

Analysing Unit Root Properties of Macro-Economic Variables for Turkey*

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ABSTRACT

This paper will analyse the unit root properties of main macro-economic variables of Turkey. These macro-economic variables are always in demand by policy makers. This is why we have chosen 10 variables for investigation. This study will try to see whether these macro-economic variables are level stationary or first difference stationary. We applied traditional unit root and newly generated unit root tests which takes structural breaks into account for macro-economic variables of Turkey. Gross domestic product, real money supply of M1, Borsa Istanbul stock exchange index and non-agricultural unemployment rates seems to be non-stationary at their level; However, we found some mixed results for long term interest rates and interest rate spread. They appear to be either level stationary or first difference stationary. Though in most cases they are level stationary according to test results. Unemployment rate and capacity utilization rates are stationary in their level formation. Consumer Price Index of Turkey appears to be non-stationary both at level and when first differenced.

Keywords: Macro-economic variables, Unit root, Structural breaks, Central bank

JEL Classification: C22, C50, E01, E40

Türkiye İçin Önemli Bazı Makro-Ekonomik Değişkenlerin Birim Kök Testleri ile Sınanması

ÖZ

Bu çalışma, bazı önemli makro-ekonomik değişkenlerin birim kök özelliklerini inceleyecektir. Söz konusu makro-ekonomik değişkenler merkez bankaları tarafından sadece ekonomik analiz için değil, aynı zamanda üzerinde en çok durulan veri grupları arasında da yer alır. Türkiye Cumhuriyet Merkez Bankası'nın kullanmış olduğu önemli makro-ekonomik zaman serilerinin seviyede mi durağan oldukları yahut birinci dereceden farkları alındığında durağanlaştıklarını geleneksel zaman serisi birim kök testleri ve yapısal kırılmaları dikkate alan yeni nesil birim kök testleri kullanılarak araştırılmıştır. Reel GSMH, Reel M1 para arzı, BIST 100 endeksi ve Tarım-dışı işsizlik serileri seviyelerinde durağan değilken, işsizlik serisi seviyede durağan çıkmıştır. Bununla birlikte, faiz oranları vade farkı ve uzun vadeli faiz serilerinde ise karmaşık sonuçlar görülmüş ancak, daha çok seviyede durağanlığa yatkın oldukları tespit edilmiştir. Kapasite kullanım oranı serisi seviyede durağan görülmüştür. İlginç olan bulgu ise, Türkiye'ye ait Tüketici Fiyat Endeksi serisinin hem seviyede hem birinci farkları alındığında durağanlaşmadığı sonucuna ulaşılmıştır.

Anahtar Kelimeler: Makro-ekonomik değişkenler, Birim kök, Yapısal kırılmalı, Merkez Bankası

JEL Kod: C22, C50, E01, E40

1. Introduction

There are prominent macro-economic variables that are used by central banks when analyzing their economic position now and when predicting future. The mostly watched macro-economic variables are as follow:

- 1- Real Gross Domestic Products (GDP)
- 2- M1 Money Supply
- 3- Consumer Price Index (CPI)
- 4- Long Term Interest Rates (10-Years)
- 5- Interest Rate Spread (10years - 3Month T Bills)
- 6- Unemployment Rates
- 7- Non-Agricultural Unemployment Rates
- 8- Housing Permits

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9- Capacity Utilization Rate

10- Borsa Istanbul Stock Exchange, BIST 100 Index

There are also many research papers working on the links between macro-economic variables. It is thought that many or most aggregate economic time series do contain unit root (Kwiatkowski, 1992). The researchers, before going further to practice econometric models, often consider whether these macro-economic variables do contain trend or determined by shocks (Mahadeva and Robinson, 2004). These permanent shocks are defined as unit root in the series. Because, in the case of unit root, the series seem to follow a trend which means that the series' means and variances are not constant and estimation of regressions will be biased as the properties of regression will be violated. Variables in time series analysis must be stationary in order to avoid spurious regression. In other words, the traditional values of t , F and R^2 tend to be biased, the regression output may give a wrong result, even though the regression may contain higher value, despite this higher value these variables may not be related at all (Brooks, 2004). By having stationary variables, the likelihood of spurious regression will be removed and also the significance of regression will be higher (MacKinnon, 1991). For instance, for the case of time series, Sari et. al., (2007) suggest that the characters of time series can be determined by applying robust unit root estimators that will suit econometric techniques. Hence, this paper will try to apply the latest unit root methods on macro-economic variables in question.

