The Long-run Impact of Inflation on Human Development and Poverty in Turkey

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Abstract: In this study we examine the short-run and long-run impact of inflation on human development and poverty in Turkey by utilizing a time series dataset over the period of 1990-2021 and ARDL method. We used two different indicators of inflation to check validity and robustness of our results. Co-integration test results imply that inflation and human development (poverty) are co-integrated. Therefore inflation and human development (poverty) move together in the long-run in Turkey. The long-run coefficient estimation findings reveal that there is a negative statistically significant relationship between inflation and human development and hence a positive statistically significant relationship between inflation and poverty. More specifically, if inflation jumps by 1% then human development lessens by 0.1088% and 0.1101% in two distinct models. Put it differently, if inflation goes up by 1% then poverty increases by 0.1088% and 0.1101% in Turkey. Also diagnostic test findings point out that none of the models has any problem in terms of autocorrelation, heteroskedasticity, model misspecification, and parameter instability problems.

Key Words: Inflation, Poverty, Human Development, Co-integration Analysis, ARDL Model.

1. INTRODUCTION

There are abundant empirical studies examining the various aspects of human development and poverty in the literature. In his article, Neumayer (2012) examines the linkage between human development and sustainability. Based on empirical results, he concluded that countries with high and very high human development encounter the double tasks, namely accomplishing strong sustainability by severing the connection between high human development and strongly unsustainable carbon emissions and assisting other countries experiencing low levels of human development to attain weak sustainability in the first place and strong sustainability eventually. Gerring et al. (2012), in their study, test the validity of following two hypotheses: (i) a country's level of democracy in a given year affects its level of human development and (ii) a country's stock of democracy over the past century affects its level of human development. They used infant mortality rates as a core measure of human development in their analyses and they obtained only slightly supporting evidence for the first hypothesis while they found substantially supporting evidence for the second hypothesis. Barbier and Hochard (2018) evaluated the link between land degradation and poverty and they stated that land is one of the few productive assets owned by the rural poor, but the rural poor inflated in low-income countries and in sub-Saharan Africa and South Asia as a result of degrading agricultural land over the period of 2000-2010. The article of Hope (2009) examines the association between climate change and poverty patterns in Africa and analyses the resultant impact, and debates potential adaptation of policies for mitigating the consequences of climatic changes on poverty in Africa region. Dauda (2017)'s paper analyzes the paradox of increasing poverty amid high economic growth in Nigeria. Even though Nigerian economy in recent times has achieved substantial growth, poverty unabatedly persists in Nigeria. The paper discusses that the reasons for this absurdity include jobless growth, a non-pro-poor growth, and failure of poverty alleviation initiatives to address structural transformation required for a sustainable growth, employment generation, and bridging income gap within the economy. The study of Kibirige (1997) by focusing on sub-Saharan Africa region explores the relationship between population growth, poverty and poor health. The article debates that while both population growth and poor health play an important role in worsening the problem of poverty, population growth and poor health are themselves primary consequences of poverty rather than poverty's cause.

This study makes contribution to the literature by examining the short-run and long-run impact of inflation on human development and poverty in Turkey. Estimation findings exhibit that inflation and human development/poverty are co-integrated and inflation possesses negative significant impact on human development and positive significant impact on poverty.

The remaining part of the paper proceeds as follows: the next part explains data and methodology, estimation findings are obtained in the third part and the last part concludes.

2. Data and Methodology

Inflation by increasing cost of living and leading to economic and politic uncertainty may have decreasing effect on human development and hence deteriorate poverty level in a country. Therefore in this study we analyze the long-run impact of inflation on human development and poverty in Turkey over the period of 1990-2021. The analyses were conducted by utilizing two different indicators of inflation, namely inflation given by consumer prices in terms of annual % (INF1) and inflation given by GDP deflator in terms of annual % (INF2) to check the robustness of our results. Since there is no time series data on poverty for a sufficiently long period of time with no missing data, researchers usually prefer to use proxies of poverty such as per capita income, human development index (HDI) etc. where observation are available for a long consecutive period of time. We computed correlation coefficients between HDI and some of the well-known series measuring poverty (i.e., head count poverty, poverty gap, and Watts index) in the literature and they are reported in Table 1. Correlation coefficients were imputed for the period of 2002-2019. As seen from Table 1, correlation coefficients between HDI and other poverty measures are quite high, statistically significant, and take anticipated negative sign (i.e., higher HDI means lower poverty vice versa). This confirms that HDI is a good proxy for poverty. As a result, jumps in HDI score improve human development and lessen poverty level in a country. HDI data were gathered from UNDP. All variables are in logarithmic forms.

