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FORECASTING TURKEY'S ENERGY GAP BY AR(I)MAX TECHNIQUE

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ABSTRACT

This study aims to explain and forecast energy gap (kt. of oil equivalent) of Turkey by AR(I)MAX technique due to its forecast accuracy advantages by accounting for autoregressive-moving average and econometric cause effect factors for the period of 2012-2023. The energy gap of Turkey is found dependable on the energy use per capita, openness level, the earlier year's energy gap (energy import) and time factor positively and shocks, which necessitate researching new energy sources, policies and strategies to reduce the gap in this open economy.

Keywords: Energy gap, energy import, forecasting, AR(I)MAX, Turkey.

JEL-Clasification: C1, C51, C53, F17

AR(I)MAX TEKNİĞİ İLE TÜRKİYE'NİN ENERJİ AÇIĞI ÖNGÖRÜSÜ

ÖZET

Bu çalışmada otoregresif-hareketli ortalamalar ve sebep sonuç faktörlerini bünyesinde bulundurduğundan öngörü yeteneği yüksek olan AR(I)MAX tekniği kullanılarak Türkiye'nin enerji açığını açıklayıcı bir model geliştirilmiş ve 2012-2023 dönemi için enerji açığı öngörüsü amaçlanmıştır. Türkiye'nin enerji açığı kişi başı enerji kullanımı, ülkenin açıklık seviyesi, önceki yılların enerji açığına veya enerji ithalatına, zamana ve şoklara istatitiksel olarak anlamlı bir şekilde ilişkili bulunmuştur. Bu bulgular doğrultusunda Türkiye'nin enerji açığının azaltılması için yeni politika ve stratejiler ile yeni enerji kaynakları bulunması gerekliliği sonucuna varılmıştır.

Anahtar Kelimeler: Enerji açığı, enerji ithalatı, öngörü, AR(I)MAX, Turkiye.

1. INTRODUCTİON

Each country wants to know her energy necessitates to follow an appropriate energy policy and strategy for its well being. The forecasting energy gap shall be one of the most important policy tools for policy makers. Therefore, a reliable forecast is necessary and it can be done more accurately via somewhat sophisticated techniques as AR(I)MAX (Autoregressive (Integrated) Moving Average Cause Effect), rather than only a cause-effect regression technique or only an autoregressive model not to face energy crises. The cause-effect regression technique does not recover lagged systematical effects and shocks for an accurate forecast, on the other hand, an autoregressive technique does not account cause-effect part. However, an AR(I)MAX model includes autoregressive filters to account systematical effects and moving average filters to account shock effects itself in addition to explanatory variables pointed out by the cause-effect regression model. Therefore, AR(I)MAX technique is able to outperform the cause-effect or AR(I)MA techniques in terms of forecast accuracies (Akal, 2004). The degree of forecast accuracies of AR(I)MAX models are found to be superior to all other techniques in a comprehensive work by Akal (2002).

Energy plays a significant role in achieving economic and social development (Mucuk and Uysal, 2004). The economic growth and energy demand are found linking each other significantly by Wolde-Rufael (2005), Keppler (2007), Lee and Chang (2008), Kebede et al. (2010), Akkemik and Goksal (2012) in the energy literature. In this view, Ünler (2008) concludes that the economic growth in the future will be matched by strong growth in energy demand and so by a strong growth in the energy gap of Turkey as the development gap between Turkey and the industrialized nations is not closed yet and as the gap between production and consumption of primary energy gets larger for Turkey. Toksarı (2007) expects a very large growth in energy demand and so in energy gap for primary energy types such as electricity, natural gas and oil because of limited resources in Turkey as Turkish economy grows. Therefore, an appropriate forecast of energy gap is important because it may lead series of successful energy administration.

