Does EKC Hypothesis Prevail Between Inflation and Household's Consumption Expenditure: The Case of Turkiye

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Abstract: In this study I investigate the long run non-linear relationship between inflation and household's consumption expenditure in Turkiye for an annual dataset of 1960-2023. I employed ARDL estimation technique in all analyses. KPSS stationarity test results implied that CONSEX and INFSQ variables are stationary at first differences while INF and PCGDP variables are stationary at levels. The results of ARDL bounds test disclose that CONSEX, INF, INFSQ, and PCGDP variables are co-integrated. According to the long run coefficient estimations, statistically significant positive coefficient estimation was obtained for INF variable and statistically significant negative coefficient estimation was obtained for INFSQ variable. This result points out that the EKC hypothesis is valid between inflation and household's consumption expenditure. The calculated turn point is 170.6145609, and hence household's consumption expenditure increases up to this threshold value and it drops after that point in the long run in Turkiye.

Keywords: Household's Consumption Expenditure, Inflation, Stationarity, ARDL Method, EKC Hypothesis.

1. INTRODUCTION

The level of household's consumption expenditure is affected and determined by several factors. Among those factors, inflation is one of them. There are many studies in the literature addressing to the relationship between inflation and consumer spending by using different forms of data (e.g., survey data, cross-section data, time series data etc.)(see for instance, De mello&Carneiro, 2000; Bachmann et al., 2015;EffahNyamekye&AduseiPoku, 2017;Manasseh et al., 2018;Alem&Sodarbom, 2010; Taylor, 2022; Burke&Ozdagli, 2013;Ichiue&Nishiguchi, 2015 etc.)

On the other hand, the relationship between inflation and household's consumption expenditure may not be linear. Household's consumption expenditure up to a certain level of inflation may increase and after that it may decrease. Households with higher inflation expectations for future periods may attempt to realize their postponed and future consumptions at current period in order to abstain from higher prices. However, after a threshold inflation level, household's consumption expenditure may decline as result of eroding purchasing power and disposable income in response to drastically increasing prices.

Therefore in this study I try to find out if there is a nonlinear long-run relationship between inflation and household's consumption expenditure as in EKC hypothesis. The long run estimations disclose that EKC hypothesis is valid between inflation and household's consumption expenditure.

The remaining parts of the study proceed as follows; second part explains data and methodology, third part provides and discusses estimation result, and the last part concludes.

2. DATA and METHODOLOGY

In this study I investigate if there is a nonlinear long-run relationship between inflation and household's consumption expenditure as in EKC hypothesis. The sample contains observations of Turkiye for an annual data set running from 1960 to 2023 and analyses are conducted via ARDL estimation technique. The association between inflation and household's consumption expenditure is not supposed to be linear. Household's consumption expenditure up to a certain level of inflation may increase and after that it may decline. Households with higher inflation expectations for future periods will attempt to realize their postponed and future consumptions at current period in order to refrain from higher prices. However, after a threshold inflation level, household's consumption expenditure will drops as result of eroding purchasing power and disposable income in response to drastically increasing prices.

The variable of household's consumption expenditure (CONSEX) is given by households and NPISHs final consumption expenditure (% of GDP), the variable of inflation (INF) is given by consumer price index (2010 = 100), and the control variable of per capita income (PCGDP) is given by GDP per capita (constant 2015 US$).Since more per capita income means more income allocated to

consumption expenditure, I expect to see a positive coefficient for PCGDP variable. All variables were gathered from WDI of the World Bank. The logarithmic forms of all variables were utilized in all analyses.