How spurious regression exists is can be given by the example of Mahadeva and Robinson (2004). The authors assume two variables for South Africa, price level and output level and both variables are not related each other. They assign two constant growth rates for each variable and also mentioning the driving forces between the two is completely different. The authors presume that the growth rate of output and price level is the same. They write the following equation:

$$y_t = y_0 + g_t \quad (1)$$

$$p_t = p_0 + g_t \quad (2)$$

$$y_0 = p_0 \quad (3)$$

In above equations, y implies output, p indicates price level and g shows growth rates for both variables. According to above equations, $y_t = p_t$ for all time. If this is the case, then, there should be a perfect correlation between them. And, the standard error should be zero, R^2 should be 1. However, as the authors argue, there is no causal relationship between the two variables. It is claimed that the problem with this is that regressing one trending variable on another would give false results.

2.Literature Review

In their handbook work, Mahadeva and Robinson (2004), used different unit root tests to see unit root properties of macro-economic series by aiming to help central bankers and others who engaged in using tests that find unit root in data.

Similar to this study, Carrera et al. (2000) explored unit roots and cycles in Argentina's macro-economic variables. The authors try to see persistence of series, unit root and unit root with structural breaks of 14 Argentinean macro-economic variables. They found nominal interest rate, M1 growth and inflation to be stationary at level. The unemployment and participation rates found to be stationary with fractional integration. They further found that GDP, real wages, real exchange rate, trade balance, investment and employment rate series to be first differenced stationary. And, some of the variable seems to have been taken more than one units such as nominal wages, M1 and the CPI.

In their work, Cuestas and Harrison (2008), looked at stationary of inflation for Central and Eastern European countries by using panel unit tests. The applied unit root tests are Levin, Lin and Chu (2002) (LLC), Im, Pesaran and Shin (2003) (IPS), Maddala and Wu (1999) and Choi (2001) (MWC). The authors also see the effect of unit root on inflation individually for each country by applying Ng and Perron (2001) and Kapetanios, Shin and Snell (2003) (KSS) unit root tests. Authors found that the results of panel unit root tests and individual unit root tests appear to be the same and the inflation of 7 out of 12 countries

seems to be stationary when non-linearity concerned. The authors conclude that these countries were successful in stabilizing their inflation rates.

Omay (2015), when used Fractional Frequency Flexible Fourier Form to approximate smooth breaks in unit root testing for term structure of interest rate of the US, the author found that spread series shows structural break type behavior.

Cerrato et. al. (2013) investigated stationarity of 25 interest rates with different maturities for Canada and the US. The authors found that nominal interest rates were stationary when structural breaks were included in unit root testing.

To see the behavior of stock exchange index and its unit root properties, Salisu et. al. (2016) employed the Narayan and Liu (2015) trend GARCH-based unit root test for nineteen countries by using daily, weekly and monthly data frequency. Their results suggest the following countries stock exchanges were found to be non-stationary in all data frequencies; Argentina, Brazil, Chile, Hong Kong, Indonesia, Japan, Mexico, Philippines, Singapore, South Korea, Thailand and Turkey. For instance, stock exchange index of the UK and Taiwan were discovered to be stationary for all data frequencies.

To find the presence of unit in GDP and CPI index of United States, Beechey and Österholm (2008) used a non-linear trend reversion model. The authors' findings were found to be in contrast with previous researches and found that GDP and CPI are trend stationary.

By using ADF, PP and Elliott–Rothenberg–Stock DF-GLS, Chen (2011) found consumer confidence index to be stationary at level when the author analyzed the relation between consumer confidence and stock return of S&P 500 index.

