
How far away the post office (km)?	Km	5	5
Do you have private polyclinic/hospital?	Yes/No	5	5
Dependency ratio persons younger than 15 or older than 64 years	Number	1	4
Number of household members who can read only	Number	1	4
Refrigerator ownership	Yes/No	5	5
Household head is Christian	Yes/No	5	5
Ratio of Remittances sent/total household expenditures	Number	5	5
Head of household is retired (1=Yes, 0=no)	Yes/No	5	5
Rickshaw ownership	Yes/No	5	5
Ratio of male adults to female adults	Number	5	5
Rooms per person	Number	4	5
Head is salaried worker – employee	Yes/No	4	5
Head is salaried-production worker	Yes/No	4	5
Head is seller at the bazaar	Yes/No	4	5
Total number of days sick by females	Number	1	1
Average number of days sick by females	Number	1	1
Head is state official – military	Yes/No	4	5
Do you have state polyclinic/hospital?	Yes/No	5	5
Tractor ownership	Yes/No	4	5
Wardrobe in house	Yes/No	2	4
Household head is widow	Yes/No	5	4
Wooden plow ownership	Yes/No	5	5
Total amount borrowed from formal institutions	Tenge	5	4
Total outstanding debt owed to formal institutions	Tenge	3	5

Annex E: Accuracy performance of regression models

Annex E.1: Single-step OLS models with per-capita daily expenditures as continuous dependent variable (selection of regressors by MAXR)

Annex E.1.1 Results on accuracy of models, predicting the Very-Poor

Model	Description	Type	Adj. R^2	Total Accuracy (%)	Poverty Accuracy (%)	Under-coverage (%)	Leakage (%)	PIE (% points)	BPAC (% points)
1	All 260 regressors *(Ref. Table 3.1.2)*	B-5	0.567	95.71	13.51	86.48	8.1	-3.55	-64.87
		B-10	0.594	95.22	10.81	89.18	16.21	-3.30	-62.16
		B-15	0.619	95.47	10.81	89.18	10.81	-3.55	-67.56
2	Exclusion of expenditure variables except *weekly expenditures on food* and *expenditures on others (social events, leisure) in past 12 mo.* *(Ref. Table 3.2.1)*	B-5	0.558	95.83	16.21	83.78	8.1	-3.42	-59.47
		B-10	0.583	95.83	13.51	86.48	5.4	-3.67	-67.57
		B-15	0.601	95.83	16.21	83.78	8.1	-3.42	-59.47
3	Exclusion of *total value of household assets* *(Ref. Table 3.3.1)*	B-5	0.509	95.47	8.1	91.89	8.1	-3.79	-75.69
		B-10	0.563	95.1	5.4	94.59	13.51	-3.67	-75.68
		B-15	0.591	94.98	5.4	94.59	16.21	-3.55	-72.98
4	Exclusion of except *weekly expenditures on food* and *expenditures on others (social events, leisure) in past 12 mo.* *(Ref. Table 3.4.1)*	B-5	0.463	95.34	2.7	97.29	5.4	-4.16	-89.19
		B-10	0.525	95.1	8.1	91.89	16.21	-3.42	-67.58
		B-15	0.556	95.22	5.4	94.59	10.81	-3.79	-78.38