The following model for cointegration analysis constructed and estimated:

$$\Delta \text{CONSEX}_t = \alpha_0 + \sum_{i=1}^{p} \delta_i \Delta \text{CONSEX}_{t-i} + \sum_{i=0}^{q} \phi_i \Delta INF_{t-i} + \sum_{i=0}^{r} \lambda_i \Delta INFSQ_{t-i} + \sum_{i=0}^{s} \gamma_i \Delta PCGDP_{t-i} + \theta_0 \text{CONSEX}_{t-1} + \theta_1 INF_{t-1} + \theta_2 INFSQ_{t-1} + \theta_3 PCGDP_{t-1} + \varepsilon_t \quad (1)$$

In Equation 1 above: θ_0, θ_1, θ_2, and $\theta_3$notations reflect long-term coefficients; δ_i, ϕ_i, λ_i, and γ_i notations stand for short-term coefficients; Δ notation shows for first degree difference operator; $\alpha_0$representsintercept term of regression model, and ε_t notation displays white noise error term of regression model.

The null hypothesis of ARDL bounds test is represented by H_0:$\theta_0=\theta_1=\theta_2=\theta_3=0$ and claims that there is no co-integrating relationship among the variables of CONSEX, INF, INFSQ, and PCGDP. The alternative hypothesis of ARDL bounds test is provided byH_1: $\theta_0\neq\theta_1\neq\theta_2\neq\theta_3\neq0$ and asserts the existence of co-integrating relationship among the variables of CONSEX, INF, INFSQ, and PCGDP. If F-statistic value of ARDL bounds test falls beyond the critical value of upper limit at a given significance level then this will indicate the presence of co-integrating association among the variables of CONSEX, INF, INFSQ, and PCGDP. In other cases it cannot be deduced so.

I constructed and estimated the following model to obtain short-run and long-run coefficients:

$$\text{CONSEX}_t = \beta_0 + \sum_{i=1}^{p} \alpha_i \Delta \text{CONSEX}_{t-i} + \sum_{i=0}^{q} \mu_i \Delta INF_{t-i} + \sum_{i=0}^{r} \theta_i \Delta INFSQ_{t-i} + \sum_{i=0}^{s} \pi_i \Delta PCGDP_{t-i} + \gamma ECM_{t-1} + \varepsilon_t \quad (2)$$

In Equation2 above: α_i, μ_i, θ_i, and π_i symbols reflect dynamic coefficients returning the model back to the balance in the long run; ECM term represents error correction term of regression model; γ symbol is the speed of adjustment at which the model goes back to long run in response to a shock taken place in short run. The speed of adjustment term must be statistically significant and take a negative sign.