The conclusion of Yeboah et al. (2012) in their survey is the use of ARIMA models because of its providence efficient and robust forecast in forecasting energy consumption and other macroeconomic variables for the developed and developing economies. Mucuk and Uysal (2004), Erdoğdu (2007), Ediger and Akar (2007), Ediger et al. (2006), etc. all concentrate on forecasting Turkey’s energy demand by using ARIMA models. There is no application on energy gap forecasting of Turkey by using AR(I)MAX type model neither for energy demand nor energy gap forecasting in the literature. Çoban and Şahbaz (2011) found a negative effect of research and development spending and a positive effect of domestic production on energy import of Turkey. In our view, inclusion of an econometric cause effect part might improve forecast accuracy in forecasting energy gap of Turkey as an emerging economy where highly mobile economic activities such as increasing foreign investment, increasingly worldwide spreading freer trade and stock market, growing output, etc. exist and all require more energy and thus the necessity of efficient energy use to include as one or two economical variables in a model. Akal (2015, 2016) showed international economic interactions affect energy use and efficiencies of the countries.

Turkey’s economic development highly depends on imported energy consumption. In an economy, all production and many consumption activities involve energy as an essential input as energy augments the productivity of production factors (International Energy Agency, 2009). Turkey’s energy use multiplied 10.52 times from 1961 to 2011 (from 10849.817 kt in 1961 to 11418.636 kt of oil equivalent in 2011), which indicates an annual growth rate about 4.82% for the period (World Bank, 2012). Net energy import as percentage of the energy use of Turkey has increased to 70.86% in 2011 from 12.59 % in 1961 (World Bank, 2012). Trade volume as percentage of Gross Domestic Product of Turkey has increased to 56.37% in 2011 from 11.94% in 1961 (International Energy Agency, 2009). The energy gap kt of oil equivalent indicated a growth rate equals 8.3% annually between 1961 and 2011 (1365.63 in 1961 and 72907.93 kt of oil equivalent in 2011) (World Bank, 2012). The energy use kg of oil equivalent per capita indicated a growth rate equals 2.26% annually between 1961 and 2011, leading to an increase in energy gap as well as it implies growing economy. Turkey’s energy use kg of oil equivalent per capita increased to 1550.56 kg by 2011 from

375.5 kg in 1961. Turkey's GDP per unit of energy use increased very slightly to US$8.68 in 2011 from US$8.35 in 1980 while it was US$4.46 in 1980 and US$7.12 in 2011 for OECD members (constant 2005 PPP US$ per kg of oil equivalent) (World Bank, 2012). Where OECD indicated a growth rate in energy use efficiency by 0.94% while Turkey indicated an improvement in energy use efficiency by 0.077% annually on the average.

Figure 1 shows us insufficient domestic supply of energy to match energy consumption and an increasing trend in energy gap from 1961 to 2011. The growth rate of energy consumption has been greater than the growth rate of energy production for the sample period except for 1998-2005. To improve domestic energy supply Turkey objects research and development in alternative energy sources such as wind, solar, nuclear energies and inefficient use of energy and renewable energy in building and industries in the vision of 2023 programmed (International Energy Agency, 2009). However, the effect of this program on reducing energy gap depends on its success.

