AN ALTERNATIVE APPROACH TO TESTING SHOCKS IN FIRST ORDER AUTOREGRESSIVE TIME SERIES

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Özet

Günümüzde, zaman serisi analizlerinin temel ilgi konularından biri şok sürekliliğinin (oluşturduğu) değişikliklerdir. Şokların testi temel problemdir. Bu araştırma, çeşitli şoklar ve müdahaleler için uygun bir test istatistiği olup olmadığını saptamayı amaçlamaktadır. Ayrıca şokların outlier (dışsal veri) olarak ele alınması ve şok sürekliliğinin (oluşturduğu) yapısal değişiklikler gibi bazı problemlerle ilgilenir. Bu makale şokları alternatif bir model ile tanımlayıp, yıllık ve aylık zaman serileri için alternatif bir testin bölen dağılımlarını saptamaya çalışır. Birkaç gölge değişkenle ilgili alternatif test istatistiği değerleri için varyansların homojenliğini test eder. Bu çalışma alternatif test istatistiğinin **t** *istatistiğine karşı gücü hesaplandı ve* **t** *istatistiğinin sol yanda yanlış olan sıfır hipotezini kabul etmeye, sağ yanda gerçek olan sıfır hipotezini reddetmeye eğilimli olduğu sonucuna vardı.*

Anahtar kelimeler: *Autoregressive process, unit root models, shock persistence, half life shock, data generated process, shock and intervention tests, quantiles distribution, unbiasedness , confidence intervals, homogeneity.*

Abstract

Nowadays, innovation of shock persistence is one of the basic focus subjects of the time series analysis. The main problem is testing shocks. This article aims to examine whether there is an appropriate test statistics for various shocks and interventions. Additionally, it deals with some problems, which are considering shocks to be outlier and effect of shock persistence constitutes structural change. Consequently, this article defines shocks with an alternative model and tries to examine the quantiles distribution of an alternative test for annual and monthly time series. It examines homogeneity of variances for the values of alternative test statistics about several dummy variables (shocks). This study calculated power of the alternative test statistics against **t** *statistics, and concludes that* **t** *statistics*

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tends to accept the false null hypothesis in left side and reject the true null hypothesis in right side.

Keywords: *Autoregressive process, unit root models, shock persistence, half life shock, data generated process, shock and intervention tests, quantiles distribution, unbiasedness, confidence intervals, homogeneity.*

1. INTRODUCTION

This article discusses determining of shocks (persistence or die down) and their probabilities with alternative approach in unit root/autoregressive AR (1) time series. It studies examining attitude models of known test statistics and their quantiles distributions under the accepted null (H_0) hypothesis for shocks both theoretical and empirical.

Therefore, it aims to examine whether there is an appropriate test statistics for various shocks and interventions. If there is an appropriate test statistics, this article aims to determine quantiles distribution for it. When we investigate the history of time series, which has approximately lasted for a hundred years, the curiosity about this subject will be more meaningful. For example, studies on stationary and/or autoregressive time series have a background 90-year. Whereas standard unit root tests have been improved for the last 20 years. If we take into consideration ongoing studies examining shocks and interventions and their various effects, this curiosity will justified.

Whatever the results of this research may be, they are intended to serve the purpose of being a starting point for new researches. That is, it will be understood that the existing tests are appropriate or else the quantiles distribution of new test statistics will be determined.

Naturally, test statistics could be undetermined because of chaotic oscilations. Even if it should become undetermined, it would contribute to knowledge. At the same time, to bring into view anew reference point for future studies is include main target of article. If we briefly remember the historic development of time series with some main references, it will help to understand the subject.

First of World War and following economic crisis terms suddenly appeared in front of us as a period in which time series analysis gained speed. It gained a new perspective by some studies like as bases of stationary and business cycles, Wald (1938, p.13-30). He noted some special topics in stationary time series, which were realized by Yule (1921, p.497), Slutzky (1937, 105-146). Additionally, he noted that Khinteine had studied the subject of discrete stationary random process. Earlier, Cantelli had realized some important studies on sequence of random, Wald (1938, p.39). Business cycles applications about monetary theory, finance, stock exchange and Keynesian theory gained impetus in 1950s, Bratt (1953, p.96-200). ARIMA models studies gained impetus with Box and Jenkins (1970 a, b). Some authors referred them in subjects like diagnostic checks and ARIMA in non-stationary time series, Nelson (1973, p.56-100) and, Farnum and Stanton (1989, p.445-508).