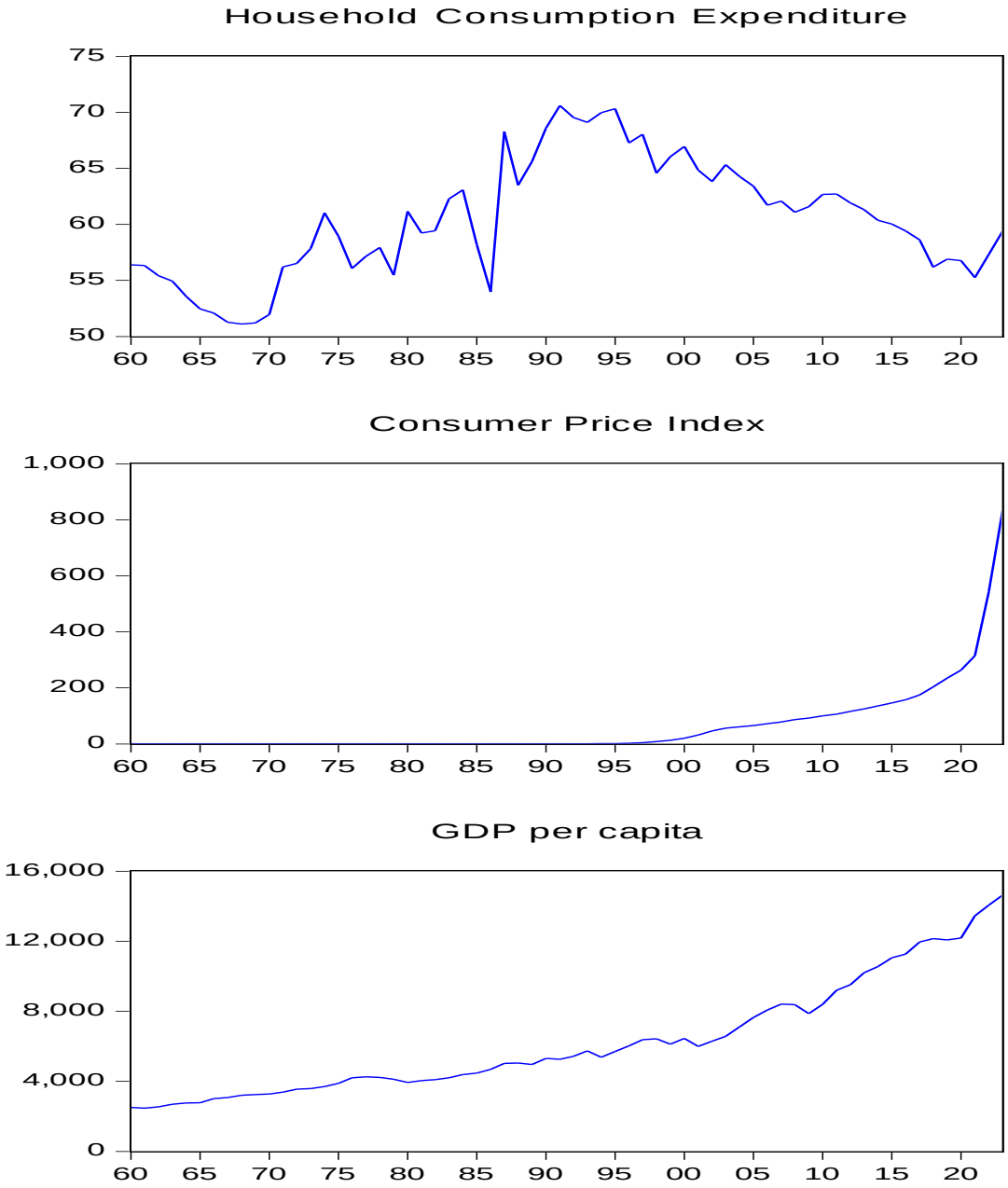
Table 1 below provides summary statistics for the variables of CONSEX, INF, and PCGDP.

Graph 1 below displays how the series of household consumption expenditure, consumer price index, and per capita GDP move over the estimation period of 1960-2023. The series of household consumption expenditure has like a head and shoulder formation without a consistent up or down trend. Consumer price index is too low to be noticed up to 1995 and after that its trend is consistently upward. On the other hand per capita GDP consistently increases during the period of estimation.

Table 1: Summary Statistics

	CONSEX	INF	PCGDP
Mean	60.41367	63.99795	6289.223
Median	60.19469	0.160591	5345.641
Maximum	70.60131	834.5931	14630.37
Minimum	51.11111	5.40E-05	2468.308
Std. Dev.	5.274847	136.9317	3233.696
Skewness	0.151028	3.687681	0.950935
Kurtosis	2.194129	18.93072	2.896294
Jarque-Bera	1.975110	821.8232	9.674313
Probability	0.372486	0.000000	0.007930
Sum	3866.475	4095.869	402510.3
Sum Sq. Dev.	1752.913	1181268	6.59E+08
Observations	64	64	64

Graph 1: Series of CONSEX, INF, and PCGDPover time



3. ESTIMATION RESULTS

Kwiatkowski-Phillips-Schmidt-Shin(KPSS) stationarity test results are reported in Table 2 for 1% significance level. As seen from the findings in Table 2, CONSEX and INFSQ variables are integrated order one (i.e., I(1)) whereas INF and PCGDP variables are integrated order zero (i.e., I(0)). Given the fact that the variables of CONSEX, INF, INFSQ, and PCGDP are not integrated two or more, the variables of CONSEX, INF,INFSQ, and PCGDP comply with the condition of ARDL bounds test and hence I am able to utilize ARDL bounds test for cointegration analysis.