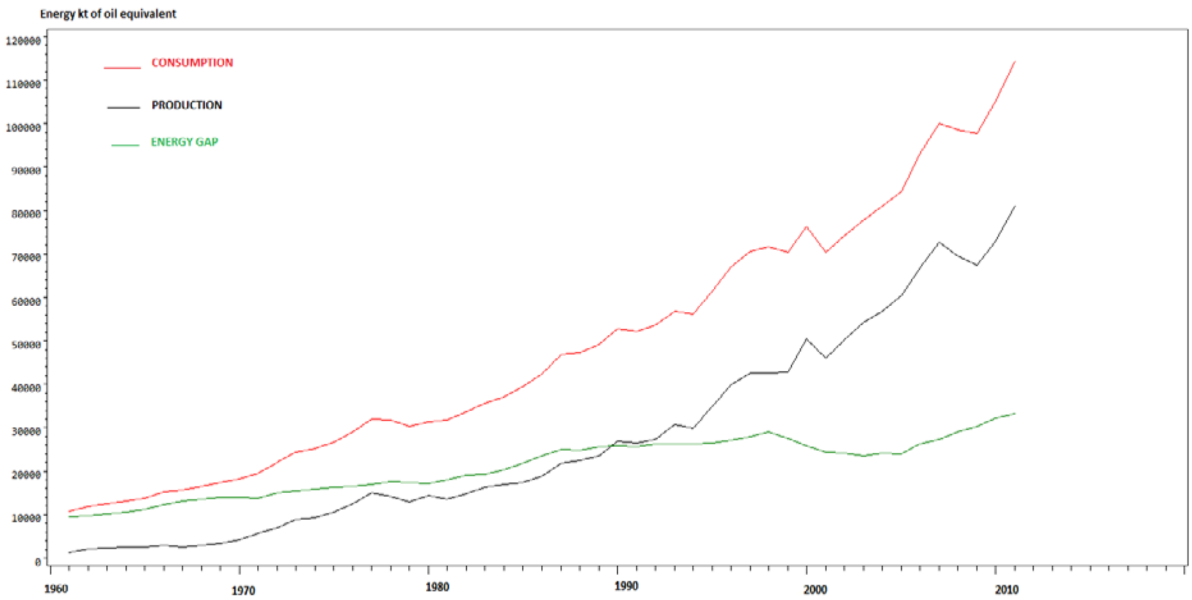

Figure 1: Energy Consumption, Production and Energy Gap of Turkey

2. METHODOLOGY

2.1. AR(I)MAX Technique

An AR(I)MAX model includes dynamic autoregressive and moving average components in addition to explanatory variables to explain variations in endogenous variable. Thus, the AR(I)MAX model accounts for the autoregressive and moving average influences in addition to theoretical explanations. Therefore, the AR(I)MAX technique corrects the insufficiencies of the econometric cause-effect technique by using dynamic filters in explaining the variations in endogenous variable. An explanatory part is integrated to the ARMA process to construct the ARMAX model. The ARMA part is considered as a special case of ARMAX without regressors by Greene (1990). Harvey (1990) and Franses (1991) treat the ARMAX problem as an extension of AR(I)MA modeling because the disturbances are generated by an AR(I)MA(p,d,q) process. An AR(I)MA(p_d_q)X model can be explicitly represented as

$$y_t = \mu + p_1 y_{t-1} + p_2 y_{t-2} + \ldots + p_p y_{t-p} + \varepsilon_t - q_1 \varepsilon_{t-1} - q_2 \varepsilon_{t-2} - \ldots - q_q \varepsilon_{t-q} + \beta x_t$$

where, μ is the constant term, β parameters are the regressors for lagged distributed x explanatory variables, p parameters are the autoregressive parameters for lagged distributed y exogenous dependent variables, q parameters are the moving average parameters for lagged distributed ε stochastic variables, and d is the degree of differencing[1]. The same lag structure is not necessarily applied to y_t and ε_t, which is required in the autoregressive distributed lag models. ε_t is the serially undistributed constant variance random variable.

The first step is to ensure that y_t and x_t must be co-integrated and its autocorrelation function shall be stationary to run the AR(I)MA part of the AR(I)MAX modeling. The stationary series is defined as exhibiting a constant mean, a constant variance, and constant autocovariances over time. This means exponentially tailing down autocorrelation function at least back two lags in the visual inspection based on the Box-Jenkins methodology (Box et al., 1994). The stationarity of the series is inspected by the analysis of actual autocorrelation correlogram (AC) and partial autocorrelation correlogram (PAC) in Box-Jenkins methodology. There must be a significant statistical association between dependent and explanatory variables, as a reason for modeling and forecasting. The existence of statistical association between the dependent and explanatory variables is researched through visual inspections of cross correlation function for the estimation of cause-effect in AR(I)MAX modeling. After cause-effect estimation, errors should exhibit stationary non white noise disturbances to apply AR(I)MA part in ARMAX models. Energy gap are theoretically and statistically correlated to the use of energy per capita and openness, and the rest consists of lagged energy gap and serially correlated shocks. An AR(I)MAX model is estimated through visual analysis and testing processes. It is important not to have highly correlated parameters (over parameterization) to avoid systematic forecast errors.

