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Full Length Research Paper

Determinants of food security at household level in Pakistan

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The main objective of the study is to examine the determinants of household's food security in Pakistan using a logistic regression procedure. The analysis is based on micro data taken from Pakistan Social and Living Standard Measurement Survey (PSLM) 2007-08. Five main variables were used out of other demographic indicators that can affect food security. These include: place of residence, dependency ratio, social capital, employment status and educational attainment level of the head of household. Three factors were found to be significant and had expected signs. The analysis found that place of residence (Urban) has a significant and negative effect on household's food security status. Dependency ratio has a significant impact on food security and has expected sign that is, negative. Educational attainment level of household's head beyond intermediate level has also significant and positive impact on food security status of household. While social capital and employment do not effect household's food security significantly. Different policies and programmes are needed to address these characteristics using a direct yet incorporated approach.

Key words: Dependency ratio, Pakistan social and living standard measurement survey (PSLM), social capital, employment status, educational attainment.

INTRODUCTION

The question arises whether a country or a region have sufficient food to meet the demand of its people living there on aggregate. Special concerns where to see the food supply fluctuations and effective mechanism were provided in order to reduce these fluctuations. In this way, measures of food security was identified at macro level such as storage of food available at national and international level and also the support of BOP for those countries, having temporary food security in particular (Valdes, 1981).

Soon it was realized that this phenomena was very limited. A large portion of Population might be living in a living in a hunger even the countries had sufficient food during the normal time period. Similarly also a large section of population could plunge into hunger during crises, even if a region or nation had adequate among of food. This was the movement of food security issue from macro level to household level and still towards the individual level.

A comprehensive definition of food security is elaborated by United Nations as "A household is food secure when it has access to food needed for a healthy life for all its members and when it is not undue risk of losing such access". Furthermore, there are short and long-term food security aspects. When a household is continuously not able to fulfill the demand of food to its members over a long period of time temporary jinx of goods and bad movements occurred, then it is long-term problem, is known as chronic- food insecurity .

The short term food security problems may make miserable any household, regarding of whether it has chronic or not. Crop failures temporary infirmity, seasonal scarcity or unemployment among the healthy members of households or an emergency need for large cash expenditures might all be the reasons for the sudden decline

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Abbreviations: PSLM, Social and Living Standard Measurement Survey; **HFS,** household food security; **WFP,** world food program; **CCA,** cost of calorie approach; **NGOs,** non-governmental organizations.

of a household's access to food to below the poverty line (adequate level of nutrition) is known as transitory food insecurity.

Chronic- food insecurity shows the continues food consumption unavailable for long period of time to meet food requirement, while transitory food insecurity concerns jumps that security push the food consumption level below the requirements level.

A household may be called food secure if and only if a person is second from both in secured from both insecurities that is, He / she has the safety against transitory and chronic food insecurities. Food insecurity it is household may be a combination of two main issues; an issue of gaining and utilization. Gaining means the ability to attain either through production or exchange.

But capacity to obtain all food does not necessarily means the ability to utilize that capacity to the maximum. Therefore food security may be classifying into two groups that is, level and the shock and further subdivide into the problems of acquirement and utilization that is, food security can be combined and may be yield four dimensional aspects of food security; they are

1. The ability to acquire the level.
2. The ability to protect against shock
3. The ability to utilized that level
4. The ability to protect against, shock to utilization

This fourfold characterization may provide a clear concept for analyzing the determinants of household food security (HFS). To identify the determinants is more complicative as there are different levels of determinants. Some have direct effect on one of the four dimensions of food security while others may define or identify other determinants by operating them.

Our main objective is to identify the main determinants of food security for Pakistan at household level conceding its first dimension of ability to improve and also to maintain the level of acquirement that is access to food

LITERATURE REVIEW

There are various challenges to acquire food security at both individual and household level. These challenges include improved human capital, size of the household, political stability and conflicts, formal and informal social safety nets, access to basic public provisions and cash income (in urban areas mainly). The argument is supported by various empirical findings of previous studies conducted for food security. As far as human capital variable is concerned, its value depends on five main types of investments in human beings, which include: health and nutrition, migration of people in search of new jobs, on the job training, and study programmes for adults, extension services in agriculture and formal education sector (Theodore, 1961). All these factors are generally considered as essential components of human capital, but most of the empirical studies emphasize on fifth dimension that is formal education.