Model	Description	Type	Adj. R^2	Total Accuracy (%)	Poverty Accuracy (%)	Under-coverage (%)	Leakage (%)	PIE (% points)	BPAC (% points)
5	Exclusion subjective variables *(Ref. Table 3.5.1)*	B-5	0.404	95.47	0	100	0	-4.52	-100
		B-10	0.468	95.47	0	100	0	-4.52	-100
		B-15	0.497	95.34	0	100	2.7	-4.40	-97.3
6	Exclusion monetary variables *(Ref. Table 3.6.1)*	B-5	0.389	95.47	0	100	0	-4.52	-100
		B-10	0.454	95.47	0	100	0	-4.52	-100
		B-15	0.487	95.34	0	100	2.7	-4.40	-97.3
7	Easily verifiable variables (SANGE) *(Ref. Table 3.7.1)*	B-5	0.472	95.34	2.7	97.29	5.4	-4.16	-89.19
		B-10	0.509	95.34	2.7	97.29	5.4	-4.16	-89.19
		B-15	0.533	95.83	10.81	89.18	2.7	-3.91	-75.67
8	Model 7 plus strong subjective and expenditure regressors *(Ref. Table 3.8.1)*	B-5	0.526	95.34	5.4	94.59	8.1	-3.91	-81.09
		B-10	0.561	95.47	5.4	94.59	5.4	-4.04	-83.79
		B-15	0.578	95.71	10.81	89.18	5.4	-3.79	-72.97
9	LSMS-type regressors *(Ref. Table 3.9.1)*	B-5	0.513	95.83	13.51	86.49	5.41	-3.67	-67.57
		B-10	0.535	95.96	13.51	86.49	2.7	-3.79	-70.27
		B-15	0.550	96.08	13.51	86.49	0	-3.92	-72.97

Annex E.1.2 Results on accuracy of models, predicting the National Poor

Model	Description	Type	Adj. R^2	Total Accuracy (%)	Poverty Accuracy (%)	Under-coverage (%)	Leakage (%)	PIE (% points)	BPAC (% points)
1	All 260 regressors *(Ref. Table 3.1.2)*	B-5	0.567	91.79	24.32	75.67	14.86	-5.51	-36.49
		B-10	0.594	92.28	32.43	67.56	17.56	-4.53	-17.57
		B-15	0.619	92.41	33.78	66.21	17.56	-4.40	-14.87
2	Exclusion of expenditure variables except *weekly expenditures on food* and *expenditures on others (social events, leisure) in past 12 mo. (Ref. Table 3.2.1)*	B-5	0.558	90.94	21.62	78.37	21.62	-5.14	-35.13
		B-10	0.583	91.79	24.32	75.67	14.86	-5.51	-36.49
		B-15	0.601	92.28	27.02	72.97	12.16	-5.51	-33.79
3	Exclusion of *total value of household assets (Ref. Table 3.3.1)*	B-5	0.509	90.82	13.51	86.48	14.86	-6.48	-58.11
		B-10	0.563	91.43	22.97	77.02	17.56	-5.38	-36.49
		B-15	0.591	91.18	24.32	75.67	21.62	-4.89	-29.73
4	Exclusion of except *weekly expenditures on food* and *expenditures on others (social events, leisure) in past 12 mo. (Ref. Table 3.4.1)*	B-5	0.463	90.69	8.1	91.89	10.81	-7.34	-72.98
		B-10	0.525	91.06	17.56	82.43	16.21	-5.99	-48.66
		B-15	0.556	91.67	25.67	74.32	17.56	-5.14	-31.09

Model	Description	Type	Adj. R^2	Total Accuracy (%)	Poverty Accuracy (%)	Under-coverage (%)	Leakage (%)	PIE (% points)	BPAC (% points)
5	Exclusion subjective variables *(Ref. Table 3.5.1)*	B-5	0.404	90.82	2.7	97.29	4.05	-8.44	-90.54
		B-10	0.468	90.94	5.4	94.59	5.4	-8.08	-83.79
		B-15	0.497	91.18	10.81	89.18	8.1	-7.34	-70.27
6	Exclusion monetary variables *(Ref. Table 3.6.1)*	B-5	0.389	90.82	2.7	97.29	4.05	-8.44	-90.54
		B-10	0.454	90.69	5.4	94.59	8.1	-7.83	-81.09
		B-15	0.487	91.67	16.21	83.78	8.1	-6.85	-59.47
7	Easily verifiable variables (SANGE) *(Ref. Table 3.7.1)*	B-5	0.472	91.06	12.16	87.83	10.81	-6.97	-64.86
		B-10	0.509	91.43	14.86	85.13	9.45	-6.85	-60.82
		B-15	0.533	91.18	14.86	85.13	12.16	-6.61	-58.11
8	Model 7 plus strong subjective and expenditure regressors *(Ref. Table 3.8.1)*	B-5	0.526	90.69	14.86	85.13	17.56	-6.12	-52.71
		B-10	0.561	90.82	13.51	86.48	14.86	-6.48	-58.11
		B-15	0.578	91.43	17.56	82.43	12.16	-6.36	-52.71
9	LSMS-type regressors *(Ref. Table 3.9.1)*	B-5	0.513	91.31	16.21	83.78	12.16	-6.48	-55.41
		B-10	0.535	91.67	17.57	82.43	9.46	-6.61	-55.41
		B-15	0.550	92.04	21.62	78.38	9.46	-6.24	-47.30