3.Data and Methodology

All the data were collected from Central Bank of Turkey and Turkish Statistical Institute. While data frequency for real GDP, real M1, CPI and unemployment rate are quarterly, other variables' frequency are monthly. We should also note that due to data insufficiency the beginning of data vary according to each series. Further, GDP and M1 series were adjusted seasonally. The logarithm function was taken for the variables with the exception of non-agricultural unemployment rate, unemployment rate, long term interest rate and the spread.

In this part of the study, we first implement traditional unit root tests and then apply newly generated unit root tests that also consider structural breaks. Hence, we use the following unit root tests for our time series:

- 1- Augmented Dickey-Fuller (ADF) (1979)
- 2- Phillips–Perron (1988)
- 3- Elliott, Rothenberg, and Stock DF-GLS (1996)
- 4- ERS - Point Optimal Tests (1996)
- 5- Kwiatkowski, Phillips, Schmidt and Shin (KPSS) (1992)
- 6- Ng- Perron (2001)
- 7- Flexible Fourier Form ADF-LM-GLS (2012)
- 8- Residual Augmented Dickey-Fuller (RALD) (2014)
- 9- Break Tests (One break test and Two breaks tests)

The above tests' tasks are to detect whether series contain unit root or not. The first contribution came from Dickey and Fuller (DF) in 1979. Their model emerged as being a first order autoregressive process.

To discuss the differences between unit root tests briefly, for instance while ADF uses parametric approach and lags of dependent variable to deal with autocorrelation, PP uses non-parametric approach and put emphasize on variance errors. DF-GLS test is proposed to estimate more robust conclusion and GLS undertakes an autoregressive and detrending a linear model. KPSS test approach the null hypothesis in a different perspective. While other unit root tests' null hypothesis is unit root in series, KPSS' is no unit root in series. Ng Perron uses detrending based on GLS and suggests the following tests. The first is modified PP MZ α , the second is modified Bhargava statistics of PP MZ t .

One of the new versions of unit roots test that also assume structural breaks is Fourier approximation test. Which is based on sine and cosine functions. The sum of sine and cosine will give flexible Fourier

model. This test considers breaks into the model with unknown date. RALS model is developed for non-normal distributed errors and based on ADF and LM test.

Having given a brief presentation of unit roots tests that are used in this study, the below tables show the results of the unit root tests.

Table 1: Unit root test result for GDP

Y	Test	Constant		Constant and Trend	
		level	First Difference	level	First Difference
LnGDP		<i>Statistics</i>	<i>Statistics</i>	<i>Statistics</i>	<i>Statistics</i>
	ADF	0.671	-7.123***	-2.825	-7.167***
	P-P	0.533	-7.123***	-2.939	-7.167***
	DF-GLS	2.501	-6.659***	-1.664	-7.214***
	ERS Point Optimal	249.1	0.757***	25.768	2.480***
	KPSS	1.183***	0.172	0.097	0.073
	NG Perron				
	MZalfa	1.841	-35.46***	-4.678	-36.76***
	MZt	2.769	-4.211***	-1.498	-4.281***
	MSB	1.504	0.119***	0.320	0.116***
	MPT	175.2	0.691***	19.269	2.512***
	Fourier ADF	0.215		-3.625	
	Fourier LM			-2.020	
	Fourier GLS	1.619		-2.271	
	RALS - ADF	-0.370		-3.345**	
	Breaks Tests				
	One break ADF (ZA)	-6.115***		-7.257***	
	One break LM (LS)	-1.707		-2.894	
	Two breaks ADF (NP)	-8.333***		-7.905***	
	Two breaks LM (LS)	-2.059		-3.931	

*, **, *** indicate significance level respectively 10%, 5% and 1%. SIC information criteria were selected for automatic lag selection. Fourier and Break tests critical values were taken from authors' papers.

The above results indicate that GDP series of Turkey do not seem to be level stationary according to almost all tests. When first differenced, the series become stationary, i.e. it is integrated of order 1, I(1).