Kidane (2004) conducted research with primary data techniques to analyze determinants of food security in Ethiopia. The study found out that educational attainment of even primary level can significantly affect household's food security status. Moreover it can also affect both present and future income of the family.

Education also has other important component of human capital that is the purchasing efficiency, food knowledge and meal preparation skills of the main food purchasers and preparer of the family. Rose et al. (1998) investigated determinants of household food security in United States of America (USA). According to results of the analysis an inverse relationship exists between schooling and food insecurity. High school graduates are less likely to be food insufficient even when the effects of income were controlled. Endogenous growth theory endorsed the perception of human capital according to which educational attainment is considered as a mean to achieve economic growth. But economic development is not the ultimate objective but an intermediate goal to ensure human freedom from deprivation of basic needs of life (Burchi, 2006).

Size of the household is the other major variable that can affect food security status of the family. Amaza (2006) analyzed factors affecting food security at household level in Nigeria. Logistic regression results showed that chances of household's food insecurity status increase as the number of dependent family members' increases overtime. The larger the dependency ratio, the higher is the burden on active members to meet the cost of minimum household nutrition and, hence the higher level of food insecurity would be.

Conflicts at family level frequently occur in developing countries. However with the passage of time nature of these conflicts has been changed and resultantly the percentage of civilian victims have increased. Teodosijevic (2003) assessed possible reasons and consequences of these conflicts. They found that different economic, environmental, political and cultural are the responsible factors and ultimate consequences of such conflicts. Although agriculture is less affected than industry from such conflicts but they deteriorate and in few cases completely destroy crops which may leads to hunger. Food shortages have remained the major cause behind the destruction of rural infrastructure including loss of livestock, population migrations and widespread use of mines.

Social safety nets can also affect food security status of a family. Emergency food aid programs and disability pensions are the prime examples of safety nets. Often poverty reduction plans in developing countries are included in these programs. The formal form of these programs comprises food aid to poor, public provisions and formal credit and saving schemes (Subbarao et al.,

1997).

Putnam (1995) investigated that informal safety nets can take various forms such as staple sharing, credits, group membership, the receipt of remittances, house sharing, and lending of farms and animals. These connections are broad and effective within extended families, because they depend on social trust. These social connections can surely reduce the probability household being food insecure. These are tools that reduce exposure to adverse shocks, and enhance the ability to tackle these shocks, which may help in strengthening the social capital. Actually "social capital refers to the features of social organization such as networks, norms and social trust that facilitate coordination and cooperation for mutual benefit" (Putnam, 1995).

Woolcock and Naryan (2003) examined that education can play a vital role in making social bonds stronger not only through text books that a person read during academic period but many other texts play important role in creating awareness of being social and enlarge spirit of brotherhood. In rural areas, community action can play successful role in diminishing food poverty because the larger these social nets the larger is the possibility to find assistance in food emergencies.

The conventional concept is that heath and education, clean water, sanitation facilities and garbage collection services provided by public sector are majorly accessible in urban areas as compare to rural areas. But the fastest growing population pressure in urban centers of developing parts of the world has collapsed the accessibility of these services in urban areas. In these areas, people living below poverty line have limited access to adequate sanitation and garbage collection facilities. Peerzada (2004) conducted an analysis regarding food security under World Food Program (WFP) for rural Pakistan. Primary and secondary data were used for the analysis. Food availability was examined on the basis of total food production and food consumption.

In Pakistan, out of 120 districts, 74 were in deficit in terms of availability of food and shortfall was 3.2 million tons annually. In terms of economic access to food FSA analyzed that income inequality, disparities in access to land, education and employment opportunities have led to inequality in access to food as well. Access to paramedics and rural health institutions are the basis on which food absorption is assessed.

The most important difference between urban and rural parts of a country regarding food access is that rural people are usually able to produce their own food, whereas urban people are entirely reliant on food purchase from the market. Food security involves more than 800 million people today. Its eradication is the prime concern of policy makers. Many strategies have been in this sector. One policy is to increase income of the people.