Annex E.2: Two-step models with a continuous dependent variable (OLS estimation) for Models 1, 4, 7, and 9

OLS 2-Step Poverty rate: 4.52%	**Adj. R^2**	**Total Accuracy (%)**	**Poverty Accuracy (%)**	**Under-coverage (%)**	**Leakage (%)**	**PIE (% point)**	**BPAC (% point)**
Model 1 Percentile 22nd	0.486 subsample	96.45	40.54	59.45	18.91	-1.83	0
Model 4 Percentile 18th	0.471 subsample	96.7	43.24	56.76	16.22	-1.84	2.70
Model 7 Percentile 20th	0.421 subsample	95.96	21.62	78.38	10.81	-3.06	-45.95
Model 9 Percentile 20th	0.433 subsample	95.84	32.43	67.57	24.32	-1.96	-10.81

Annex E.3: Summary results for all single and two-step regressions for Models 1, 4, 7 and 9

Model 1 Poverty rate: 4.52%	**Adj. R^2**	**Total Accuracy (%)**	**Poverty Accuracy (%)**	**Under-coverage (%)**	**Leakage (%)**	**PIE (% point)**	**BPAC (% point)**
Single-step methods -MAXR variable selection							
OLS	0.619	95.47	10.81	89.19	10.81	-3.55	-67.57
Quantile regression (estimation point: 26)		95.23	48.65	51.35	54.05	***0.12***	*45.95*
Linear Probability	0.253	95.96	10.81	89.19	0	-4.04	-78.37
Probit		96.45	40.54	59.46	18.92	-1.84	0
Two-step methods -MAXR variable selection							
OLS Percentile 22nd	0.486 subsample	96.45	40.54	59.45	18.91	-1.83	0
Quantile regression (estimation points 26, 5) – 22 perc. Cutoff		96.08	56.76	43.24	43.24	0	**56.76**
Linear Probability Percentile 23rd	0.375 subsample	97.06	48.65	51.35	13.51	-1.71	10.81
Probit Percentile 23rd	N/A[1]						

[1] Two-step Probit could neither be computed for Model 1 nor for Model 4, Model 7 and Model 9.

Model 4 Poverty rate: 4.52%	**Adj. R^2**	**Total Accuracy (%)**	**Poverty Accuracy (%)**	**Under-coverage (%)**	**Leakage (%)**	**PIE (% point)**	**BPAC (% point)**
Single-step methods -MAXR variable selection							
OLS	0.557	95.23	5.41	94.59	10.81	-3.79	-78.38
Quantile regression (estimation point: 27)		93.64	29.73	70.27	70.27	**0.00**	29.72
Linear Probability	0.229	95.59	5.41	94.59	2.7	-4.16	-86.48
Probit		96.21	29.73	70.27	13.51	-2.57	-27.03
Two-step methods -MAXR variable selection							
OLS Percentile 18th	0.471 subsample	96.7	43.24	56.76	16.22	-1.84	2.70
Quantile regression (estimation points 27, 5) – 18 perc. Cutoff		94.61	40.54	59.46	59.46	**0.00**	**40.54**
Linear Probability Percentile 23rd	0.389 subsample	98.04	62.16	37.84	5.41	*-1.47*	*29.73*
Probit Percentile 23rd	N/A						