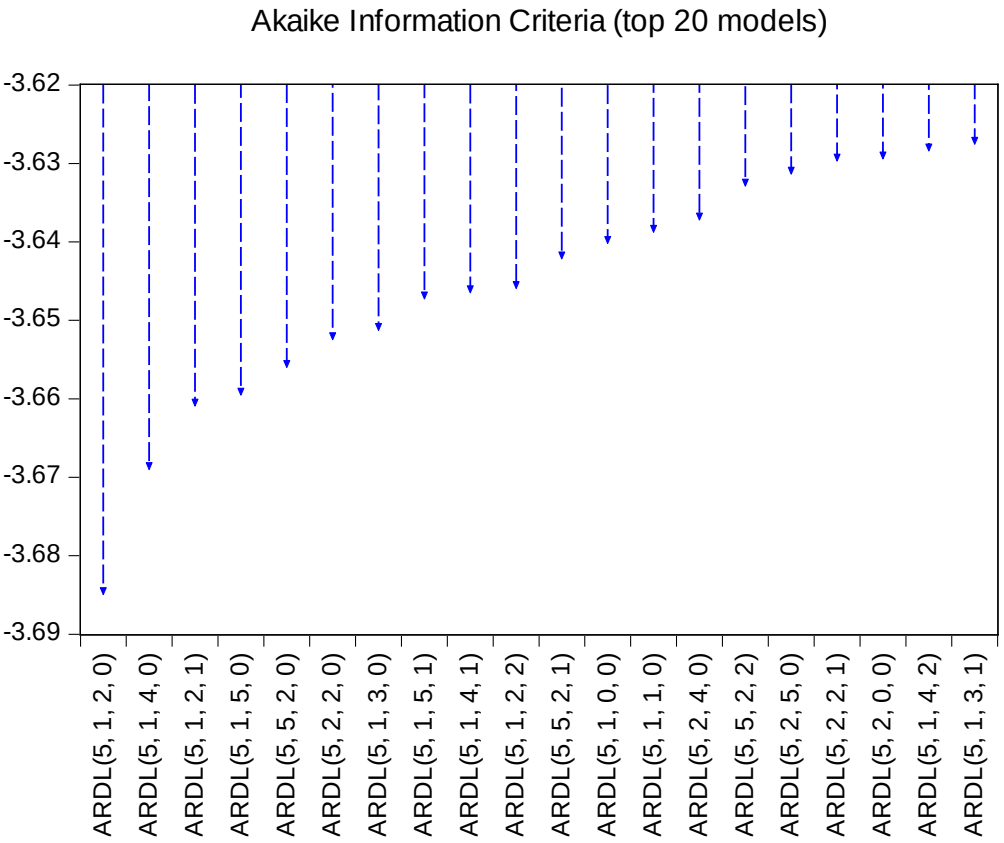
Table 2: Stationarity Test

Null Hypothesis: CONSEX is stationary		
Model: Constant, Linear Trend		
Kwiatkowski-Phillips-Schmidt-Shin test statistic		**0.220843**
Asymptotic critical value:	1% level	0.216000
Null Hypothesis: D(CONSEX) is stationary		

Model: Constant, Linear Trend		
Kwiatkowski-Phillips-Schmidt-Shin test statistic		**0.056365**
Asymptotic critical value:	1% level	0.216000
Null Hypothesis: INF is stationary		
Model: Constant, Linear Trend		
Kwiatkowski-Phillips-Schmidt-Shin test statistic		**0.133392**
Asymptotic critical value:	1% level	0.216000
Null Hypothesis: INFSQ is stationary		
Model: Constant, Linear Trend		
Kwiatkowski-Phillips-Schmidt-Shin test statistic		**0.250336**
Asymptotic critical value:	1% level	0.216000
Null Hypothesis: D(INFSQ) is stationary		
Model: Constant, Linear Trend		
Kwiatkowski-Phillips-Schmidt-Shin test statistic		**0.145767**
Asymptotic critical value:	1% level	0.216000
Null Hypothesis: PCGDP is stationary		
Model: Constant, Linear Trend		
Kwiatkowski-Phillips-Schmidt-Shin test statistic		**0.208615**
Asymptotic critical value:	1% level	0.216000

I used AIC criterion to figure out the best ARDL model in terms of optimal lag length. As can be concluded from Figure 1, after evaluation of 1080unique ARDL models, AIC criterion selected the ARDL(5,1,2,0) model as the optimal model. Therefore ARDL(5,1,2,0) model was used in all analyses.