Table 2: Unit root test result for Money Supply of M1

Y	Test	Constant		Constant and Trend	
		level	First Difference	level	First Difference
LnM1		<i>Statistics</i>	<i>Statistics</i>	<i>Statistics</i>	<i>Statistics</i>
	ADF	-0.548	-10.19***	-2.299	-10.13***
	P-P	-0.511	-10.19***	-2.299	-10.12***
	DF-GLS	1.394	-9.579***	-2.275	-10.05***
	ERS Point Optimal	159.67	0.733***	9.879	2.477***
	KPSS	1.185***	0.070	0.126**	0.068
	NG Perron				
	MZalfa	1.326	-37.59***	-9.259	-37.14***
	MZt	1.632	-4.333***	-2.137	-4.310***
	MSB	1.231	0.115***	0.231	0.116***
	MPT	108.9	0.660***	9.904	2.453***
	Fourier ADF	-1.098		-2.710	
	Fourier LM			-2.884	
	Fourier GLS	1.508		-2.913	
	RALS - ADF	-1.362		-2.903	
	Breaks Tests				
	One break ADF (ZA)	-9.402***		-11.68***	
	One break LM (LS)	-3.279*		-3.294	
	Two breaks ADF (NP)	-12.88***		-13.71***	
	Two breaks LM (LS)	-3.874**		-10.34***	

*, **, *** indicate significance level respectively 10%, 5% and 1%. SIC information criteria were selected for automatic lag selection. Fourier and Break tests critical values were taken from authors' papers.

Similar to GDP, M1 data also looks a first difference stationary. Break tests outcome suggest that, when structural breaks are taken into account, the series become level stationary. However, both traditional tests and flexible Fourier test strongly suggest non-stationary at level.

Table 3: Unit root test result for CPI

Y	Test	Constant		Constant and Trend	
		level	First Difference	level	First Difference
LnCPI		<i>Statistics</i>	<i>Statistics</i>	<i>Statistics</i>	<i>Statistics</i>
	ADF	-3.717***	-2.348	-7.508***	-2.729
	P-P	-8.615***	-3.243**	-6.006***	-4.160***
	DF-GLS	0.288	-1.228	-1.240	-2.625
	ERS Point Optimal	1649.3	10.792	1098.2	7.663
	KPSS	1.078***	0.785***	0.251***	0.254***
	NG Perron				
	MZalfa	0.132	-3.080	-4.459	-12.699
	MZt	0.093	-1.152	-1.400	-2.472
	MSB	0.700	0.374	0.314	0.195
	MPT	31.844	7.810	19.69	7.446
	Fourier ADF	2.949		-6.048	
	Fourier LM			-2.991	
	Fourier GLS	0.228		-3.159	
	RALS - ADF	1.826		0.708	
	Breaks Tests				
	One break ADF (ZA)	-0.672		-2.775	
	One break LM (LS)	-1.673		-3.346	
	Two breaks ADF (NP)	-2.215		-4.151	
	Two breaks LM (LS)	-1.859		-6.073**	

*, **, *** indicate significance level respectively 10%, 5% and 1%. SIC information criteria were selected for automatic lag selection. Fourier and Break tests critical values were taken from authors' papers.

CPI level in Turkey seems to be stationary when second-differenced, i.e. integrated of order I(2). Mahadeva and Robinson (2004) found similar outcome for South African inflation. The reason for this is stated by the authors that during some period South African monetary policies were aiming a disinflation period. As result, this variable become difference stationary and I(2). Similarly, in post crisis period of 2001, Turkey also applied new monetary policies to bring down its high inflation rate. Especially after 2003, macro-economic outlook appeared to be helping a disinflationary period in Turkey.