Test of trend stationary or unit root have been studied since 1979, Dickey and Fuller (1979, p.427 ; 1981, p.1057), Sargan and Bhargava (1983, p.153), Said and Dickey (1984, p.599), Dickey and Pantula (1987, p.455), Phillips and Perron (1988,p.335), Kwiatkowski and at al (1992, p.159), Evens and Savin (1984, p.1241), Corbae and Ouliaris (1986, p.375), Perron (1989, p.1361), Hylleberg and et al (1990, p.215), Cochran (1991, p.275), Fuller (1996, p.546-640).

Power of unit root tests was studied by Nebaya and Tanaka (1990, p.247), De Jong and et al (1989, 1992 p.232-242), Pippenger and Goering (1993, p.471-473). Andrews (1993, p.139) studied about exact median unbiased estimator.

Abadir (1993, p.198) compared power of unit root tests modifications with others. He determined that the performance of unit root (t) test modification was better than other tests in "without constant models" even in small samples.

There are some important researches about current topics like innovations of shock persistence and structural changes, Maddala and Wu (1999, p.631), Mayadunne and Inder (1995, p.145), Greasley and Oxley (1997, p.348), Lumsdaine and Papel (1997, p.212), Yin and Maddala (1998, p.269). After the target of research was expounded, general definitions and development process of time series analysis were aimed to be explained as summary in first chapter. The basis of alternative approach to testing shock was discussed and some information tried to clarify about method, configuration of empirical research, and some related analysis in second chapter. Consequences of empiric research, tests and comparison of power were in third chapter. Finally, conclusion and summary were in last chapter. The quantiles distributions were placed in appendix.

2. ALTERNATIVE TEST MODEL FOR DEFINITION SHOCKS AND INTERVENTIONS

Nowadays, innovation of shock persistence is one of the basic focus subjects of time series analysis. In generally, considering shocks to be outliers and being related to the effect of shock persistence reminds of some questions and problems.

First, known unit root tests are biased while they are testing outliers. Especially, analysis will become harder or their biases will increase by the number of dummy variables, Mayadunne, Evens and Inder (1995, p.145-156), Greasey and Oxley (1997, p.348-362), Yin and Maddala (1998, p.269-305). Although, some researchers used unit root tests for determining innovation of shock persistence. Nevertheless, shocks do not appear only like outliers. Additionally, there are interventions, applied for removing the shock effects. Both of them may be outliers or they may move among the confidence intervals like fickle or central waves. In this situation, if tests are realized with known models, they will tend to accept null hypothesis, which are claimed that there are neither shocks nor interventions, Yin and Maddala (1998, p.269-305). The second particularity is being determined attitude model of the test statistics about shock hypothesis. If model is known, temporary effects of shocks can be easily determined, also. So, probability of shock can be computed about unexpected movements. Because of this reason, empirical sampling distribution must be examined on the frame of proposed model. The arising form of shock effect may be positive or negative. Thereupon, using two dummy variables are accepted sufficient for three possible situations.

On the frame of proposed model, in any t period appeared shock is accepted as neither outlier, nor shock ratio, but it is defined in *equation 1*:

$$Y_t - Y_{t-1} = \varepsilon_{t,shock} \tag{1}$$

Consequently, using dummy variables in frame of Dickey Fuller Models are sufficient for testing shocks. Additionally, shock ratio (α) is easily estimated by using *equation 2*:

$$Y_{t-1}(1+\alpha)^n = Y_{t+n} \tag{2}$$

Especially, examining of the empirical distribution of test statistics supplies chance about determining effect of shocks with assistance of Half Life Shock (HLS) method which shock ratio is less then unit, namely the value is not reason of trend breakage or structural changes, Andrews(1993, p.139).

It is well known that, desired characteristics and results must be convenient for generalization. That is why; two different studies were realized with number of observations (T) were respectively accepted 122 and 40 for annual and monthly time series. This approach additionally aims determining effects of the number of observations on empirical distributions of the test statistics.

When theoretical building and sampling process of empirical study are explained, discussing of the consequences of empirical researches will be more useful.

The hundred arrays were generated and **SPSS 9.0** was preferred for the Data Generation Process. Generated error terms ε_t were obtained as $\varepsilon_t \sim$ IID $(0, \sigma^2)$ white noise. At the same time, error terms are asymptotic fitted NID (0; 1). Autoregressive arrays Y_t were generated without constant and trend terms by *equation 3*:

$$(3) \qquad Y_t = Y_{t-1} + \varepsilon_t \ , \qquad \varepsilon_t \sim \text{iid}\,(0, \sigma^2), \qquad t = 1...T$$

then, $\text{Var}(Y_t) = \sigma_y^2 = t\sigma^2$, which is not constant over time Hamilton (1994, p.475- 477).