Grimard (1996) conducted a study in Pakistan to analyze the effects of this policy in Pakistan. Results reveal that elasticity of calories with respect to incomes is significantly different from zero. Poor households are more responsive to the change in their consumption levels after increase in their income as compare to the entire sample. Moreover rural elasticity is relative low as compare to urban areas.

In the present analysis all possible variables pointed out in literature review have been incorporated in the model. Data on the public provisions, political stability and conflicts was not addressed in concerned survey [Pakistan Social and Living Standard Measurement Survey (PSLM) 2007-08]. For that reason these variables though having significant impact unfortunately cannot be included in the model. The edge of the study is incorporating variable of social capital in the model for Pakistan which had never been done before the studies conducted on food security regarding Pakistan.

DATA AND METHODOLOGY

Data source

The study is based on micro data taken from PSLM 2007-08.The household survey is carried out by the Federal Bureau of Statistics, Government of Pakistan and provides the comprehensive data on household related variables. The sample size of this survey is substantial enough to obtain concrete and robust results.

This survey contains the data of four provinces of Pakistan including all urban and rural areas of Pakistan .Data consists of household consumption expenditure, education, employment and other socio economic indicators at household level both in published and unpublished form. The published form of the data contains the information with respect to the entire group and does not mention the information regarding each individual/household, while the unpublished data contains the full information at individual / household level.

This study describes the relationship between food security status of household and different characteristics of household. The selection of the year for the survey to be conducted is based on variables selected for example (education level, occupational status etc.) which do not show much changes in short time period. At least five to six years are required to see the changes of these variables on economy. 97000 households were taken in PSLM for the year 2007-08 out of which 54686 were selected finally for the analysis.

Variables construction

In order to find the determinants of food security at household level in Pakistan, we used food security as dependent variable and income of the household, dependency ratio, and social capital, place of residence (region), employment status and educational attainment of household's head as explanatory variables (Table 1).

Dependent variable

Food security: Food security means economic and physical access by people of household to sufficient food for an active, healthy life (1996 World Food Summit). By food security we mean "minimum readily availability of nutritionally adequate and safe food, and an assured ability to acquire that food". Food security can be discussed in three main components namely: food availability, economic access to food and food absorption. In the present analysis we have assumed that availability of food is though

enough but still people lack food due to economic factors for example, access to public provisions and market, income, increasing ratio of non-earning persons in the family.

There are different approaches to measure food security including Cost of Calorie Approach (CCA) (Foster et al., 1986). By using this approach a separate food security line is defined for Pakistan for the present analysis. Therefore following CCA approach, the food security line is given as:

$$\varepsilon = e^{\alpha+\beta\varsigma}$$

$$\ln \varepsilon = \alpha + \beta\varsigma$$

$$\ln \varepsilon = 6.124+6.454\,\varsigma$$

Where "ε" is adult equivalent expenditure of food (in Pakistani Rupees) and ς is the actual calorie consumption per adult equivalent of a household (kilo calories). The calorie content of the recommended minimum daily nutrients level (Food Basket Foundation International, 1995) was used to determine the food insecurity line, Z using equation:

$$Z = e^{\alpha+\beta\zeta}$$

Where Z is the cost of buying the minimum calorie intake (food security line), "α" and "β" are parameter estimates from the expenditure equation, ζ is the daily recommended calorie level[1].

$Z = e^{6.124+6.454*2260}$

Z = 1702 (Rs per month per head)

So Rupees 1702 per month per person is the cost of buying minimum calorie intake to acquire food security level. A household was then considered food secure if per capita food expenditure of the household was greater than cost of minimum calorie required per person in the family was assigned the value "1" and if "0" otherwise[2].

Independent variables

There are many factors that can affect food security. The details of explanatory variables used in present study are as follows:

Income of the Household: Household income is a measured by taking sum of income of all residents in each household, which also includes wages and salaries earned in the form of cash during last month, regular rental receipts, personal business, investment, or other type of income received. The residents of the household have to have relation with head of the household for their earnings to be considered part of the household's income. But unemployment insurance, disability payments, and child support payments are not included in income[3].

