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The Role of Poverty, Food Security, and Rapid Population Growth on Human Development in Pakistan

Mujeeb-ur-Rehman[1], Aziz Ahmed[2], Anwar Khan[3] and Ajmal Khan[4]

[1] Corresponding Author, Research Officer, Balochistan Think Tank Network, Quetta, Pakistan; Email: mujeeb33493@gmail.com
[2] Director Research, Balochistan Think Tank Network, Quetta, Pakistan; Email: Barshore2006@yahoo.com
[3] Director Research, Balochistan Think Tank Network, Quetta, Pakistan; Email: anwar.aerc@gmail.com
[4] Research Officer, Balochistan Think Tank Network (BTTN), Quetta, Pakistan; Email: ajmal_kakar2004@yahoo.com

Abstract

This study examines the relationships among poverty, food security, rapid population growth, and human development in Pakistan over 1990-2018 to achieve the targets of Sustainable Development Goals (SDGs) 1: No poverty and 2: Zero Hunger. The study applies time series based econometric approaches, which have the ability to incorporate regime shifts in the estimation process. The Zivot and Andrews unit root test is supplied for first-order integration, Bound, and Gregory Hansen cointegration tests to support the cointegration relationship among the variables. Similarly, the results obtained from autoregressive distributed lags (ARDL) stated that food security and income growth simultaneously increase human development in Pakistan. In contrast, the role of rapid population growth is negatively affecting human development in the country. The results from fully modified ordinary least squares (FMOLS) and canonical cointegrating regression (CCR) are simultaneously supporting the results of ARDL. The estimates of Granger causality revealed that income is unilaterally, and population growth is bi-directionally, causing human development in Pakistan. Similarly, the causality from human development to food security is also unidirectional. Finally, the study informs policymakers to devise effective policy guidelines for achieving the targets of SDGs 1 and 2 for Pakistan.

Key Words: Food insecurity, Human development, Population Growth, Poverty, Autoregressive distributed lags, Pakistan**.**

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1. INTRODUCTION

Human development depends upon many factors including food security, adequate income, education, and livelihood earning. The development

of humans, including cognitive, emotional and psychological development in children and adults, requires adequate quantity and quality of food to ensure smooth life (Cook and Frank 2008). There are various reasons for the lack of food security in Pakistan, including poverty, rapid population growth, and inadequate levels of human development (Pakistan-Vision-2025, 2015). Lack of access to sufficient food for the public remains an obstacle, forcing the researchers to think about its security and availability for poverty reduction and human development in Pakistan. Similarly, these indicators are interlinked and can cause one another in the state of interrelationships in developing countries, including Pakistan (Smith et al., 2000; UNDP, 2019). Therefore, to understand the nature of likely causality and linkages among these indicators pertaining to SDGs 1 and 2, the following study is undertaken.

Human development is considered one of the most critical aspects of the social, economic, and political development of any country in the world. Pakistan's human development index (HDI) value for 2019 is 0.557 that depicts Pakistan's HDI as low as 154th out of 189 countries, indicating lower levels of human development in Pakistan. The reasons may include food insecurity due to lower agriculture productivity, inadequate and disrupted supply chains of food distribution, the prevalence of malnutrition, fluctuation in food items prices, market imperfections, and rapid population growth in Pakistan (FAO, 2021; McGuire, 2015). The frequent and non-terminating prevalence of food insecurity, widespread poverty and higher population growth are considered the most pressing determinants mentioned in the global reports giving impetus to researchers to explore its evidence in terms of data supported development programs for poverty reduction and access to food security for human development in developing countries (World Development Report, 2021)

Population growth and poverty are interlinked in terms of low per capita income. The case of Pakistan also presents the same relationship in terms of rapid population growth, lower per capita income, poverty and lower levels of human development (Mallick et al., 2005).

The Case and Novelty of the Study

This study adds in the plethora of knowledge about the phenomena of the study in the context of Pakistan in the following ways: (1) it is a maiden attempt that analyzes the data of food insecurity and poverty to see the impact on human development of Pakistan; (2) it further analyzes the role of rapid population growth on human development in Pakistan; and (3) further utilizes the updated panel econometric approaches like ARDL and its methodological

underpinnings, which can undertake the regime shifts in the data and, therefore, giving unbiased and efficient conclusions about the nexus among poverty, food insecurity, rapid population and human development. Finally, this study attempts to give informed policy guidelines to policymakers in achieving the targets of SDGs in Pakistan.