The help of SPSS 9.0 and Excel XP did all the other analyses. The performance of unit root t test modification is greater then the others for this autoregressive configuration, Abadir (1993, p.189, 205-207). In addition, distributions of the test statistics for unit root are different from standard normal distribution, Fuller (1996, p.547 - 549). Known approach about models discuss them in the frame of *equation 4*:

$$(4) \qquad \varepsilon_{t,shock} = Y_t - \overline{Y}$$

With confidence interval of Y_t

$$(5) \qquad \overline{Y} \mp \tau\sigma_y = \overline{Y} \mp \tau.(t.\sigma_\varepsilon^2)^{\ 1/2}$$

However, this study discusses them as differences. Hence it provides some opportunities about determined non –outlier shocks or interventions which centralize the series. Therefore, we can determine probability of shock. Additionally we can determine whether difference between two sequential time points is cause of shock effect. According to the shock model, it will take form as *equation 6*:

$$\Delta Y_t = \beta_1 Y_{t-1} + \beta_2 DW_1 + \beta_3 DW_2 + \varepsilon_t \ , \tag{6}$$

which DW_1 is dummy variable for first shock, DW_2 is dummy variable for second shock.

Namely, τ test was constituted on based Dickey Fuller Models. If the test is realized for shock ratio by (α):

$$\alpha = \frac{Y_t - Y_{t-1}}{Y_{t-1}} \tag{7}$$

Shock ratio α will fit Cauchy Distribution, like confidence intervals of exact median unbiased estimator, Andrews (1993, p.155).

The number of observations is 122 for each monthly time series. There are two groups of monthly time series and, there are 50 series in each group. Because of the shock effect (α) is less then 0.5, there will be (T-1) observation without shock for each Y_t series which have T observation. Two different dummy variables DW_1 and DW_2 were constituted under the null hypothesis

$$H_{01} : \beta_2 = 0 \quad ; \qquad H_{02} : \beta_3 = 0 \tag{8}$$

by using the sampling with replacement. There is only one value, which is accepted one, and other (T-1) values are equal to zero. The number of DW_1 and DW_2 are 100 for each group Y_t. Totally, there are 200 dummy variable arrays for each group. Sampling method paid attention the first shock period (t_i) before then the second shock period (t_j). The hundred replications were applied to each Y_t, totally 10000 replications were realized. The numbers of tested shocks were 20000. New test statistics of shock based Dickey Fuller approximation with *equation 6.* Error terms distribute asymptotic normal, because of this reason test statistics for shock (τ – shock) is

$$(9) \qquad \tau_{shock} = \frac{\hat{\beta}_{i,shock} - \beta_{i,shock}}{s_{\beta}} \qquad \text{for} \qquad (t_i \neq t_j)$$

Where estimation of shock parameter is $\hat{\beta}_{i,shock}$ and $\beta_{i,shock}$ is theoretical value of shock parameter, which is defined in null hypothesis.

Some tests were realized about whether differences of "the τ – *shock statistics* distributions" for DW_1 and DW_2 are significant in the samples and, between the samples or not. According to results distribution of quantiles were calculated.

Additionally, process was repeated for situation in which orders of shocks is not important $(t_i \neq t_j)$. Obtained results were approximately same with others.

The number of observations is 40 for annual time series. There are two groups of annual time series and, there are 50 series in each group. The number of DW_1 and DW_2 are 30 for each group Y_t. Totally, there are 60 dummy variable arrays for each group. The thirty replications were applied to each Y_t. Totally, 3000 replications were realized. The numbers of calculated test statistics were 6000.

The quantiles distribution of test statistics was regenerated for annual time series. Differences of the test statistics' distributions of annual and monthly series were tested. Subsequently, powers of test statistics were calculated and their performances were compared with the other. The conclusion chapter explained results of empirical researches. The determinations of this article are agreed with preceding researches.

3. EMPIRICAL CONSEQUENCES OF RESEARCH AND TESTS OF HYPOTHESIS

First, replications are realized to find the quantiles distribution of the proposed test statistics in two sample groups. Using *equation 9* helps to calculate the test statistics (τ-shock) for $\beta_{i,shock}$. Differences between the means of the quantiles distributions are tested within samples and between samples. It tries to understand whether the added new dummy variable changes the distribution or not, for fixed T. Estimations of all β_2 and β_3 is respectively

$\hat{\beta}_{21}$ and $\hat{\beta}_{31}$ in the first sample group, $\hat{\beta}_{22}$ and $\hat{\beta}_{32}$ in the second sample. It tries to test for the τ-shock statistics, which have same quantiles distributions for all $\hat{\beta}_{ij}$.