Table 1. Correlation Matrix

	HDI	HEADCOUNT	POVGAP	WATTS
HDI	1			
Prob.	-----			
HEADCOUNT	-0.793	1		
Prob.	0.000	-----		
POVGAP	-0.706	0.970	1	
Prob.	0.001	0.000	-----	
WATTS	-0.695	0.959	0.999	1
Prob.	0.001	0.000	0.000	-----

ARDL boundary test by estimating the models given below were performed for co-integration analysis:

$$\Delta \mathrm{HDI}_t = \beta_0 + \sum_{i=1}^{p} \delta_i \Delta \mathrm{HDI}_{t-i} + \sum_{i=0}^{q} \phi_i \Delta \mathrm{INF1}_{t-i} + \theta_0 \mathrm{HDI}_{t-1} + \theta_1 \mathrm{INF1}_{t-1} + \varepsilon_t \quad (1)$$

$$\Delta \mathrm{HDI}_t = \beta_0 + \sum_{i=1}^{p} \delta_i \Delta \mathrm{HDI}_{t-i} + \sum_{i=0}^{q} \phi_i \Delta \mathrm{INF2}_{t-i} + \theta_0 \mathrm{HDI}_{t-1} + \theta_1 \mathrm{INF2}_{t-1} + \varepsilon_t \quad (2)$$

In above two equations, θ_0 and θ_1 symbols represent long-term coefficients; δ_i and ϕ_i symbols stand for short-term coefficients; Δ symbol is first degree difference operator; β_0 symbol shows constant of the models, and ε_t is white noise error term of the models.

The null hypothesis of ARDL boundary test is given by $H_0: \theta_0 = \theta_1 = 0$ expressing absence of co-integrating association between HDI (i.e., poverty) and inflation and the alternative hypothesis of ARDL boundary test is given by $H_1: \theta_0 \neq \theta_1 \neq 0$ .stating presence of co-integrating association between HDI (i.e., poverty) and inflation. If F-statistic value of ARDL boundary test is bigger than the critical value of upper limit for a given significance level then there is co-integrating relationship between HDI (i.e., poverty) and inflation. Moreover if F-statistic value of ARDL boundary test is smaller than the critical value of lower limit for a given significance level then there is no co-integrating relationship between HDI (i.e., poverty) and inflation. On the other hand, it is impossible to decide if F-statistic value of ARDL boundary test is between the critical values of lower and upper limits.

Short-run and long-run coefficients were obtained by estimating following models:

$$\mathrm{HDI}_t = \alpha_0 + \sum_{i=1}^{p} \delta_i \Delta \mathrm{HDI}_{t-i} + \sum_{i=0}^{q} \phi_i \Delta \mathrm{INF1}_{t-i} + \gamma ECM_{t-1} + \varepsilon_t \quad (3)$$

$$\mathrm{HDI}_t = \alpha_0 + \sum_{i=1}^{p} \delta_i \Delta \mathrm{HDI}_{t-i} + \sum_{i=0}^{q} \phi_i \Delta \mathrm{INF2}_{t-i} + \gamma ECM_{t-1} + \varepsilon_t \quad (4)$$

In Equation 3 and 4 given above, δ_i and ϕ_i notations show dynamic coefficients which bring the model back to the balance in the long run; ECM notations displays error correction term of the model; γ notation stands for the speed of adjustment at which the model returns back to long run path as a reaction to a shock occurred in short-run. Coefficient of the speed of adjustment term must be negative and statistically significant.

3. Empirical Findings

We firstly conducted Augmented Dickey-Fuller (ADF) unit root test to determine the integration order of HDI, INF1, and INF2 variables. The null hypothesis of ADF unit root test claims the non-stationarity of the particular variable whereas the alternative hypothesis of ADF unit root test assumes the stationary of the particular variable. Table 2 below depicts the ADF unit root test results.