2. LITERATURE REVIEW

This section of the paper covers a literature review confined to the existing literature about the relationship among the variables of the interests and hypothesizes a theoretical model in line with the relevant literature. The literature review is precise in three sub-sections covering food security and human development, poverty and human development, and population growth and human development. The model is hypothesized based on the three sub-sections of the literature review and supported by relevant literature.

Food Security and Human Development

Food security ensures reducing poverty and diminishing stunting in children are the indicators of good health and different indices of human development in multi-directional relations (Cafiero et al., 2018; FAO, 2021; McGuire, 2015; Misselhorn & Hendriks, 2017; Smith et al., 2000; Smith et al., 2017) (FAO, 2004). There is evidence that human development is possible only by having a long, healthy life and through education. Quality of food, availability of proteins, clean drinking water is essential for significant improvement in human health and development (Junaidi & Umiyati, 2021; Linhartova, 2021; Lundahl, 2021; Mihalache, 2019; Odusola, 2021; Saidov, 2020). Thus, human development may be strengthened by ensuring access to food by the mass population and reducing poverty of a country or territory (Abah et al., 2020; Alamgir, 1980; Arrow, 1982; Bardhan, 1984; Kårlund et al., 2020; Ranis et al., 2000).

Poverty and Human Development

The literature also shows the nexus between poverty indices and human development. The evidence of selected studies shows that poverty is negatively related to human development indicators across the countries over the years. Human development reduces poverty and its different indicators showing the consensus-based nexus between the two both in theory and practice across the globe. Thus, the evidence is replete in showing negative relationships between

poverty and human development (A. Banerjee & E. Duflo, 2020a; A. V. Banerjee & E. Duflo, 2020b; House, 2018; Initiative, 2018; Lundahl, 2021; Mallick et al., 2005; NUREEV, 2020; Poverty & Initiative, 2019; Ranis et al., 2000; Shymanska, 2020; Wodon, 2017).

Population Growth and Human Development

Population growth is one of the essential variables to affect multi-aspects of human development and economic growth. The literature shows bi-directional relationships directly and indirectly to give strong evidence of the relationship between rapid population growth and human development. The association is significantly demonstrated in the context of cross-sectional, time-series and panel databases in the latest version of studies about the nexus under debate. Many aspects of socioeconomic development under SDGs and its targets of human development, poverty, health and access to food are also present in the binding relationship between human development and population growth in most of the territories and countries of the world (Crist et al., 2017; Ghislandi et al., 2019; Güney, 2017; Herrero et al., 2019; Mensah, 2019; O'Sullivan, 2018; Shaheen et al., 2021).

Theoretical Setting

The above-cited literature gives insights to hypothesize the nexus among the variables of poverty, food security, rapid population growth, and human development. The hypothesized theoretical model of the nexus among the variables of interest is confined and sub-theoretically modelled in the context of the universal theory of SDGs (particularly SDG 1 & SDG 2). The hypothesized theoretical model is not against the contents of the theories of development paradigms (Dills & Romiszowski, 1997; Gilbert & Lennox, 2019; Midgley, 1984; Schuurman, 2000), articulated in different shapes and has relevancy with the studies of well-versed development theorists (Banerjee & Duflo, 2011; Drèze, 2004; Easterly, 2008; Easterly et al., 2004; Sachs, 2014; Sen & Dreze, 1999; Sen et al., 1997; Ul Haq, 1995).

3. DATA, MODELS, AND METHODS

Data Collection

We found relevant data on the HDI from HDI reports, the food production index to calculate the food security from:

www.theglobaleconomy.com[17]. At the same time, for the rest of the variables (poverty, population growth, and real GDP per capita), we draw data from World Bank Indicators (World Bank 2021) and the global economy.com. Due to missing values in the data of poverty over the selected period, we have interpolated some values for the variables following the study (A. Khan et al. 2019). The descriptive analysis of the data is shown in Table 1 below.