Model 7 Poverty rate: 4.52%	**Adj. R^2**	**Total Accuracy (%)**	**Poverty Accuracy (%)**	**Under-coverage (%)**	**Leakage (%)**	**PIE (% point)**	**BPAC (% point)**
Single-step methods -MAXR variable selection							
OLS	0.533	95.84	10.81	89.19	2.70	-3.92	-75.68
Quantile regression (estimation point: 18)		92.66	21.62	78.38	83.78	**0.24**	*16.22*
Linear Probability	0.160	95.59	5.4	94.59	2.7	-4.16	-86.49
Probit		95.96	24.32	75.68	13.51	-2.82	-37.84
Two-step methods -MAXR variable selection							
OLS Percentile 20th	0.421 subsample	95.96	21.62	78.38	10.81	-3.06	-45.95
Quantile regression (estimation points 18, 4) – 20 perc. Cutoff		94.61	43.24	56.76	62.16	**0.24**	**37.84**
Linear Probability Percentile 20th	0.241 subsample	97.18	48.65	51.35	10.81	-1.84	8.10
Probit Percentile 20th	N/A						

Model 9 Poverty rate: 4.52%	**Adj. R^2**	**Total Accuracy (%)**	**Poverty Accuracy (%)**	**Under-coverage (%)**	**Leakage (%)**	**PIE (% point)**	**BPAC (% point)**
Single-step methods –MAXR variable selection							
OLS	0.550	96.08	13.51	86.49	0	-3.92	-72.97
Quantile regression (estimation point: 23)		94.74	45.95	54.05	62.16	***0.37***	*37.84*
Linear Probability	0.166	95.59	5.4	94.59	2.7	-4.16	-86.49
Probit		96.20	32.43	67.57	16.22	-2.33	-18.92
Two-step methods -MAXR variable selection							
OLS Percentile 20th	0.433 subsample	95.84	32.43	67.57	24.32	-1.96	-10.81
Quantile regression (estimation points 23, 5) - 20 perc. Cutoff		94.61	40.54	59.46	59.46	0	**40.54**
Linear Probability Percentile 22nd	0.463 subsample	96.94	43.24	56.76	10.81	-2.08	-2.7
Probit Percentile 22nd		N/A					

Annex F: Variables included in the BEST15 models

Annex F.1: Variables included in the single-step OLS models (BEST 15 sets)

Variable label	M1	M2	M3	M4	M5	M6	M7	M8	M9
Autorickshaw ownership	X	X	X	X	X	X			
Head of household sleeps on floor or thin sleeping mat	X			X		X			
Household often didn't have enough food	X		X	X					
Percentage of dependents younger than 18 and older than 60 years (in relation to household size)	X						X	X	
Share of food expenditures from total household expenditures section C	X								
Household belongs to traders association	X	X	X	X	X	X			
Number of steps above the step identified as respective nat. poverty line (if minus below)	X	X	X	X				X	
Annualized food expenditures, recall 1 week	X								
Expenditures in school/education, last 12 months	X								
Expenditures on others (social events, leisure), last 12 months	X	X	X					X	
Value of color TVs	X						X		
Total value of household assets	X	X							X
Number of horses owned	X		X	X	X				
Household has piped water in house	X	X	X		X				X
Head is salaried-production worker	X	X							
Squared age of household head		X	X	X				X	X
Metal frame with padlock as lock in main entrance door		X							
Exterior walls material is wireframed reed or clay		X				X	X	X	X
Days in the last seven days with the main meal based on butter		X							
Number of adult household		X			X	X			

Variable label	M1	M2	M3	M4	M5	M6	M7	M8	M9
members who can read and write									
Weekly expenditures on food		X	X						
Number of milk cows owned		X				X			X
Number of sheep and goats owned		X			X	X			X
Household has mobile (cell phone)			X	X	X	X	X	X	X
Number of meals served to the household members during the last 2 days			X	X				X	
Kilograms of flour usually bought in a single purchase			X	X				X	
Maximum education level of any household member			X	X	X	X			
Value of dishes			X	X	X				
Rickshaw ownership			X	X	X	X	X	X	
Days in the last seven days with the main meal based on cheese and/or sausages				X				X	
Musical instrument ownership				X			X	X	X
House structure: dilapidated					X				
Household's water source is dam/pond/river/spring					X		X		
Value of washing machines					X				
Number of carpets owned					X	X			
Head is salaried worker – employee					X	X			X
Recent home improvements done in the last three years (yes/no)						X			
Dishes ownership						X			
Refrigerator ownership						X	X	X	
Flooring material is linoleum, dutch tile or parquet							X		
Position on the ladder of a household with a monthly income of 15 000 tenge							X		
Horses ownership							X	X	
Change on living standards in last 8 years (source H09)							X		
Expenditures on home, last 12 mo							X		
Annualized total household expenditures							X	X	
Sum of household clothing expenditures in past 12 months									X
Remittances sent/ total household expenditures							X	X	