Table 2. ADF Unit Root Test

Variable	Model	Test Stat.	Prob.	Result
INF1	Constant	*-1.14119*	*0.68700*	-
1st. Diff. of INF1	Constant	*-4.84308*	*0.00040*	I(1)
INF2	Constant	*-1.35912*	*0.58950*	-
1st. Diff. of INF2	Constant	*-6.42077*	*0.00000*	I(1)
HDI	Constant	*-0.56005*	*0.86550*	
1st. Diff. of HDI	Constant	*-4.82967*	*0.00050*	I(1)

As pointed out by the findings in Table 1, all variables are not stationary at level but stationary at first difference, hence they are integrated order one. Since integration order of HDI, INF1, and INF2 variables are not more than one, ARDL boundary test can be applied for co-integration analysis.

Next we used the AIC criterion to identify the optimal leg length of each model given in Equation 1 and 2. Table 3 and 4 imply that the best model is ARDL(1,1) for each model.

Table 3. Optimal Lag Length Selection for Model in Equation 1

Model	LogL	**AIC***	BIC	HQ	Adj. R-sq	Specification
29	92.665505	**-6.567815**	-6.375839	-6.510731	0.992716	**ARDL(1, 1)**
28	93.644133	-6.566232	-6.326262	-6.494876	0.992918	ARDL(1, 2)
30	91.569429	-6.560698	-6.416717	-6.517885	0.992429	ARDL(1, 0)
4	96.890967	-6.510442	-6.078496	-6.382002	0.993194	ARDL(5, 2)
26	94.816467	-6.504924	-6.168966	-6.405026	0.992857	ARDL(1, 4)
27	93.734030	-6.498817	-6.210853	-6.41319	0.992630	ARDL(1, 3)
23	92.684519	-6.49515	-6.25518	-6.423794	0.992396	ARDL(2, 1)
22	93.644366	-6.492175	-6.204211	-6.406549	0.992581	ARDL(2, 2)
24	91.590942	-6.488218	-6.296242	-6.431133	0.992113	ARDL(2, 0)
10	95.515126	-6.482602	-6.09865	-6.368433	0.992861	ARDL(4, 2)
11	94.408299	-6.474689	-6.138731	-6.374791	0.992638	ARDL(4, 1)
2	98.245082	-6.462599	-5.934665	-6.305616	0.993074	ARDL(5, 4)
17	93.116651	-6.453085	-6.165122	-6.367459	0.992285	ARDL(3, 1)
5	95.102494	-6.452037	-6.068085	-6.337868	0.992639	ARDL(5, 1)
25	95.100252	-6.451871	-6.067919	-6.337702	0.992638	ARDL(1, 5)
8	97.056037	-6.448595	-5.968656	-6.305884	0.992882	ARDL(4, 4)
16	93.963828	-6.441765	-6.105807	-6.341867	0.992392	ARDL(3, 2)
3	96.928247	-6.439129	-5.95919	-6.296418	0.992814	ARDL(5, 3)
20	94.899334	-6.436988	-6.053036	-6.322819	0.992528	ARDL(2, 4)
18	91.852882	-6.433547	-6.193577	-6.362191	0.991913	ARDL(3, 0)
21	93.739461	-6.425145	-6.089188	-6.325247	0.992264	ARDL(2, 3)
9	95.677988	-6.420592	-5.988646	-6.292152	0.992555	ARDL(4, 3)
12	92.548790	-6.411022	-6.123058	-6.325395	0.991953	ARDL(4, 0)
1	98.519787	-6.408873	-5.832946	-6.23762	0.992761	ARDL(5, 5)
6	93.239086	-6.38808	-6.052123	-6.288183	0.991972	ARDL(5, 0)
7	97.181283	-6.383799	-5.855865	-6.226816	0.992506	ARDL(4, 5)

14	95.165592	-6.382636	-5.950691	-6.254196	0.992266	ARDL(3, 4)
19	95.139407	-6.380697	-5.948751	-6.252257	0.992251	ARDL(2, 5)
15	94.065219	-6.375201	-5.99125	-6.261032	0.992051	ARDL(3, 3)
13	95.466400	-6.330844	-5.850905	-6.188133	0.991992	ARDL(3, 5)