2.2. Data, Variables, Expected Relationships

All data are obtained from World Bank Database (World Bank, 2012). The symbols used in models and their theoretically expected signs in influencing energy gap are described as follow:

LEIM=Natural log values of ”energy consumption kt of oil equivalent-energy production kt of oil equivalent”.

LCKGPC= Natural log values of Energy use kg of oil equivalent per capita, base year 2000 US$, More energy use per capita leads to larger energy gap or import; $\frac{\partial LEIM}{\partial LCKGPC} > 0$.

LOPENR = Natural log values of Trade % of GDP; measure of openness. Openness is expected to lead larger energy import via trade volume relative to gross domestic product; or vise versa; $\frac{\partial LEIM}{\partial LOPENR} > 0$. Energy use must be efficient to avoid energy crisis in future (Yeboah et al., 2012).

Liberalization improves countries’ export and import and brings about reductions in prices of goods and requires exhausting of more energy for production of goods and services. Turkey’s outward looking industrialization has necessitated larger amount of energy uses since 1980 compared to the import oriented period under limited sources of energy (see Figure 1) in Turkey. Moreover, openness attracts foreign direct investment inflows into the country which increases energy demand as it contributes to domestic output. These realities make time trend variable meaningful in addition to openness in a model.

TIME=Trend factor; 1,2,3,…..,63; $\frac{\partial LEIM}{\partial TIME} > 0$ for Turkey.

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[1] AR(I)MAX model can also be represented implicitly by lag operators, $C(L)\, y_t = \mu C(1) + B(L) x_t + D(L)\varepsilon_t$.

2.3. Estimated Models

Methodologically, Box-Jenkins approach is followed for energy gap forecast models, including input series. The AR-MA part of the estimated models is determined depending on stationarized autocorrelation functions after running input variables in a model. And, whether integrated or cointegrated relations exists is validated by unit root test. To avoid over parameterization causing systematic forecast errors, a couple of influenceable variables such as gross domestic product (GDP), GDP per capita are dropped from the model. Energy prices or energy price index variables are not used due to incomplete data for the period of 1961-1978 even energy prices (for household and industrial uses) are seen important for such modeling. All the finalized estimated models satisfy model selection criterions, including criterion of whitening noises of errors.

Both energy gap and energy use per capita and openness series indicated trend effect, therefore, a linear trend is found statistically significant for estimated models under 1% (***) significance level as follows:

Maximum Likelihood Estimations of Models:

Model 1; LKGPC*:* Dependent Series: *LCKGPC*$_{1961\text{-}2011}$, Mean=6.702663, Standard Deviation=0.386573, N=51, *ARIMAX(1_0_0)TIME;*

$$LCKGPC_t = \underset{(0.05463)^{***}}{5.99223} + \underset{(0.07519)^{***}}{0.83618}\, LCKGPC_{t-1} + \underset{(0.0017411)^{***}}{0.0269}\, TIME \qquad (1)$$

Std Error Estimate = 0.039653, AIC = -180.372, SBC =-174.577, $\chi^2_{(0\text{-}6)}$ =2.59, $\chi^2_{(6\text{-}12)}$ =11.22, $\chi^2_{(12\text{-}18)}$ = 12.48, $\chi^2_{(18\text{-}24)}$ = 18.26; satisfying white noise criterion. Correlations of Parameter Estimates: $r_{(AR1,TIME)}$ = -0.056; satisfying non over parameterization criterion.