Dependency ratio of household: The dependency ratio is usually defined as the ratio of the non-earning (young and the aged) persons of the family to the working members of the household. It is expected to decrease the probability of food security of the household[4].

Social capital: In the present analysis social capital is measured by taking into account the payments received by a household in form of cash from relatives, non-relatives, non-governmental organizations (NGOs) and trusts in case of emergencies[5]. This variable has the taken form of a dummy variable. Household received these payment has been assigned the value "1" and "0" otherwise.

Employment status: We divided employment into paid employee (non agriculture), self employed (non agriculture), self employed (agriculture) and unpaid family workers. Dummy variable has been used for employment status assigning value '1' for paid employee (non agriculture), "2" for self employed (non agriculture), "3' for self employed (agriculture) and "0" for unpaid family workers. Its data for this category is taken from section 1, Part B of male questionnaire from PSLM 2007-08.

Region: Residing area of the household is categorized into two regions, rural and urban. Value "1" is assigned to the household living in urban areas and "0" for a household living in rural area.

Educational attainment level of head of the household: This is divided in two categories and has been assigned the value "1' for class 5-12 and the value "2" for class above 12[6].

Model

Modeling the food security and its determinants at household levels seems to comprise different methodologies and techniques. It includes the different techniques from ordinary least square to discrete choice models. It is unwise to use OLS regression when confronted with a binary dependent variable. The main difficulty occurs with regression model when the researcher wishes to use a binary variable as dependent variable. The variable does not follow normal distribution. Rather, it is distributed as binomial random variable. When we connect regression line to data points we can see the hetroscadasticty problem in linear relationship between dependent and independent variable. Moreover, if we estimate on OLS regression model and check the distribution of the residuals, we will find that they are not normally distributed. Therefore, when using OLS regression with a binary dependent variable, we usually violate at least two assumptions that underlie this model. There are two alternative regression models that are used most often when dealing with a binary dependent variable: Logistic regression and Probit regression. These two models use different link functions, having similar results.

The discrete choice model has number of attractive features as compare to regression approach. The most important feature of the discrete model approach is that it gives probabilistic estimates for the different status of food security while regression approach does not have this particular feature. It means that in regression analysis we cannot make probability statement about the effects of different explanatory variables on food security.

Model specification

Firstly we have checked data distribution

[1]FAO recommended minimum daily energy requirement per adult equivalent is 2260 kilo calories.

[2] Data for food calorie consumption and food expenditure is taken from part "A" of female questionnaire in section 6 of PSLM 2007-08.

[3] Data of income is taken from part "B" of male questionnaire's section "1" from PSLM 2007-08.

[4]Data regarding dependency ratio of the household has been taken from section "1" of male questionnaire from PSLM 2007-08.

[5] Data form these payments has been collected from Section "8" of male questionnaire from PSLM 2007-08.

[6] Data of educational attainment is taken from part "B" of male questionnaire's section "4" from PSLM 2007-08

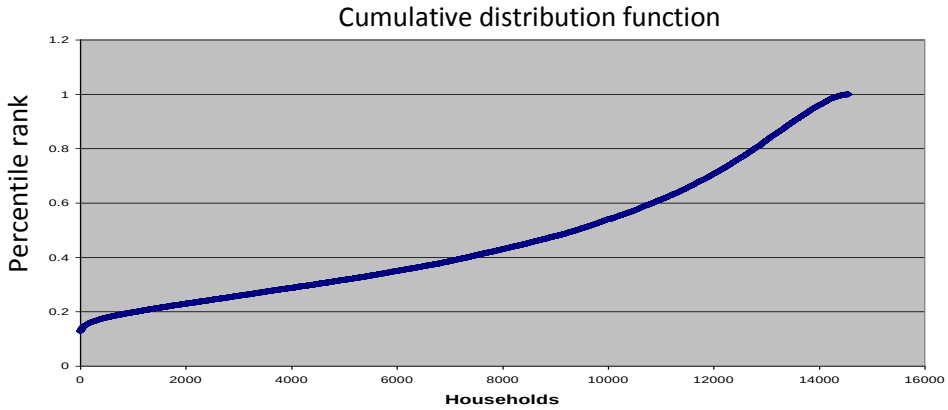

Figure 1. Cumulative distribution function of food security.

through CDF[7] to make choice of Logit or Probit model (Chen, 2008). On "x" axis we have taken households and on "y" axis we have taken percentile rank of the households. We checked data distribution through "xy" scatter plot. To make a choice of Logit or Probit Model we have to calculate kurtosis[8] value of "xy" scatter plot. The calculated value of kurtosis is positive (152.0131). if kurtosis value is positive then we have to choose Logit model for the analysis.