Table 4. Optimal Lag Length Selection for Model in Equation 2

Model	LogL	**AIC***	BIC	HQ	Adj. R-sq	Specification
29	93.472077	**-6.627561**	-6.435585	-6.570477	0.993139	**ARDL(1, 1)**
30	91.883749	-6.583981	-6.44	-6.541168	0.992604	ARDL(1, 0)
28	93.537241	-6.558314	-6.318344	-6.486959	0.992861	ARDL(1, 2)
27	94.503435	-6.55581	-6.267846	-6.470183	0.993038	ARDL(1, 3)
23	93.472096	-6.553489	-6.313519	-6.482133	0.992827	ARDL(2, 1)
26	95.439762	-6.551093	-6.215136	-6.451196	0.993180	ARDL(1, 4)
11	95.335097	-6.543341	-6.207383	-6.443443	0.993127	ARDL(4, 1)
5	96.198289	-6.533207	-6.149255	-6.419038	0.993213	ARDL(5, 1)
17	93.917533	-6.51241	-6.224446	-6.426783	0.992729	ARDL(3, 1)
24	91.889504	-6.510334	-6.318358	-6.453249	0.992285	ARDL(2, 0)
21	94.562359	-6.486101	-6.150143	-6.386203	0.992722	ARDL(2, 3)
22	93.539970	-6.484442	-6.196478	-6.398816	0.992523	ARDL(2, 2)
25	95.488002	-6.480593	-6.096641	-6.366424	0.992846	ARDL(1, 5)
20	95.450663	-6.477827	-6.093875	-6.363658	0.992827	ARDL(2, 4)
14	96.373528	-6.472113	-6.040168	-6.343673	0.992928	ARDL(3, 4)
10	95.353904	-6.47066	-6.086708	-6.356491	0.992775	ARDL(4, 2)
2	98.344735	-6.46998	-5.942047	-6.312998	0.993125	ARDL(5, 4)
8	97.322792	-6.468355	-5.988415	-6.325644	0.993021	ARDL(4, 4)
4	96.216781	-6.460502	-6.028557	-6.332062	0.992846	ARDL(5, 2)
18	92.121691	-6.453459	-6.213489	-6.382103	0.992072	ARDL(3, 0)
3	97.034652	-6.447011	-5.967072	-6.3043	0.992870	ARDL(5, 3)
16	94.028813	-6.446579	-6.110621	-6.346681	0.992428	ARDL(3, 2)
9	95.930890	-6.439325	-6.00738	-6.310885	0.992693	ARDL(4, 3)
15	94.842398	-6.43277	-6.048819	-6.318601	0.992496	ARDL(3, 3)
12	92.769820	-6.427394	-6.13943	-6.341767	0.992084	ARDL(4, 0)
19	95.492594	-6.406859	-5.974913	-6.278419	0.992452	ARDL(2, 5)
7	97.436453	-6.4027	-5.874767	-6.245718	0.992647	ARDL(4, 5)
6	93.424480	-6.401813	-6.065856	-6.301915	0.992082	ARDL(5, 0)
1	98.422697	-6.401681	-5.825754	-6.230428	0.992709	ARDL(5, 5)
13	96.373579	-6.398043	-5.918103	-6.255332	0.992512	ARDL(3, 5)

Co-integration test findings obtained from ARDL bound tests are depicted in Table 5 and 6 and as can seen from the results, F-statistic values exceed the upper limit critical values at all significance level. In the light of those findings, we can deduce that HDI (poverty) and inflation are co-integrated regardless of which model is evaluated; and hence HDI (poverty) and inflation have a co-movement in the long-run in Turkey.

Table 5. ARDL Bound Test Findings for Model in Equation 1

F-statistic:	17.96702	<u>*Critical Values*</u>	
	Significance	*Lower Limit*	*Upper Limit*
	10%	3.303	3.797

5%	4.09	4.663
1%	6.027	6.76

Table 6. ARDL Bound Test Findings for Model in Equation 2

F-statistic: 19.62808	*Critical Values*	
Significance	*Lower Limit*	*Upper Limit*
10%	3.303	3.797
5%	4.09	4.663
1%	6.027	6.76

Table 7 exhibits the long-run coefficient estimation findings and the long-run coefficient estimations indicate that inflation has negative and statistically significant effect on human development (i.e., significant positive impact on poverty) in both models. In other words, if inflation increases by 1% then human development diminishes by 0.1088% and 0.1101% for models given in Equation 1 and 2 respectively. This means that if inflation goes up by 1% then poverty augments by 0.1088% and 0.1101% in Turkey.