Model 2: LOPENR*:* Dependent Series: *LOPENR*$_{1961\text{-}2011}$, Mean= 3.215017, Standard Deviation= 0.628673, N=51, *ARIMAX(1_0_1)TIME;*

$$LOPENR_t = \underset{(0.14034)^{***}}{2.21978} + \underset{(0.13198)^{***}}{0.6478}\, LOPENR_{t-1} + \underset{(0.16517)^{**}}{0.37509}\, e_{t-1} + \underset{(0.0046055)^{***}}{0.03837}\, TIME \qquad (2)$$

Std Error Estimate = 0.141124, AIC = -50.0308, SBC =-42.3035, $\chi^2_{(0\text{-}6)}$ =4.05, $\chi^2_{(6\text{-}12)}$ =8.96, $\chi^2_{(12\text{-}18)}$ = 19.52, $\chi^2_{(18\text{-}24)}$ = 20.77; satisfying white noise criterion. Correlations of Parameter Estimates: $r_{(AR1,\ TIME)}$ = -0.039, $r_{(MA1,\ TIME)}$ = -0.036, $r_{(MA1,\ AR1)}$= 0.573; satisfying non over parameterization criterion(correlation between constant and the other estimates are ignored).

Then energy gap models are estimated as follows:

Model 3: LEIM*:* Dependent Series: *LEIM*$_{1961\text{-}2011}$, Mean= 9.726795, Standard Deviation= 1.129081, N=51, *ARIMAX(1_0_1)LCKGPC, LOPENR,TIME;*

$$LEIM_t = \underset{(1.02196)^{***}}{-2.53} + \underset{(0.16921)^{***}}{1.623}LCKGPC_t + \underset{(0.04256)^{***}}{0.1256}LOPENR_t + \underset{(0.0092497)^{***}}{0.03138}TIME + \underset{(0.06582)^{***}}{0.92626}LEIM_{t-1} + \underset{(0.13019)^{***}}{0.647}e_{t-2} \qquad (3)$$

Std Error Estimate = 0.062877, AIC = -127.922, SBC =-116.331, $\chi^2_{(0\text{-}6)}$ =4.29, $\chi^2_{(6\text{-}12)}$ =8.72, $\chi^2_{(12\text{-}18)}$ = 10.34, $\chi^2_{(18\text{-}24)}$ = 15.58; satisfying white noise criterion. Correlations of Parameter Estimates: $r_{(AR1,\ TIME)}$ = -0.382, $r_{(MA1,\ TIME)}$ = -0.046, $r_{(MA1,\ AR1)}$ = 0.173, $r_{(AR1,\ LCKGPC)}$ = 0.007, $r_{(MA1,\ LCKGPC)}$ = -0.038, $r_{(AR1,\ LOPENR)}$ = -0.048, $r_{(MA1,\ LOPENR)}$ = 0.083, $r_{(LOPENR,\ LCKGPC)}$ = -0.152, $r_{(TIME,\ LCKGPC)}$ = -0.517, $r_{(LOPENR,\ TIME)}$ = -0.056; satisfying non over parameterization criterion (correlation between constant and the other estimates are ignored).

Both Model 3 and Model 4; moreover, their cause effect parts indicate the existence of long run and short run co-integrated relationship as seen in Table 1 accordingly. The following Model 4 in the first differences is estimated to outline short run co-integrated relationship and to be used for forecasting, which explains changes in energy gap by the changes in energy use per capita and openness with a linear de-trend and shock effects significantly as a result of data analysis under the suspect of having more accurate forecast which can produce at similar integration levels.

Model 4: ΔLEIM: Dependent Series: Δ*LEIM*$_{1962\text{-}2011}$, Mean= 0.081637, Standard Deviation= 0.102231, N=50, *ARIMAX(0_1_2)ΔLCKGPC,ΔLOPENR,TIME;*

$$\Delta LEIM_t = 0.0844 + 1.3856\Delta LCKGPC_t + 0.1614\Delta LOPENR_t - 0.0018TIME + 0.44e_{t-2} - 0.58\, e_{t-5} \quad (4)$$

$$(0.01591)^{***}\ (0.13201)^{***}\qquad (0.0408)^{***}\qquad (0.00051)^{**}\qquad (0.215)^{**}\qquad (0.218)^{**}$$