Table 1. Variables and Descriptive Statistics

Variable`s definition	Acronym	Data	Descriptive statistics			
--	--	--	Mean	Max.	Min.	J-B test
Human Development Index (0 - 1)	HD	GE	0.48	0.56	0.40	2.57(0.27)
Poverty ratio, per cent living on less than 1.90 USD a day	POV	WDI	20.93	60.60	4.00	4.39(0.11)
GDP per capita constant at 2010 US$	Y	WDI	1151.52	1502.89	924.63	2.02(0.36)
Population growth, percent	PG	WDI	2.44	2.96	2.06	3.27(0.19)
Food production index ((2004-2006 = 100)	F	GE	75.22	108.10	45.76	1.56(0.45)

Note: GE indicates Theglobaleconomy.com, WDI stands for World Development Indicators, J-B is Jarque Bera test, while the values in parenthesis are probability scores.

Empirical Model

We developed the following functional form of empirical model (equation 1) for the empirical estimation based on the hypothesized theoretical model mentioned above. It indicates the theoretical model to test for short and long-run relationships between the dependent and independent variables.

$$Human\ development = f(Poverty, Food\ insecurity, population\ growth) \quad \ldots 1$$

While turning this functional form into the econometric equation, firstly, we added the variables of interest; secondly, we transformed the variables into logarithm except for population growth, which is already in percentage form (to reduce chances of econometric issues and harmonizing data for proper estimation). The empirical form of the model becomes (equation 2);

$$LogHD_t = \alpha_t + \beta_1 LogPOV_t + \beta_2 LogFS_t + \beta_3 PG_t + \beta_4 LogY_t + \varepsilon_t \quad \ldots 2$$

[17] https://www.theglobaleconomy.com/download-data.php on payment.

Where HD is human development, POV indicates poverty; FS is used for food security, PG stands for population growth; and Y shows real GDP per capita at 2015 prices. In addition, $t, \alpha, and\ \varepsilon$ explains the time interval, slope coefficient, and the corresponding error term, and $\beta_{1,\ldots\ldots,4}$ are associated with the coefficients of independent variables to be estimated with the help of the following procedures of estimations.

Econometric Estimation

We adopted five simple steps for empirical estimation to explore the impact of independent variables on the dependent variables. The first step involves identifying the stationarity of the variables for the given period. In the second step, based on the order of integration, we utilized cointegration analysis. In the third step, we further carried out the long-run estimation of the dependent and independent variables. The fourth step tests the causal relationships between the variables under study. Finally, we again tested the variables for their possible long-run relationship, applying various estimators for robustness (Enders, 2015; Nkoro & Uko, 2016).

Unit Root Tests

By considering the complexities in structural breaks in the data, we started to determine the unit roots in time series by applying the (Zivot and Andrews 1992) unit root test. Following this unit root test, we again turned towards using the standard unit root test to supplement the results obtained from the former test. To this end, we further adapted the Augmented version of (Dickey and Fuller 1979) (ADF) test of unit root, which will help us know the order of integration in the time series.

Cointegration Analysis

After the unit root test, we apply the ARDL bound cointegration test (Pesaran, Shin, and Smith 2001) between the variables of interest. In a further step, we used the ARDL cointegration algorithm to determine the short, and long-run dynamics of the dependent and independent variables for the given models (N. H. Khan, Ju, and Hassan 2019). The choice of the ARDL approach is due to its statistical priority compared to other parallel tests (Phillips and Hansen 1990). For instance, the ARDL approach gives unbiased results in case of I (0), I (1), and mixed order of integration, except the higher integration

cases, i-e I (2) (Danish, Wang, and Wang 2018). Similarly, this method is best and performs well while addressing the endogeneity problem in the model and is equally suitable for small and finite samples of poverty and food security.

To check the existence of a cointegration relationship, we calculated F-statistics to see the correlation with critical bound values (Pesaran, Shin, and Smith 2001). The F statistics is used to elaborate the support or rejection of the null hypothesis in the study. If the F-statistics values lie greater than upper bond values, it supports cointegration. In contrast, if the values lie below the lower bound values imply there is no cointegration, and if the F-statistics lies in between the lower and upper bound limits indicates an indecisive zone. Finally, for the efficiency of results and stability of the parameters, various post estimation tests have been conducted (Autocorrelation, Heteroscedasticity, and Jarque-Bera).

Robustness Analysis

To the equilibrium relationship between the variables, we applied (Gregory and Hansen 1996) cointegration test, which best accounts for the possible breaks in the data which the Bound cointegration test cannot counter. In line with the studies of (Ahmad and Du 2017; Ur Rahman et al. 2020) and (Jiang, Khattak, and Rahman 2021), for the robustness of the estimated results, we again apply the Fully modified OLS (FMOLS) and canonical cointegration analysis (CCR) of time series algorithms. There are multiple advantages of using the FMOLS, including that it is more appropriate in controlling the autocorrelation and endogeneity issues in the data (Jiang, Khattak, and Rahman 2021; Ur Rahman et al. 2020). Therefore, this study applied the FMOLS and CCR on the data to explore the long-run elasticities between dependent and independent variables. Hence to verify the results obtained from the standard ARDL estimator.