If the samples' variances of τ-shock statistics are homogeneous for all $\hat{\beta}_{ij}$ test procedure goes on the means of τ-shock statistics.

The test of homogeneity of variances uses likelihood ratio test (-2log λ) which fits Chi-square distribution (χ^2) with (k-1) degree of freedom, Mood and Graybil and Boes (1974, p.439). Where λ is

$$\lambda = \frac{\prod_{j=1}^{k} (\sigma_j^2)^{n_j/2}}{\left(\sum n_j \hat{\sigma}_j^2 / \sum n_j\right)^{\Sigma n_j/2}} \tag{10}$$

While fixed T is 122 for monthly series, the value of the likelihood ratio tests (-2log λ) is 3,461027 and critical value of χ^2 is 11,341 with 3 degree of freedom. Because of the calculated value is small then critical value χ^2, null hypothesis about homogeneity is accepted. The samples' variances of test statistics (τ-shock) are homogeneous for all $\hat{\beta}_{ij}$.

Although it is not essential, the homogeneity of variances is tested within two samples by F statistics. After it accepted homogeneity hypothesis, equality hypothesis are tested for the means of $\hat{\tau}_{\beta 21}$ and $\hat{\tau}_{\beta 31}$ at the *Table I.* It accepted that the means are equal by the reason of the calculated value t-statistics is small than the critical value t_α. Same test is realized for the second sample, and same result is accepted at the *Table II.* Differences are tested between the samples for $\hat{\beta}_{2j}$ and $\hat{\beta}_{3j}$ at the *Table III* and *Table IV.*

Hypothesis about homogeneity of variance and equality of means are tested for merged $\hat{\beta}_2$ and $\hat{\beta}_3$ at *the Table V.* It showed that, the variances are homogeneous and the means are equal to each other for merged $\hat{\beta}_i$.

Same results could be accepted for the parameter estimations of two samples by F test. In the same way, F test result is displayed at the *Table VI* for all $\hat{\tau}_{\beta_{ij}}$, which are realized hypothesis about homogeneity and asymptotical normal distribution. The results are same with others. Descriptive statistics of τ_{β} are displayed at the *Table VI b.*

Table 1: Equality Test For Means (Of τ_{shock}) In First Sample Group

t-Test: Two Samples for Equal Variances		
	$\hat{\tau}_{\beta 21}$	$\hat{\tau}_{\beta 31}$
Mean	0,001034	-0,0224
Variance	1,040664	1,042974
Observation	5000	5000
Cumulated Variance	1,041819	
Provided Difference of Means	0	
df	9998	
t Stat	1,147685	
P(T<=t) one-side	0,125563	
t Critical one-side	2,326724	
P(T<=t) two-sides	0,251126	
t Critical two-sides	2,576326	

Table 2: Equality Test For Means (Of τ_{shock}) In Second Sample Group

t-Test: Two Samples for Equal Variances		
	$\hat{\tau}_{\beta 22}$	$\hat{\tau}_{\beta 32}$
Mean	0,027615	-0,00887
Variance	0,97201	1,02073
Observation	5000	5000
Cumulated Variance	0,99637	
Provided Difference of Means	0	
df	9998	
t Stat	1,827733	
P(T<=t) one-side	0,03381	
t Critical one-side	2,326724	
P(T<=t) two-sides	0,067619	
t Critical two-sides	2,576326	

Table 3: Equality Test For Means (Of $\tau_{\beta_{2,shock}}$) Of Two Different Samples

t-Test: Two Samples for Equal Variances	$\hat{\tau}_{\beta 21}$	$\hat{\tau}_{\beta 22}$
Mean	0,001034	0,027615
Variance	1,040664	0,97201
Observation	5000	5000
Provided Difference of Means	0	
Df	9986	
t Stat	-1,32488	
P(T<=t) one-side	0,092621	
t Critical one-side	1,645008	
P(T<=t) two-sides	0,185242	
t Critical two-sides	1,960202	

Table 4: Equality Test For Means (Of $\tau_{\beta_{3,shock}}$) Of Two Different Samples

t-Test: Two Samples for Equal Variances	$\hat{\tau}_{\beta 31}$	$\hat{\tau}_{\beta 32}$
Mean	-0,0224	-0,00887
Variance	1,042974	1,02073
Observation	5000	5000
Cumulated Variance	1,031852	
Provided Difference of Means	0	
Df	9998	
t Stat	-0,66558	
P(T<=t) one-side	0,252848	
t Critical one-side	1,645005	
P(T<=t) two-sides	0,505697	