Std Error Estimate = 0.05409, AIC = -140.06, SBC =-128.588, $\chi^2_{(0\text{-}6)}$ =1.73, $\chi^2_{(6\text{-}12)}$ =4.38, $\chi^2_{(12\text{-}18)}$ = 7.90, $\chi^2_{(18\text{-}24)}$ = 12.71; satisfying white noise criterion. Correlations of Parameter Estimates: $r_{(MA1,\ TIME)}$ = 0.097, $r_{(MA2,\ TIME)}$ = -0.088, $r_{(MA1,\ MA2)}$ = -0.599, $r_{(MA1,\ LCKGPC)}$ = 0.542, $r_{(MA1,\ \Delta LOPENR)}$ = 0.058, $r_{(MA2,\ \Delta LCKGPC)}$ = -0.370, $r_{(MA2,\ \Delta LOPENR)}$ = -0.085, $r_{(\Delta LOPENR,\ \Delta LCKGPC)}$ = -0.136, $r_{(\Delta LOPENR,\ TIME)}$ = -0.016, $r_{(\Delta LCKGPC,\ TIME)}$ = 0.118, $r_{(MU,\ \Delta LCKGPC)}$ = -0.330, $r_{(MU,\ \Delta LOPENR)}$ = -0.039, $r_{(MU,\ TIME)}$ = -0.876, $r_{(MU,\ MA2)}$ = 0.152, $r_{(MU,\ MA1)}$ = -0.198; satisfying non over parameterization criterion (ignoring high relationship between constant and TIME).

However, an average of Model 3 and Model 4 may forecast Turkey’s energy gap more accurately because it overcomes over forecast biases of Model 3 and under forecast biases of Model 4, which can be suspected under various scenarios of economic developments.

2.4. Unit Root and Cointegration

Dickey and Fuller unit root test procedure is followed to determine stationarities of the series

Table 1: Stationarity Test for the Series

Variables	***Δ²LEIM***	***Δ²LCKGPC***	***Δ²LOPENR***	*Δ*ERROR Model 3	*Δ*ERROR Model 4	*Δ*ERROR Model 3 without ARMA Part	*Δ*ERROR Model 4 without ARMA Part
Type of D-F Test Equation	constant, no trend	constant, no trend	no constant, no trend	no constant, no trend	no constant, no trend	no constant, no trend	no constant, no trend
Constant	0.0683***	0.0268***					
Estimated ρ-1	-0.9259***	-0.9708***	-0.7945	-1.127	-0.9941	-0.2722	-0.8786
Estimated tau(ρ-1)	-7.38	-6.63	-5.60	-8.74	-8.86	-2.78	-7.38
ADF Critival Values %1	-3.58	-3.58	-2.62	-2.62	-2.62	-2.62	-2.62
Integration Level	***LEIM~I(1)***	***LCKGPC~I(1)***	***LOPENR~I(1)***	ERROR3~***I(0)*** cointegrated	ERROR4~***I(0)*** cointegrated	ERROR3~***I(0)*** cointegrated	ERROR4~***I(0)*** cointegrated
ADF critival values %1 for the numbers of cointegrated vectors equal 6 and for 4 in model including constant term (Model 3 and 4)				-5.28 cointegrated	-5.28 cointegrated	-4.94 noncointegrated	-4.94 cointegrated

(Dickey and Fuller, 1979,1981). All the series are found stationary at the first order differences, thus, LEIM~I(1), LCKGPC~I(1), LOPENR~I(1) to have a valid co-integrated relationship between energy gap and these variables, as the unit root test results are seen in Table 1. Standard stationarity test on error series of the models indicated co-integrated relationship for the estimated energy models as seen in Table 1, meaning that openness and energy use per capita series have moved as energy gap series since 1961. Under the expectation of the continuity of this co-movement pattern the energy gap of Turkey is forecasted by both ARMAX and ARIMAX type models for the period of 2012-2023, *which require the forecast of input variables for the related periods.* For this purpose, Model 1 is found appropriate for energy use kg of oil equivalent per capita and Model 2 is found appropriate for the openness series.