4. RESULTS AND DISCUSSIONS

Table 2 explains the unit-roots presented in the data; we have elaborated that all the variables have non-stationarity properties at levels. After taking the first difference, the variables considered in the study turned stationary with and without breaks in the data. This process has followed the study's first objective, which allowed us to determine cointegration relationships between the variables.

Table 2. Unit Root Tests

Symbols	ADF statistics [level]	P-values	ADF statistics[1st]	P-values
HD	-0.417	0.893	-3.456	0.018
POV	-0.981	0.742	-3.974	0.025
Y	1.052	0.996	-6.517	0.000
PG	-1.100	0.700	-5.047	0.000
F	0.412	0.980	-6.712	0.000
Zivot-Andrews	Statistics	Break Year	Statistics	Break Year
HD	-3.128	2004	-4.65	2005
POV	-4.263	1995	-4.669	1998
Y	-2.726	2002	-6.929	1998
PG	-5.336	2009	-8.944	2000
F	-3.372	2004	-7.152	2002

Note: Critical values: 1%: -4.93 5%: -4.42 10%: -4.11.

Cointegration results obtained from the bound testing approach and Gregory and Hansen 1996 test are summed up in Table 3. The F-statistics from the bound test are higher than upper bound limits, thus concluding that the variables have an equilibrium relationship. The results of the bound test are further supplemented by (Gregory and Hansen 1996) cointegration, which helps account for the regime shifts indicated the similar results, that the chosen dimension of variables is cointegrated since the calculated statistics of two of the tests (ADF, & Zt) are more significant than critical values at 5% level. The results are robust as the error correction term holds a negative sign and is strongly significant. Thus, any impulse to the model restores its equilibrium position with a speed of 0.446% in the long run. Finally, the model is tested for any possible econometric issues, including the heteroscedasticity (ARCH test), Autocorrelation (BG-LM), and stability (CUSUM & CUSUM sq tests). The non-existence of Hetro and autocorrelation with insignificant probability values are provided in the table's diagnostic section, and the model produced stable results.

After finding that all the variables are I (1) integrated and have an equilibrium relationship with both conventional Bound test and (Gregory and Hansen 1996) test with regime shifts, thus allowed us to test the magnitude of linkages towards the dependent variable. Therefore, we applied the ARDL estimator.

Table 3. Cointegration Analysis

Bound test			Diagnostics		
Lag order	(3, 1, 0, 2, 1)	Decision	Stability	ARCH	BG-LM test
F-test	8.360041	Cointegrated	Stable	0.354(0.551)	4.597(0.104)
Upper bound values I (1) at 5%	3.48				
Lower bound values I (0) at 5%	2.26				
ECT (-1)	-0.446(0.000)				
Gregory Hansen test					
Test	Test Statistics	Break Point	1%	5%	10%
ADF test	-33.88	1997	-6.36	-5.83	-5.59
Zt-test	-14.82	2003	-6.36	-5.83	-5.59
Za-test	-28.27	2003	-76.95	-65.44	-60.12

The results given in Table 4 imply that food and poverty positively contribute to human development in the short run, while income growth and population simultaneously negatively affect human development in Pakistan. While turning towards the long-run impacts, the statistics exhibit that increased food production is positively related to human development in Pakistan with explanatory power of 0.4947%, which indicates that a one percent rise in food production improves human development by 0.4947% in the long run. On the other hand, the role of poverty in human development remains insignificant. Similarly, a rise in income is positively associated with human development; it indicates that a one per cent rise in income implies a 0.3499% increase in the country's human development. In comparison, population growth tends to decrease the human development in the country by 0.1823% by keeping other covariates of the model constant.