Figure 1: Selection ofARDL Model with Optimal Lag Length



I implemented cointegration analysis by using optimal ARDL(5,1,2,0) model in ARDL bounds test and the results of ARDL bounds test are reported in Table 3. As seen from the results given in Table 3, value of F-statistic exceeds the critical values at all significance levels and sample sizes, thus it is deduced that there is cointegration association among the variables of household consumption expenditure, consumer price index, square of consumer price index, and per capita GDP. Therefore the variables of household consumption expenditure, consumer price index, square of consumer price index, and per capita GDP move together in the long run during the estimation period.

Table 3: ARDL Bounds Test

	Signif.	Lower Limit	Upper Limit
		Asymptotic: n=1000	
F-statistic: **6.033146**	10%	2.97	3.74
k: 3	5%	3.38	4.23
	2.5%	3.8	4.68
	1%	4.3	5.23
Actual Sample Size: 59		Finite Sample: n=60	
	10%	3.13	3.968
	5%	3.684	4.584
	1%	4.928	5.95
		Finite Sample: n=55	
	10%	3.132	3.956
	5%	3.692	4.582
	1%	4.99	6.018

Table 4 shows the long run coefficient estimation results. In parallel to prior expectations, I obtained statistically significant (at 5% significance level) positive coefficient estimation for INF variable and statistically significant (at 1% significance level) negative coefficient estimation for INFSQ variable. On the other hand, no statistically significant coefficient estimation was obtained for PCGDP variable even though it takes positive sign. This finding confirms the EKC hypothesis between inflation and consumption expenditure. The computed turn point (i.e., threshold value) is 170.6145609. Therefore household's consumption expenditure increases up to this turn point and it drops after that point in the long run in Turkiye over the estimation period.

Table 4: Long-run Coefficient Estimations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INF	0.0215	0.0085	2.5291	0.0149
INFSQ	-0.0021	0.0005	-4.4019	0.0001
PCGDP	0.0837	0.1181	0.7091	0.4818
TREND	-0.0091	0.0050	-1.8025	0.0780

Short run coefficient estimation findings are given in Table 5. All short run coefficient estimations of CONSEX variable are positive and statistically significant and short run coefficient estimation of INF variable is positive and statistically significant. Short run coefficient estimation of INFSQ variable is negative at current period but positive at first lag. The coefficient of ECM term takes statistically significant and negative sign as required.

Table 5: Short-run Coefficient Estimations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CONSTANT	4.1648	0.7287	5.7152	0.0000
D(CONSEX(-1))	0.3865	0.1767	2.1870	0.0339
D(CONSEX(-2))	0.5044	0.1722	2.9297	0.0053
D(CONSEX(-3))	0.6268	0.1446	4.3338	0.0001
D(CONSEX(-4))	0.4693	0.1223	3.8361	0.0004
D(INF)	0.1084	0.0263	4.1172	0.0002
D(INFSQ)	-0.0119	0.0038	-3.1252	0.0031
D(INFSQ(-1))	0.0093	0.0041	2.2537	0.0290
ECMt-1	-1.1107	0.1940	-5.7262	0.0000