Table 7. Long-run Coefficient Estimations of Models in Equation 1 and 2

Model in Equation 1			
Variable	Coefficient	t-statistic	Prob.
INF1	-0.1088	-2.6710	0.0127
Constant	0.2678	1.1325	0.2674
Model in Equation 2			
Variable	Coefficient	t-statistic	Prob.
INF2	-0.1101	-3.1013	0.0045
Constant	0.2401	1.2408	0.2253

We depict the error correction estimation results in Table 8 for the model given in Equation 1. We have no significant short-run coefficient estimation; however, as anticipated, negative and statistically significant coefficient estimation for error correction term was provided. We also implemented Breusch-Godfrey Serial Correlation LM test for autocorrelation, ARCH test for heteroskedasticity, and Ramsey RESET test for model misspecification. According to the diagnostic test results, the model does not contain autocorrelation, heteroskedasticity, and model misspecification problems.

Table 8. Error Correction Estimation Results of Model in Equation 1

	Dependent Variable: HDI		
	Coefficient	*t-Statistic*	*Prob.*
$\Delta INF1$	-0.000405	-0.086813	0.9315
ECM_{t-1}	-0.039203	-7.608792	0.0000
EC = HDI - (-0.1088*INF1 + 0.2678)			
Diagnostic Tests			
Tests			Test Stat. / Prob.

Breusch-Godfrey Serial Correlation LM Test	0.163543 (0.8500)
ARCH Heteroskedasticity Test	0.650550 (0.4267)
Ramsey RESET Test	2.309477 (0.1407)

Table 9 reports the error correction estimation results for the model given in Equation 2. Short-run coefficient estimation is not significant; but, in parallel to expectation, negative and statistically significant coefficient estimation for error correction term was obtained. Moreover the model has no any undesirable econometric problem as pointed out by the findings of diagnostic tests.

Table 9. Error Correction Estimation Results of Model in Equation 2

	Dependent Variable: HDI		
	Coefficient	*t-Statistic*	*Prob.*
$\Delta INF2$	0.000149	0.041440	0.9673
ECM_{t-1}	-0.043964	-7.952737	0.0000
EC = HDI - (-0.1101*INF2 + 0.2401)			
Diagnostic Tests			
Tests			Test Stat. / Prob.
Breusch-Godfrey Serial Correlation LM Test			0.173634 (0.8416)
ARCH Heteroskedasticity Test			0.841916 (0.3667)
Ramsey RESET Test			1.783050 (0.1933)

Lastly we checked the stability of parameters in each model as seen from the CUSUM test results given by the graphs in Figure 1 and 2, none of the models suffer from parameter instability.