3. RESULTS

Current values of all series are found dependable on the last year's values except for the first order differenced energy gap series, which shows short run co-integrated relationships, as a result of model estimations. The current year's energy gap depends on the last year's gap positively, the current year's energy use per capita depends on the last year's energy use per capita positively, and the current year's openness tied on the last year's openness level positively. Both energy use per capita and openness are found increasing the energy gap of Turkey, which will be continuing in the future unless governmental policies are proceeded towards increasing efficiency in energy use (or reducing energy use per capita) and increasing GDP more than increasing trade volume via increasing domestic productivity and increasing supply of domestic energy sources that is expected to limit openness ratio but reducing energy gap, as seen in both Table 2 and Figure 2. Improving the efficiency of energy use by energy use informative programs and controls can reduce energy gap through breaking energy use per capita and promote economic growth. The adoption of more energy-efficient technologies also improves energy efficiency. Bessec and Méritet (2007) point out both that energy price increases promote technological innovations which lead to increases in energy saving, and energy taxes by governments on the promotion of energy efficiency and energy conservation improve energy efficiency in OECD countries, which are also expected to reduce energy gap of Turkey. In addition, variables such as population, income, energy prices, trade, stock index, and temperature influence consumption of energy and thus energy gap to be used in modeling Yeboah et al. (2012).

Table 2: Forecasts for Variables

YEAR	Forecasts for variables				95% Confidence Limits for Forecasts for Natural Log of Energy Gap; LEIM, Model 3				Average Forecast EIM
	CKGPC	OPENR	Model 4 EIM	Model 3 EIM	Forecast	Std Error	Lover Limits	Upper Limits	
2012	1597.50	62.817	85188.52	87180.14	11.3757	0.0629	11.2525	11.4990	86184.33
2013	1645.13	67.018	85337.07	92283.53	11.4326	0.0857	11.2646	11.6006	88810.30
2014	1693.49	70.845	86636.73	102358.01	11.5362	0.1277	11.2860	11.7865	94497.37
2015	1742.69	74.437	89773.51	113231.51	11.6372	0.1549	11.3336	11.9407	101502.51
2016	1792.80	77.907	94555.52	124985.43	11.7360	0.1749	11.3932	12.0787	109770.47
2017	1843.92	81.333	97077.60	137704.45	11.8329	0.1904	11.4598	12.2059	117391.03
2018	1896.13	84.770	99431.73	151475.72	11.9282	0.2027	11.5309	12.3255	125453.72
2019	1949.48	88.259	101616.95	166393.03	12.0221	0.2127	11.6052	12.4390	134004.99
2020	2004.07	91.827	103629.43	182554.66	12.1148	0.2210	11.6817	12.5479	143092.05
2021	2059.94	95.498	105464.62	200067.14	12.2064	0.2278	11.7600	12.6529	152765.88
2022	2117.16	99.286	107117.40	219044.68	12.2970	0.2335	11.8394	12.7547	163081.04
2023	2175.80	103.206	108582.70	239611.51	12.3868	0.2383	11.9198	12.8538	174097.10

Note: Forecast values of natural logarithmic values of Energy use kg of oil equivalent per capita (LCKGPC) and Trade % of GDP (LOPENR) are found along 95% Confidence Limits. And their values are converted to original values

Forecasts based on both models and averages of two indicate continuity of increases of energy gap of Turkey for the period of 2012-2023. The average forecast of two models indicates 88810.30 kt by 2013, 117391.03 kt by 2017 and 174097.10 kt of oil equivalent energy gap forecast by 2023. However, the gap may be more than these values if the expansion of economic activities of Turkish economy continues as in recent ten years, then, Model 3 is expected to forecast much more accurately than Model 4. On the other hand, the gap may be less than the average forecasts if the world recession continues as in recent five years, then, Model 4 is expected to forecast much more accurately than Model 3. Furthermore, it shall be known that forecast bias increases as forecast period extends. Hence, these scenarios suggest us caring of the average of forecasts of two models.