Table 4. ARDL Estimates

Variable(s)	Coefficient	Std. Error	t-Statistic	P-values
LogHD(-1)	-0.4469	0.0999	-4.4734	0.00
Log(F(-1))	0.2211	0.0512	4.31757	0.00
Log (POV)	0.0121	0.0058	2.0604	0.05
Log (Y(-1))	-0.1564	0.0368	-4.2497	0.00
PG(-1)	-0.0815	0.0158	-5.1449	0.00
Δ Log(F)	0.09871	0.0436	2.2634	0.03
Δ Log(Y(-1))	0.1251	0.0636	1.9632	0.06
Δ (PG)	0.0842	0.0346	2.4334	0.02
Long Run analysis				
Log(F)	0.4947	0.0618	7.9952	0.00
Log(POV)	0.0271	0.0155	1.7440	0.10
Log(Y)	0.3499	0.0421	8.3065	0.00
PG	-0.1823	0.0184	-9.8624	0.00

To the robustness of the results given in Table 4, we again analyzed the variables with FMOLS and CCR; the obtained results are similar in magnitude and direction with that of ARDL, thus confirming the existence of long-run relationships between the variables. Therefore, we can say that the estimated results are efficient and robust; we can use them for forecasting and policy guidelines.

Table 5. Robustness of Long-run Results

Variables	Coefficient	t-Statistic	P-Values
Fully Modified-OLS	--	--	--
Log(F)	0.3017	36.0527	0.00
Log(POV)	0.0009	0.5035	0.61
Log(Y)	0.0338	2.5053	0.01
PG	-0.1272	-31.8664	0.00
Constant	-1.4851	-14.7074	0.00
Canonical cointegration Regression	--	--	--
Log (F)	0.2633	8.5219	0.00
Log(POV)	0.0093	1.6199	0.11
Log(Y)	0.1056	2.4632	0.02
PG	-0.1161	-8.1314	0.00
Constant	-2.3513	-7.5006	0.00

The results given in Table 6 depicts various causal linkages between the variables. We can see that there is one-way causality from human development to poverty and food security in Pakistan. At the same time, the two-way causal run was detected between population growth and human development. The results further reveal that poverty is caused by income, and food production, while bidirectional causality was seen between population growth and poverty. Similarly, the results indicate a one-way causality from income to population growth, while bidirectional causality between food security and population growth for Pakistan.

Table 6. Granger Causality Test

Variables	HD	POV	Y	PG	F
HD		4.997(0.01)	1.330	34.512(0.00)	2.565(0.00)
POV	0.07025		0.211	20.209(0.00)	1.262
Y	8.522(0.00)	3.662(0.04)		6.487(0.00)	2.954(0.00)
PG	6.214(0.00)	8.762(0.00)	1.2396		4.693(0.02)
F	0.33842	3.926(0.03)	1.437	12.784(0.00)	

Note: F-statistics is given with probability values in parenthesis.

5. CONCLUSIONS AND RECOMMENDATIONS

The primary purpose of this study was to estimate the impact of food insecurity, poverty, and population growth on the human development of Pakistan over 1990-2018. To this end, the study hypothesized a theoretical framework in the context of development and SDGs relevant theories adopted updated econometric algorithms to account for structural shifts in the data. The empirical results obtained from the study have identified that food security in the country tends to raise the human development in Pakistan. Similarly, the role of income is also positive. With rising income, people get better off, which improves their living standards, investment in education, and health, thus resulting in the country's human development.

This study proposes various policies for development policymakers in Pakistan, thus ensuring human development by not neglecting the country's poverty, population, and food production. To achieve the targets of SDGs 1 of No poverty and 2 of Zero Hunger, human development is likely to play a crucial role in reducing poverty, access to food, and reducing population growth rate strategies for Pakistan. Pakistan being agriculturally based economy must ensure to produce sufficient food and make it available to its population as well as investing in mechanization of agriculture to boost up the production of agricultural commodities. Similarly, the government should focus on reducing the pressure of poverty through enhancing youth skills that may boost up their income level hence to improve the human development of the country. Importantly, Pakistan will need to stem its high population growth rate as a priority for achieving SDG targets and improving its HDI. By applying these policies, Pakistan can resolve its intractable concomitant issues of poverty, food insecurity, and rapid population growth that hamper achievement of better quality of life and higher HDI.

The study is efficient in its estimation. However, the study has some limitations. For example, first, the data are limited to only four study variables confined to the targets of SDGs 1 and 2 for human development. Secondly, some updated econometric approaches may also be integrated to better and more reliable regime shift estimates. Finally, such studies must also be conducted in panel structures to ensure food security and give more robust evidence and policy guidelines to reduce hunger and poverty for achieving the targets of SDGs 1 and 2 in the context of human development for developing countries.

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