Variable label	M1	M2	M3	M4	M5	M6	M7	M8	M9
Head is craftsman									X
Remittances sent to relatives in the last 12 months									X
Toilet: shared or own latrine									X
Number of household members with incomplete primary education									X
Number of household memebers with incomplete secondary education									X

Annex F.2: Variables included in the two-step OLS regressions (Models 1, 4, 7, and 9)

Variables Two step OLS	Model 1		Model 4		Model 7		Model 9	
	First step	Second step	First step	Second step	First step	Second step	First step	Second step
Head of household sleeps on floor or thin sleeping mat	X	X	X	X				
Autorickshaw ownership	X		X	X				
Household often didn't have enough food	X	X	X	X				
Percentage of dependents younger than 18 and older than 60 years (in relation to hh size)	X	X		X	X	X		
Share of food expenditures from total household expenditures	X	X						
Household belongs to traders association	X	X	X	X				
Number of steps above step identified as respective nat pov. Line, if minus below	X	X	X	X				
Annualized food expenditures, recall 1 week	X	X						
Expenditures in school/education in last 12 months	X	X						
Expenditures on other expenditures (social events, leisure) in last 12months	X	X						
Value of color TVs	X	X			X	X		
Total value of household assets	X	X					X	X
Number of horses owned by the household	X	X	X	X				
Household has piped water in house	X	X				X	X	X
Head is salaried-production worker	X	X						
Squared age of household head			X	X			X	

Variables Two step OLS	Model 1		Model 4		Model 7		Model 9	
	First step	Second step	First step	Second step	First step	Second step	First step	Second step
Sum of household clothing expenditures in past 12 months		X					X	
Expenditure on health in last 12 months		X						
Maximum education level of any household member		X	X	X				
Number of literate male adults in the household		X						
Rooms per person		X						
Metal frame with padlock as main entrance's lock		X		X				
Do you have Mobile (cell phone) in the house?		X	X	X	X	X	X	X
Horses ownership		X			X	X		
Head is craftsman		X				X	X	X
Contribution to school committee		X						
Household ate sometimes rice and cereals because other food was scarce		X						
Kilograms of flour usually bought in a single purchase		X	X	X				
Wireframed reed or clay as exterior walls' material		X			X	X	X	X
Number of meals served to the household members in the last 2 days			X	X				
In the last seven days, how many days Cheese and Sausages were served in a main meal?			X	X				
Value of dishes			X	X				
Floor material is linoleum, dutch tile or parquet					X	X		
Water source is dam/pond/river/spring					X	X		
Location of a household on the ladder, who has an income equal to 15000 tenge per month					X	X		
Subjective change in living standards in last 8 years					X	X		

Variables Two step OLS	Model 1		Model 4		Model 7		Model 9	
	First step	Second step	First step	Second step	First step	Second step	First step	Second step
Expenditures on home in the last 12 months					X	X		
Annualized total household expenditures					X	X		
Musical instrument ownership			X	X	X	X	X	X
Refrigerator ownership				X	X	X		X
Ratio of remittances sent/total household expenditures					X	X		
Rickshaw ownership			X	X	X	X		
Household rarely ate crackers because other food was scarce				X				
Household head is divorced				X				
In last 12 months were you and worried that your food would run out before you had money to buy more?				X				
Number of memberships out of 22 institutions				X				
Number of motorcycles owned by the household				X				
Household head is seller at the bazaar				X				
Value of black/ white TV s						X		X
Number of VCRs owned by the household						X		
Electric or gas cooker ownership						X		
Birth of own child in last 3 years						X		
Degree of participation in traders associations				X		X		
Do you have shop for pesticides and /or fertilizer in your community						X		
Remittances sent to relatives in the last 12 months							X	X
Head is salaried worker – employee							X	X
Number of milk cows owned by the household							X	X