Table 4: Unit root test result for long term interest rates

Y	Test	Constant		Constant and Trend	
		level	First Difference	level	First Difference
LONG		<i>Statistics</i>	<i>Statistics</i>	<i>Statistics</i>	<i>Statistics</i>
	ADF	-1.854	-5.311***	-3.095	-5.290***
	P-P	-1.673	-8.209***	-2.256	-8.174***
	DF-GLS	-1.534	-1.887*	-2.888*	-2.962*
	ERS Point Optimal	4.496	1.509***	3.915***	3.049***
	KPSS	0.911***	0.058	0.143*	0.056
	NG Perron				
	MZalfa	-6.309*	-6.135*	-22.118**	-12.43
	MZt	-1.704*	-1.734*	-3.318**	-2.475
	MSB	0.270*	0.283	0.150**	0.199
	MPT	4.127*	4.051*	4.168**	7.434
	Fourier ADF	-3.531*		-4.497**	
	Fourier LM			-4.015*	
	Fourier GLS	-3.385**		-3.977*	
	RALS - ADF	-1.200		-2.357	
	Breaks Tests				
	One break ADF (ZA)	-5.963***		-6.268***	
	One break LM (LS)	-3.306*		-5.527***	
	Two breaks ADF (NP)	-7.194***		-7.027***	
	Two breaks LM (LS)	-3.905**		-6.696***	

*, **, *** indicate significance level respectively 10%, 5% and 1%. SIC information criteria were selected for automatic lag selection. Fourier and Break tests critical values were taken from authors' papers.

With the inclusion of trend, long term interest rates seems to be level stationary for all unit root tests. It looks as if there is a weak tendency to be stationary with constant in level. In long term interest rates, breaks occurred in the aftermath of the financial crises, when almost all central banks decreased their level of interest rates. The Turkish interest rates follow the similar path.

Table 5: Unit root test result for interest rate spread

Y	Test	Constant		Constant and Trend	
		level	First Difference	level	First Difference
SPREAD		<i>Statistics</i>	<i>Statistics</i>	<i>Statistics</i>	<i>Statistics</i>
	ADF	-2.504	-7.975***	-2.553	-7.946***
	P-P	-2.615	-10.15***	-2.665	-10.35***
	DF-GLS	-2.514**	-0.956	-2.547	-1.980
	ERS Point Optimal	2.090**	0.443***	7.595	0.844***
	KPSS	0.280	0.048	0.208**	0.043
	NG Perron				
	MZalfa	-11.66**	-1.995	-11.897	-4.537
	MZt	-2.410**	-0.981	-2.438	-1.450
	MSB	0.207**	0.492	0.205	0.320
	MPT	2.120**	12.09	7.663	19.67
	Fourier ADF	-3.943**		-4.113	
	Fourier LM			-3.851*	
	Fourier GLS	-3.857**		-4.002*	
	RALS - ADF	-2.690		-3.611**	
	Breaks Tests				
	One break ADF (ZA)	-3.645		-3.972	
	One break LM (LS)	-3.438*		-4.361*	
	Two breaks ADF (NP)	-4.962**		-5.058**	
	Two breaks LM (LS)	-3.871***		-6.412***	

*, **, *** indicate significance level respectively 10%, 5% and 1%. SIC information criteria were selected for automatic lag selection. Fourier and Break tests critical values were taken from authors' papers.

Implied by the above test results, interest rate spread seems to be level stationary, $I(0)$. In this case, only ADF ve PP tests reject level stationarity. Akin to long term rates, spread in Turkey looks a downward way in the post crisis period. This is probably due to expectation of lower inflation.

Table 6: Unit root test result for stock exchange index

Y	Test	Constant		Constant and Trend		
		level	First Difference	level	First Difference	
LnBIST100		<i>Statistics</i>		<i>Statistics</i>		
	ADF	-2.915**	-9.327***	-1.454	-9.647***	
	P-P	-2.774*	-13.82***	-1.329	-13.98***	
	DF-GLS	1.647	-8.315***	-0.594	-8.741***	
	ERS Point Optimal	510.1	0.197***	66.75	0.662***	
	KPSS	2.152***	0.599*	0.563***	0.028	
	NG Perron					
		MZalfa	0.839	-107.1***	-1.334	-118.91***
		MZt	1.721	-7.316***	-0.598	-7.710***
		MSB	2.050	0.068***	0.449	0.065***
		MPT	262.2	0.229***	43.362	0.768***
		Fourier ADF	-2.887		-4.631**	
		Fourier LM			-4.502**	
		Fourier GLS	2.541		-4.022*	
		RALS - ADF	-2.289		-0.801**	
		Breaks Tests				
		One break ADF (ZA)	-3.394		-5.190**	
		One break LM (LS)	-1.627		-4.723**	
		Two breaks ADF (NP)	-4.638		-5.877***	
		Two breaks LM (LS)	-1.722		-5.275	

*, **, *** indicate significance level respectively 10%, 5% and 1%. SIC information criteria were selected for automatic lag selection. Fourier and Break tests critical values were taken from authors' papers.