Figure 1: CUSUM Test for Parameter Stability of Model in Equation 1

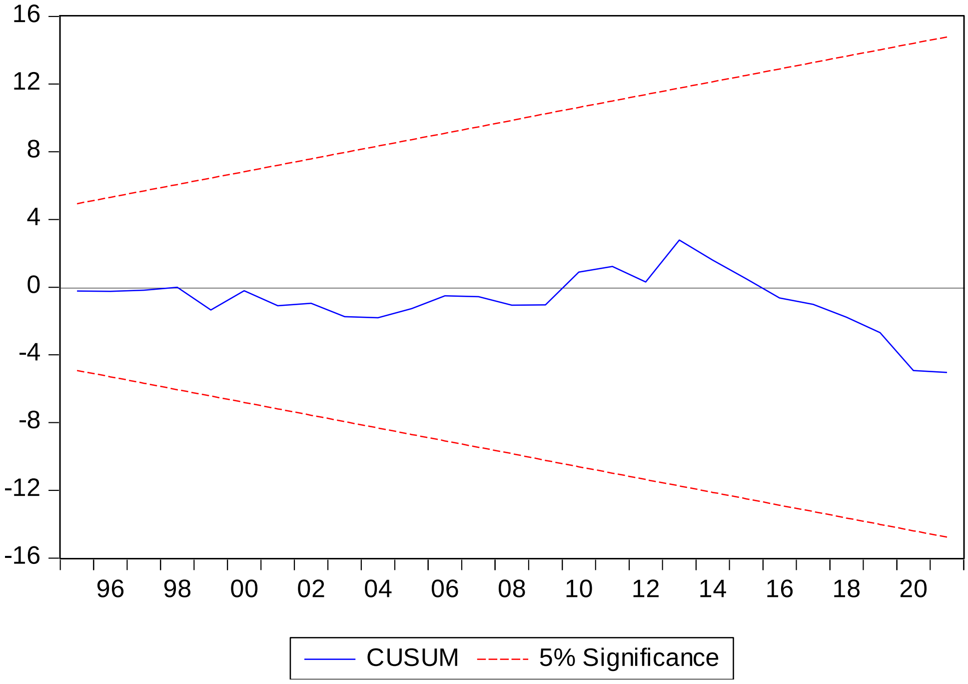
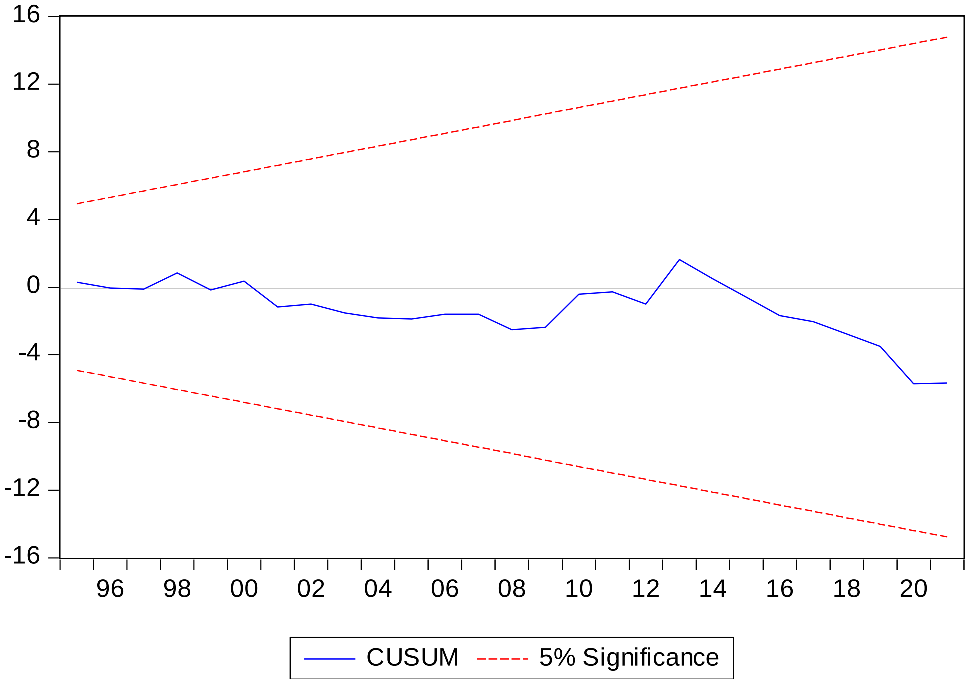


Figure 2: CUSUM Test for Parameter Stability of Model in Equation 2



4. CONCLUSION

This study attempts to explore the short-run and long-run impact of inflation on human development and poverty in Turkey by utilizing a time series dataset over the period of 1990-2021 and ARDL method. We used two different indicators of inflation to see validity and robustness of our results. ADF unit root test firstly was conducted to figure out the integration order of inflation and human development variables. ARDL boundary test for co-integration analysis was implemented and co-integration test findings revealed that inflation and human development (poverty) are co-integrated. Therefore inflation and human development (poverty) move together in the long-run in Turkey. The long-run coefficient estimation results disclose that there is a negative statistically significant relationship between inflation and human development and thus a positive statistically significant relationship between inflation and poverty. More specifically, if inflation goes up by 1% then human development deteriorates by 0.1088% and 0.1101% in two distinct models. In other words, if inflation increases by 1% then poverty enhances by 0.1088% and 0.1101% in Turkey. Meanwhile diagnostic test findings show that the both models do not have any problem in terms of autocorrelation, heteroskedasticity, model misspecification, and parameter instability problems.

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