Variables Two step OLS	Model 1		Model 4		Model 7		Model 9	
	First step	Second step	First step	Second step	First step	Second step	First step	Second step
Value of musical instruments								X
Sum of all household members, past 12 months								X
Household head completed only secondary/post primary education								X
Number of household members with incomplete secondary education, excluding household head							X	X
Number of household members with incomplete primary education							X	X
Toilet: shared or own latrine							X	X
Number of sheep and goat owned by the household							X	X
Area of agricultural land under irrigation			X	X				X
Whether spouse has any account								X
Number of females with some disability								X

Annex F.3: Poverty indicators used in the best model (in terms of maximization of BPAC)

Variable	Model 1	Model 4	Model 7	Model 9
Type of model	2-step Quan	2-step Quan	2-step Quan	2-step Quan
Household expenditures[1]				
Annualized total household expenditures			X	
Sum of household clothing expenditures in past 12 months	X			X
Expenditures on health, past 12 months	X			
Expenditures on school/education past 12 months	X			
Annualized food expenditures, recall 1 week	X			
Share of food expenditures from total household expenditures	X			
Expenditures on other expenditures, past 12 months	X			
Expenditures on home, past 12 months			X	
Education				
Household Head				
Household head completed only secondary/post primary education				X
Household Members				
Number of household members with incomplete secondary education, excluding household head				X
Maximum education level of any household member	X	X		
Number of literate male adults in the household	X			
Number of household members with incomplete primary education				X
Housing Characteristics				
Rooms per person	X			
Metal frame with padlock as main entrance's lock	X	X		
Do you have Mobile (cell phone) in the house?	X	X	X	X
Exterior walls material: wireframed reed or clay walls	X		X	X
Household has piped water in house	X		X	X

Variable	Model 1	Model 4	Model 7	Model 9
Cooking fuel is Gas from public grid			X	
Floor material is linoleum, dutch tile or parquet			X	
Floor material is ground			X	
Water source: dam, pond, river or spring			X	
Toilet: shared or own latrine				X
Assets[2]				
Consumer durables				
Household head sleeps on floor or thin mat	X	X		
Value of color TV's	X		X	
Autorickshaw ownership	X	X		
Total value of household assets	X			X
Value of black/white TVs			X	X
Musical instrument ownership		X	X	X
Refrigerator ownership		X	X	X
Rickshaw ownership		X	X	
Number of motorcycles owned by the household		X		
Value of dishes		X		
Electric or gas cooker ownership			X	
Value of musical instruments				X
Agriculture				
Number of horses owned by the household	X	X		
Horses ownership			X	
Number of milkcows owned by the household				X
Number of sheep and goat owned by the household				X
Area of agricultural land under irrigation		X		X
Financial				
Remittances sent/total household expenditures in past 12 months			X	
Remittances sent to relatives in last 12 months				X
Whether spouse has an account				X
Other				
Household head is craftsman	X		X	X
Household head is salaried production worker	X			
Proportion of dependents younger than 18 or older than 60 years old (in relation to household size)	X	X	X	

[2] For analysis, all monetary variables were used in LOG terms.