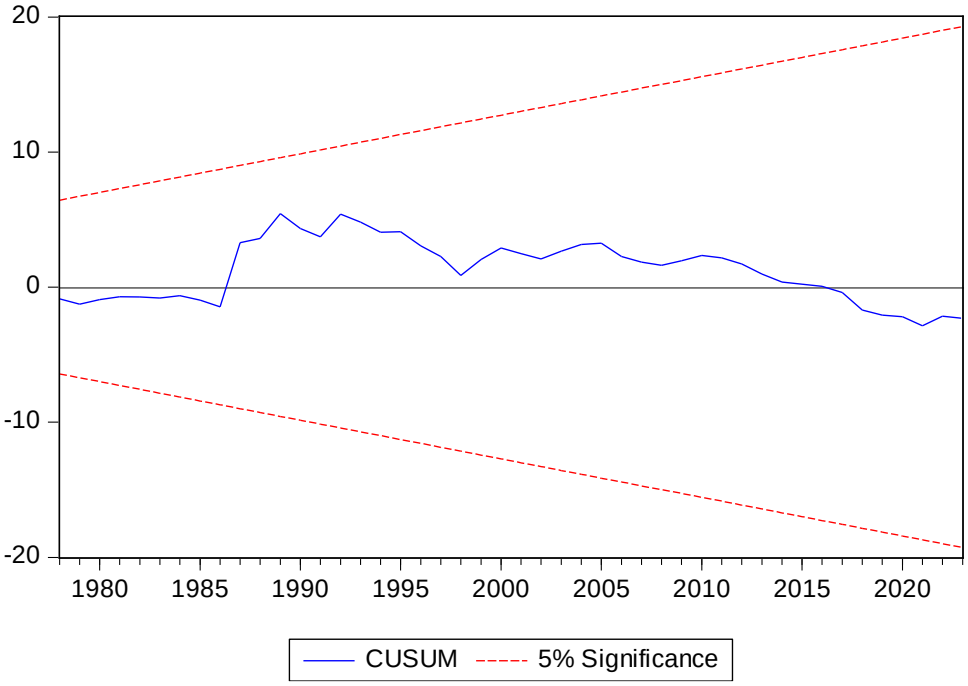
In Table 6 below I reported the diagnostic test results for normality, autocorrelation, heteroscedasticity, and model specification error. As pointed out by the test findings in Table 6, ARDL(5,1,2,0) model suffer from autocorrelation, heteroscedasticity, and model misspecification problems except non-normality problem. In other words, ARDL(5,1,2,0) model is free from autocorrelation, heteroscedasticity, and model misspecification problems.

Table 6: Diagnostic Test Results

Tests	Test Value / (Prob.)
Jerque-Bera Normality Test	125.7038 *(0.0000)*
Breusch-Godfrey Serial Correlation LM Test	1.205244 *(0.3093)*
Harvey Heteroskedasticity Test	1.047083 *(0.4247)*
Ramsey RESET Test	1.495886 *(0.2277)*

I also implemented parameter stability test by using CUSUM parameter stability test. CUSUM parameter stability test results in Figure 2 imply that the parameters of ARDL(5,1,2,0) model are stable.

Figure 2: CUSUM Parameter Stability Test



4. CONCLUSION

In this study I explore the non-linear long run effect of inflation on household's consumption expenditure in Turkiye for an annual dataset for the period of 1960-2023. I conducted all analyses via ARDL estimation technique. KPSS stationarity test results revealed that CONSEX and INFSQ variables are stationary at first differences while INF and PCGDP variables are stationary at levels. Cointegration analysis conducted by using ARDL bounds test and the test findings show that CONSEX, INF, INFSQ, and PCGDP variables are co-integrated and thus they move together in the long run.

In regard to the long run coefficient estimations, statistically significant positive coefficient estimation was obtained for INF variable and statistically significant negative coefficient estimation was provided for INFSQ variable. However, I got no statistically significant coefficient estimation for PCGDP variable even though it gets expected positive sign. The findings indicate that the EKC hypothesis exists between inflation and consumption expenditure. The calculated turn point is 170.6145609, and thus household's consumption expenditure augments up to this turn point and it declines after that point in the long run in Turkiye over the period of 1960-2023.

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