Logit model

Like in linear regression we assume that some sets of independent variables are useful for predicting the dependent values, but we are claiming that this set predicts the probability that Y=1 (assuming we have coded the dependent variable as [0,1]). The basic formula for estimating Y=1 consists of transforming the regression equation as equation 1.

$$p(Y=1) = \frac{1}{1} + \exp[-a(\alpha + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 \dots\dots\dots \beta_k x_k)] \quad (1)$$

The whole function is called the logistic distribution function and it is estimated by maximum likelihood (ML) techniques (Figure 1). An advantage of this function is that it guarantees that the probability ranges from 0 to 1 as the regression equation predicts values from negative infinity to positive infinity (Cameron and Trivedi, 2005). It is also called log-odds as we can write logistic function as:

$$Logit\,[p(Y=1)] = \alpha + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 \dots\dots\dots \beta_k x_k \quad (2)$$

$$Logit\,[p(Y=1)] = Log\, e\left[\frac{p(y=1)}{1} - p(y=1)\right] \quad (3)$$

This fits the model;

$$Ln\left[\frac{p}{1-p}\right] = \alpha + \sum b_i\, x_i \quad (4)$$

Where p is the probability of a household having the food insecurity during the 30 days preceding the survey, "α" shows intercept term and "βi" are estimated regression coefficients, and xi are the background characteristics of households, consisting of family size, income of the household, social capital, dependency ratio and regional zones (Table 1). So our estimated model may be written as:

Ln [(p)/(1-P)] = $\gamma_{0+}\gamma_1\aleph_1 + \gamma_2\aleph_2 + \dots\dots\dots\dots\dots\gamma_6\aleph_6$

Where $\aleph_1$ = Place of Residence (Region), $\aleph_2$ = Dependency Ratio of the Household, $\aleph_3$ = Social Capital, $\aleph_4$ = Employment Level, $\aleph_5$ = Educational Attainment Level of Head of the Household. $\aleph_6$ = Income level.

RESULTS AND DISCUSSION

For the present analysis the selected estimation method used is Binomial Logit Model. 54686 cases are being selected for the present analysis. The choice of sample size is based on the variables selected for study. Out of 97000 only 14686 households have full data information regarding selected variables in PSLM 2007-08.

Average income of the entire sample is 5299.79 along with standard deviation of 10963.09 which is depicting the fact that distribution of income is uneven among different sectors of Pakistan (Table 3). Another important factor here is dependency Ration which is 5 persons on average for each household in Pakistan which is showing that 5 persons per family are dependent members. Frequency distribution of categorical variables is as follows: Employment, from selected households 2317 persons are self employed, 6624 are paid employees, 430 are employed in livestock sector, 3451 are unemployed while remaining are employed in other sectors which are not taken into account for the sake of analysis. Another categorical variable is education. From entire sample of 54686 households 5156 persons have attained education from class 5 to class 12 while 7945 have attained education above class 12, 10022 households are

[7]Cumulative Distribution Function describes the probability that revealed valued random variable variable "X" with a given probability distribution will be found at a value less than X. CDF is monotone non-decreasing and its value ranges from 0 t 1.

[8]Kurtosis is a measure of peakedness of probability distribution. Higher kurtosis means more of the variance is the result of infrequent extreme deviations.

Table 1. Definition of variables used in analysis.