Variable	Model 1	Model 4	Model 7	Model 9
Household belongs to traders association	X	X		
Contribution to school committee	X			
Squared age of household head		X	X	X
Household head is seller at the bazaar		X		
Birth of own child in last 3 years				
Degree of participation in traders associations		X	X	
Household head is divorced		X		
Number of memberships out of 22 institutions				
Where on the ladder would you locate a household that has an income equal to 15000 tenge per months?			X	
Subjective change in living standards in the last 8 years			X	
Household head is salaried worker - employee				X
Number of females with some disability				X
Subjective variables				
Household often didn't have enough food to eat	X	X		
Number of steps above step identified as poverty line	X	X		
Household ate sometimes rice and cereals because other food was scarce	X			
Kilograms of flour usually bought in a single purchase	X	X		
Household rarely ate crackers because other food was scarce		X		
In last 12 months were you and worried that your food would run out before you had money to buy more?		X		
Number of meals served to the household members in the last 2 days		X		
In the last seven days, how many days Cheese and Sausages were served in a main meal?		X		
Community				
Do you have a shop for pesticides and /or fertilizer in your community?			X	

Endnotes

[1] This report consists of original work and data analysis. Citation of entire paragraphs or tables in published material by other authors is only permitted after prior consent with the authors and the IRIS Center. The cleaning and processing of data, as well as the entire analysis presented in this report, was carried out at the Institute of Rural Development, Georg-August-University of Göttingen, Germany. The sampling, questionnaire design, and adaptation, as well as training were led by Jean-Luc Dubois, University of Versailles, Paris, France, together with Fatima Jandosova of SANGE research center. Dr. Dubois was visiting SANGE in July and September of 2004. We also gratefully acknowledge the valuable comments and support given by the IRIS project members Thierry van Bastelaer, Tresja Denysenko, Kate Druschel, Anthony Leegwater, by Don Sillers of USAID, and by Stefan Schwarze of the Institute of Rural Development at the University of Göttingen. We thank Norbert Binternagel, Marinella Fader and Isabel Jaisli of the Institute of Rural Development for able research assistance. The input by the SEEP Network and its Poverty Assessment Working Group (PAWG), the Advisory Panel for the Developing Poverty Assessment Tools project, and USAID are gratefully acknowledged. In particular, Christian Grootaert provided valuable comments and advice during all phases of the field research and data analysis, especially with regard to the choice of regression technique, in particular the alternative two-step estimation method presented in chapter 4. We gratefully acknowledge the provision and translation of data regarding the subsistence levels and consumer price indices and other data of NSA by the SANGE Research Center in Almaty, Kazakhstan. We thank Ilyas Sarsenov of the World Bank office in Astana for the provision of data on the headcount indices and expenditure distributions for the forth quarter of 2004. Our thanks also go to Mary Norris and Gaukhar Serikbayeva from USAID's office in Almaty for their input and support. All remaining errors are ours.

[2] Contact Information: SANGE Research Center, Almaty city, 52 Abai Avenue, office 322-330 tel. 7(3272) 509 445, 42 63 02, fax 424744, sange@kaznet.kz . SANGE Research Center on the Web: http:// www.sange.kz

[3] Of the 840 households, a final sample of 817 households was retained for analysis. Twenty-three households were not present at the time of the benchmark survey so that their data on benchmark expenditures are missing.

[4] Source: For 1993 PPP exchange rates, www.worldbank.org/povmonitor/ppp1993.htm. For CPI price data, IMF *International Financial Statistics*, various issues.

[5] For social protection reasons, the Parliament of Kazakhstan has set up a threshold at 40 percent of the minimum subsistence level per month. Those falling below this extreme poverty line are eligible for social services by the state. This yielded a headcount index of about 15 percent of the population in 2002. One may refer to this as the lower poverty line of the country which covers the extreme poor based on national legislation. However, for the purposes of the IRIS study, the minimum subsistence level as such is the relevant national poverty line.

[6] All data on subsistence minimum level and consumer price indices were obtained by SANGE research center from the National Statistical Office, and translated from Russian into English.

[7] Poverty headcount rates have sharply fallen in recent years. In 1998, the NSA estimated that 39 percent of its population fell below the national poverty line. For 2003, data provided by NSA to SANGE show an estimated headcount index of 19.8 percent, i.e. a drop of about 4.4 percent percentage points compared to the headcount rate of 24.2 percent in 2002. For forth quarter of 2004, NSA data provided by the World Bank office in Kazakhstan shows a headcount rate of 12.2 percent whereas the yearly average for 2004 is 16.1 percent.