Much of the unit root tests suggest a strong first difference stationarity for Borsa Istanbul stock exchange index. Hence, we conclude that BIST 100 index is integrated of $I(1)$. As this is the case almost for all stock exchanges around the world (Subha, 2010).

Table 7: Unit root test result for unemployment rate

Y	Test	Constant		Constant and Trend		
		level	First Difference	level	First Difference	
UNEMP		<i>Statistics</i>		<i>Statistics</i>		
	ADF	-4.517***	-3.289***	-4.550***	-3.294*	
	P-P	-3.385**	-13.44***	-3.795***	-14.65***	
	DF-GLS	-3.255***	-0.714	-4.228***	-1.722	
	ERS Point Optimal	0.170***	6.164	0.225***	13.34	
	KPSS	0.203	0.189	0.082	0.173**	
	NG Perron					
		MZalfa	-94.19***	-0.421	-436.84***	0.196
		MZt	-6.854***	-0.399	-14.778***	0.137
		MSB	0.073***	0.948	0.034***	0.697
		MPT	0.277***	45.68	0.210***	105.4
		Fourier ADF	-4.380**		-4.401**	
		Fourier LM			-4.420**	
		Fourier GLS	-3.727**		-4.599**	

RALS - ADF	-3.576**	-4.002**
Breaks Tests		
One break ADF (ZA)	-4.632*	-5.321**
One break LM (LS)	-5.069***	-4.511**
Two breaks ADF (NP)	-6.164***	-8.393***
Two breaks LM (LS)	-5.243***	-5.736*

*, **, *** indicate significance level respectively 10%, 5% and 1%. SIC information criteria were selected for automatic lag selection. Fourier and Break tests critical values were taken from authors' papers.

Unemployment rate looks level stationary when all tests' outcome is analyzed. Unemployment rate is I(0). This finding is in line with the Argentinean unemployment rate that is studied by Carrera et. al. (2000).

Table 8: Unit root test result for non-agricultural unemployment rate

Y	Test	Constant		Constant and Trend	
		level	First Difference	level	First Difference
NON-AGRI		<i>Statistics</i>	<i>Statistics</i>	<i>Statistics</i>	<i>Statistics</i>
	ADF	-2.041	-3.617***	-2.003	-3.620**
	P-P	-1.751	-8.394***	-1.721	-8.398***
	DF-GLS	-2.062**	-3.630***	-2.063	-3.655***
	ERS Point Optimal	1.853***	0.547***	6.755*	2.052***
	KPSS	0.138	0.101	0.127*	0.091
	NG Perron				
	MZalfa	-13.82***	-44.40***	-13.89	-44.49***
	MZt	-2.602***	-4.712***	-2.608	-4.716***
	MSB	0.188***	0.106***	0.188	0.106***
	MPT	1.879*	0.552***	6.723	2.049***
	Fourier ADF	-2.348		-2.750	
	Fourier LM			-2.040	
	Fourier GLS	-2.355*		-2.512	
	RALS - ADF	-2.107		-2.056	
	Breaks Tests				
	One break ADF (ZA)	-4.148		-4.003	
	One break LM (LS)	-2.645		-2.893	
	Two breaks ADF (NP)	-5.464***		-7.250***	
	Two breaks LM (LS)	-2.931		-5.301	

*, **, *** indicate significance level respectively 10%, 5% and 1%. SIC information criteria were selected for automatic lag selection. Fourier and Break tests critical values were taken from authors' papers.

Non-agricultural unemployment rates results shows that this series stationary when first differenced.