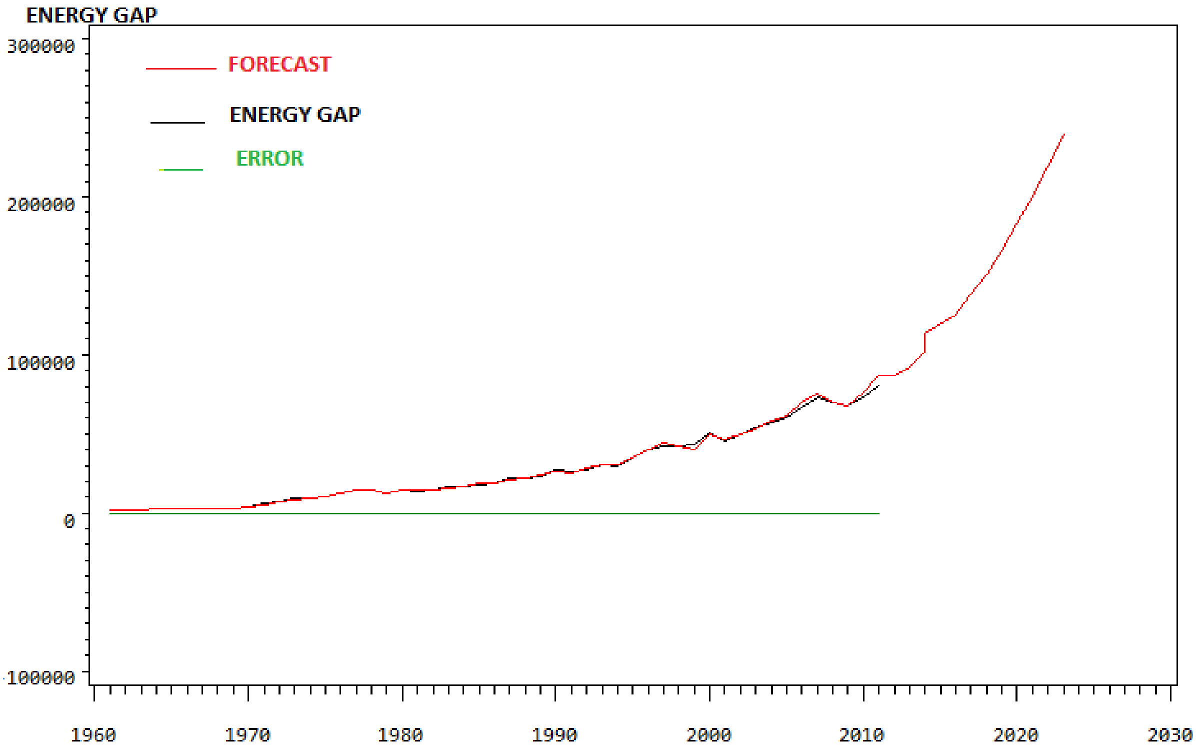

Figure 2: Forecast Values of Energy Gap of Turkey for 2012-2023

4. CONCLUSİON

There exist both long run and short run co-integrated relationship between energy gap and energy use per capita and openness with exhibiting a linear trend. The current year's energy gap is found dependable on the last year's energy import; gap and a shock significantly at two year back to explain and forecast energy gap of Turkey. On the other hand, the short run energy gap model indicated two shock effects at lag two and five in addition to the cause effect part, which is also used for forecasting. It is forecasted that Turkey's energy gap or import has a tendency to increase incrementally in the future unless (i) new energy sources are provided domestically, (ii) efficiency in energy use is succeeded or reduced further and (iii) economic productivity is improved by kind of strategies and policies followed either by government or civilian authorities not to face any energy crisis.

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