Variable	Symbol	Definition
Food security (dependent)	FS	FS=1 if food secure =0 otherwise
Explanatory variable		
Income	INC	Sum of all the income of all residents each household, including all wages and salaries earned in cash from during last month, regular rental receipts, as well as any personal business, investment, or other kinds of income received in Thousand (Pakistani Rupees)
Region	REG	REG=1 if Urban = 0 otherwise
Social capital	SC	SC=1 if received assistance = 0 otherwise
Employment status	EMP	EMP= "1' for paid employee ="2" for self employed = "3' for self employed = "0" for unpaid family workers.
Dependency ratio	DR	No. of dependent family members
Educational attainment	EDU	EDU= "1' for class 5-12 ="2" for class above 12

are residing in urban areas while 4664 are residing in rural areas. This is revealing the fact that majority of Pakistani population is residing in urban areas.

The results of Binomial estimation for food security analysis in Pakistan are shown in Table 2. Food security is influenced by number of factors. The estimation depicts that dependency ration, place of residence and education level (above class 12) has statistically significant bearing on food security status of a household. The logit value of the place of residence (Region) REG is 0.407 depicting a negative sign. This states that being an urban resident can possibly reduced food security status by 0.407 units. Urban resident has high odd ratio of 0.666 of being food insecure than rural areas. It has a p –value .000 which is less than 0.01 which is shows its significance at 1%. This result is consistent with the others (Konard, 2007).

Number of dependent persons in the family (DR) has a significant (1%) but negative effect on food security. Increasing Dependency ratio to the total household size by one unit will decrease food security by 1.203 units (Sidhu et al., 2008).

The logit value of educational status of the head of the family EDU (1) is 0.264. This means that *ceteris paribus*, if household's head attain education above primary education, on average, the estimated logit of food security increases by 0.246. While coefficient value of 2nd category of education EDU (2) is 0.353. This states that getting education beyond intermediate level will increase food security status of the family by 0.353. This result is again statistically significant at 5% (Rose et al., 1998).

The logit value of social assistance in the case of food emergency (SC) is 0.15 which means that one unit increase in social capital can positively affect food security by 0.15 units but this result is statistically not significant.

The logit value of employment status of the head of the family (EMP) is 0.116, 0.65, 0.81 respectively for self employed, paid employee and employed in live stock sector. With partial coefficient of -1.35 with a negative sign depicts unemployment status reveal that unemployed worker will reduce food security status by 1.35 units. Unemployed head has high odd ratio of 0.873 of being food insecure than employed and self employed person (IFPRI, 2004).

Conclusion

We have tried to explore the determinants of Pakistan's food security at household level, and also highlighted several policies and programs to eliminate food insecurity. The findings show that the educational attainment

Table 2. Binomial estimation food security determinants in Pakistan.

Variable	Coefficient	SE	P-value	Odd ratio
Constant	0.938	0.262	0.000	2.554
REG(1)	-0.407*	0.107	0.000	0.666
DR	-1.203*	0.053	0.000	0.300
EDU			0.151	
Edu(1)	0.264	0.194	0.175	1.302
Edu(2)	0.353**	0.187	0.059	1.423
SC	0.015	0.101	0.884	1.015
EMP			0.910	
EMP(1)	0.116	0.171	0.498	1.123
EMP(2)	0.065	0.163	0.690	1.067
EMP(3)	0.081	0.127	0.525	1.084
EMP(4)	-0.135	0.322	0.6740	.873

*1% level of significance, **5% level of significance.

Table 3. Summary statistics of the data: Mean and standard deviation.

Variable	N	Mean	Std. deviation
Income	14686	5299.7932	10963.0936
REG	14686	1.3175	.4655
SC	14686	6067.56	40451.03
FS	14686	3.248	.1773
EMP	14686	1.8624	1.2658
DR	14686	5.39	2.83

level of household's head plays the significant role and considered as one of the important determinants of the food security. The high probability value of low level of education adds to any household being food insecure. The promotion of education is, therefore, vital in solving the problems of food shortages. The household's dependency ratio is another determinant effecting food security in Pakistan.

The analysis of the determinants of food security shows that negative relationship exists between household being food secure and household residing in urban areas. As people living in urban areas are mostly engaged in informal sectors and seasonality of employment, dysfunctional institutions and low asset base are the reasons of higher food insecurity level in urban areas. Policy and programs need to address these characteristics using a direct yet integrated approach.

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