Table 9: Unit root test result for capacity utilization rate

Y	Test	Constant		Constant and Trend	
		level	First Difference	level	First Difference
LnCAPU		<i>Statistics</i>	<i>Statistics</i>	<i>Statistics</i>	<i>Statistics</i>
	ADF	-2.999**	-10.15***	-2.967	-10.15***
	P-P	-2.475	-10.21***	-2.455	-10.28***
	DF-GLS	-2.080**	-10.17***	-2.812*	-10.18***
	ERS Point Optimal	3.225**	0.344***	6.047**	1.274***
	KPSS	0.377*	0.114	0.220***	0.046
	NG Perron				
	MZalfa	-8.685**	-70.97***	-16.25*	-70.97***
	MZt	-2.079**	-5.956***	-2.802*	-5.957***
	MSB	0.239*	0.084***	0.172*	0.084***
	MPT	2.841**	0.347***	5.905*	1.286***
	Fourier ADF	-3.272		-3.575	

Fourier LM		-3.469
Fourier GLS	-3.153*	-3.585
RALS - ADF	-2.514	-2.172
Breaks Tests		
One break ADF (ZA)	-7.142***	-7.216***
One break LM (LS)	-3.912**	-4.931**
Two breaks ADF (NP)	-8.459***	-8.165***
Two breaks LM (LS)	-4.831***	-7.639***

*, **, *** indicate significance level respectively 10%, 5% and 1%. SIC information criteria were selected for automatic lag selection. Fourier and Break tests critical values were taken from authors' papers.

While Fourier unit root tests suggest non-stationarity of capacity utilization series at level, all other, traditional and break tests strongly offer a level stationarity of series at level.

Table 10: Unit root test result for housing permit

Y	Test	Constant		Constant and Trend		
		level	First Difference	level	First Difference	
LnPERMIT		<i>Statistics</i>	<i>Statistics</i>	<i>Statistics</i>	<i>Statistics</i>	
	ADF	-2.298	-5.151***	-2.240	-5.238***	
	P-P	-7.716***	-40.53***	-10.51***	-43.28***	
	DF-GLS	1.083	-0.843	-0.792	-1.368	
	ERS Point Optimal	319.9	85.97	126.2	419.6	
	KPSS	1.171***	0.203	0.246***	0.165*	
	NG Perron					
	MZalfa	1.244	0.339	-0.850	0.507	
	MZt	2.373	0.863	-0.652	1.187	
	MSB	1.907	2.542	0.767	2.342	
	MPT	248.2	354.1	107.2	1094.0	
	Fourier ADF	-1.550		-2.035		
	Fourier LM			-0.265		
	Fourier GLS	0.925		-1.922		
	RALS - ADF	-2.665		-2.375		
	Breaks Tests					
	One break ADF (ZA)	-3.713		-3.656		
	One break LM (LS)	-2.020		-5.571***		
	Two breaks ADF (NP)	-4.575**		-5.523**		
	Two breaks LM (LS)	-2.443		-7.202***		

*, **, *** indicate significance level respectively 10%, 5% and 1%. SIC information criteria were selected for automatic lag selection. Fourier and Break tests critical values were taken from authors' papers.

Housing permit series do not seem to stationary neither at level nor first differenced. However when trend included, the break test provide stationarity in level.

4. Conclusion

This study analyzed the unit root property of several important macroeconomic variables that mostly used by Central Bank of Turkey to gauge economic outlook of the country. In addition to traditional unit root test, we also employed newly generated tests which consider structural breaks in the series.

The finding of the study suggest that GDP, money supply of M1, stock exchange index and non-agricultural unemployment rate appear to be non-stationary in their level by essentially all unit root test.

While, the unit root test results of long term rates and interest rate spread seems a mixture of stationarity and non-stationarity, with structural break tests these variables are stationary in level with unemployment rate and capacity utilization rate.

CPI level in Turkey seems to be stationary when second-differenced, i.e. integrated of order I(2). Mahadeva and Robinson (2004) found similar outcome for South African inflation. The reason for this is stated by the authors that during some period South African monetary policies were aiming a disinflation period. As result, this variable become difference stationary and I(2).

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