[8] See World Bank (2004) World Development Indicators. www.worldbank.org/data/wdi2004/pdfs/table2-5.pdf

[9] As poorer households have above-average household sizes in Kazakhstan, the percentage of poor people (i.e. the headcount index) in the IRIS sample is slightly higher. Out of a total of 3268 people in 817 households, 317 people belong to households that have per-capita expenditures below the national poverty line. This translates into a headcount index of 9.7 percent for the IRIS sample. This headcount index is close to the headcount index of 12.2 percent that was estimated by the NSA for the forth quarter of 2004.

[10] For example, of the 166 households in the sample living in the South Kazakhstan region, 20 (i.e. 12.05 percent, see Table 1.3.6) were found to have daily per-capita expenditures less than the regional poverty line of 168 tenge per day per adult-equivalent (see Table 1.3.2). The poorest 10 of these 20 poor households thus represent the very-poor members of the regional sample. All of these very-poor households live on less than 129 tenge per day per adult-equivalent. On this basis, the regional poverty median line for South Kazakhstan is estimated at 129 tenge per day per adult equivalent.

[11] Data provided by the World Bank office in Kazakhstan to IRIS in early April 2004.

[12] In the sample of 817 households, 109 households are clients of financial institutions and business development organizations. Over 95 percent of these clients are clients of one of the following three private banks: *Narodny bank*, *Temurbank*, and *Kazkommertsbank*. Only 2.75 percent of households being clients of financial or BDS institutions have expenditures below the national poverty line, and 0.9 percent of client households belong to the very poor.

[13] The best sets of poverty indicators identified on each of the nine models refer to the combination of 5, 10 or 15 indicators selected by the SAS-MAXR procedure.

[14] The terms regressor and poverty indicator are used interchangeably in this document. Literally speaking, they refer to a certain type of variable used in the regression. The regressors can be derived from one or many questions from the composite questionnaire. For example, some regressors or poverty indicators are directly computed from the variable obtained in the survey, such as the age of the household head. Other regressors require computation (using info from one or several questions), as they are not asked directly but are derived from the responses to the questions asked. An example is the size of the household (which is calculated from the information given in section B of the questionnaire).

[15] For the case of zeros as original monetary values, these were replaced by the value of one pro mille of the mean in order to be able to compute the natural logarithm.

[16] Using the MAXR function of SAS, we selected in a prior model the two best regressors among 13 expenditure categories (referring to questions C1 to C12 as well as clothing expenditures of section B of the composite questionnaire). The inclusion of only the best two of the expenditure categories was done so as to avoid dominance of expenditure variables in subsequent models.

[17] It is therefore important to consider the framework of incentives for when, where, and by whom a poverty assessment is carried out (incentives for the respondent as well as the interviewer). The following quote taken from an email by Jan Maes (Trickle Up Program) highlights some of the issues involved here: "One way of preventing clients from exaggerating their poverty or otherwise responding in a way they think 'would help their case,' is to conduct the poverty assessment survey after loan approval rather than to use it as part of the approval process. In other words, this implies that the USAID certified tools will be ex post poverty assessment tools rather than ex ante poverty targeting tools"… "If you use the assessment as part of the loan application or selection process, you will have to interview all potential clients,

including of course those who ‘fail the poverty test’. On the downside, since you only get your poverty results after clients have already entered the program, you might learn when it is already too late that you are not reaching the poorest.”

[18] The survey team of SANGE Research Center were asked to rate the verifiability of each of the indicators on a scale from 1 to 5, where 1 is very difficult or impossible to verify, and 5 stands for easy verifiability. In Annex D, we list the rating given by the survey firm SANGE Research Center. In addition, SANGE Research Center rated the corresponding questions contained in the questionnaire according to their difficulty to ask. In model 7, we include only the regressors that have been rated as easily verifiable (i.e. a score of 4 or 5), and easy to ask (i.e. a score of 4 or 5, where a rating is available).

[19] These variables were identified by the SAS-MAXR procedure as the strongest variables among all subjective variables which were excluded in Model 5.