Table 5: Equality Test For Variances And Means (Of Merged τ_{shock} In Sample)

t-Test: Two Samples for Equal Variances

	Sample 1	*Sample 2*
Mean	-0,01068	0,009371
Variance	1,041852	0,996603
Observation	10000	10000
Cumulated Variance	1,019228	
Provided Difference of Means	0	
df	19998	
t Stat	-1,40443	
P(T<=t) one-side	0,080104	
t Critical one-side	2,326533	
P(T<=t) two-sides	0,160207	

F-Test: For Two Samples Variances

	Sample 1	*Sample 2*
Mean	-0,01068	0,009371
Variance	1,041852	0,996603
Observation	10000	10000
df	9999	9999
F	1,045403	
P(F<=t) one-side	0,013214	
F Critical one-side	2,326533	
P(T<=t) two-sides	1,047632	

Table 6: Equality Test For Means (Of All τ_{shock})

Groups	*Observations*	*Total*	*Mean*	*Variance*
Column 1 $\hat{\tau}_{\beta 21}$	5000	5,167833	0,001034	1,040664
Column 2 $\hat{\tau}_{\beta 31}$	5000	-111,976	-0,0224	1,042974
Column 3 $\hat{\tau}_{\beta 22}$	5000	138,0749	0,027615	0,97201
Column 4 $\hat{\tau}_{\beta 32}$	5000	-44,3664	-0,00887	1,02073

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P- Value*	*F Critical*
Between Groups	6,711088	3	2,237029	2,195115	0,086392	2,605354
Within Groups	20377,81	19996	1,019095			
Total	20384,53	19999				

Table 6b: Descriptive Statistics For τ_{shock} (T=122)

	$\hat{\tau}_{\beta 21}$	$\hat{\tau}_{\beta 31}$	$\hat{\tau}_{\beta 22}$	$\hat{\tau}_{\beta 32}$
Mean	0,001034	-0,0224	0,027615	-0,00887
Standard Error	0,014427	0,014443	0,013943	0,014288
Median	-0,01521	-0,04638	0,022198	0,022493
Standard Deviation	1,020129	1,021261	0,985906	1,010312
Sample Variance	1,040664	1,042974	0,97201	1,02073
Kurtosis	0,125686	0,052549	0,145704	0,151993
Skewness	0,09883	0,021144	0,027131	0,028426
Minimum	-3,48172	-3,53166	-3,84509	-3,91156
Maximum	3,76897	3,229595	3,664538	3,353138
Observation	5000	5000	5000	5000

The quantiles distributions of various τ_{β} series were summarized at the *Table VII.* Distribution of τ_{β} values is displayed at the *Figure I,* and *Table VIII.*

T is equal to 40 in the second situation.

Descriptive statistics of τ_{β} are displayed at the *Table IX* for two samples groups.

Homogeneity of the variances is tested by the likelihood ratio statistics. Likelihood ratio value is calculated as 4,275343. Additionally, differences between the means are tested by F statistics. The test result showed that the null hypothesis about equality of the means is not rejected, at the *Table X.* Homogeneity of the variances and equality of the means are tested about values of the τ-shock statistics of merged $\hat{\beta}_2$ and $\hat{\beta}_3$, at the *Table XI.* The test results show that their variances are homogeneous and their means are equal. Their descriptive statistics are at *the Table XII.*

Table 7: Descriptive Statistics For τ_{shock} (T=122)

QUANTİLES	q0.995	q0,99	q0,975	q0,95	q0,90	q0,005	q0,01	q0,025	q0,05	q0,10
Mean	2,728854	2,447505	2,019617	1,674896	1,285586	-2,69124	-2,34461	-1,88495	-1,61732	-1,25874
Standard Error	0,034466	0,02166	0,029319	0,015709	0,001443	0,023261	0,054973	0,030895	0,016094	0,019351
Median	2,738188	2,45891	2,00796	1,670022	1,286048	-2,70634	-2,30924	-1,89312	-1,61333	-1,27561
Standard Deviation	0,068931	0,04332	0,058639	0,031417	0,002886	0,046521	0,109947	0,06179	0,032188	0,038702
Sample Variance	0,004752	0,001877	0,003439	0,000987	8,33E-06	0,002164	0,012088	0,003818	0,001036	0,001498
Minimum	2,63617	2,385862	1,961524	1,643501	1,28188	-2,72828	-2,50475	-1,95034	-1,65993	-1,28281
Maximum	2,80287	2,486338	2,101026	1,716037	1,288367	-2,624	-2,2552	-1,80322	-1,58266	-1,20091
NUMBER of SERIES	4	4	4	4	4	4	4	4	4	4

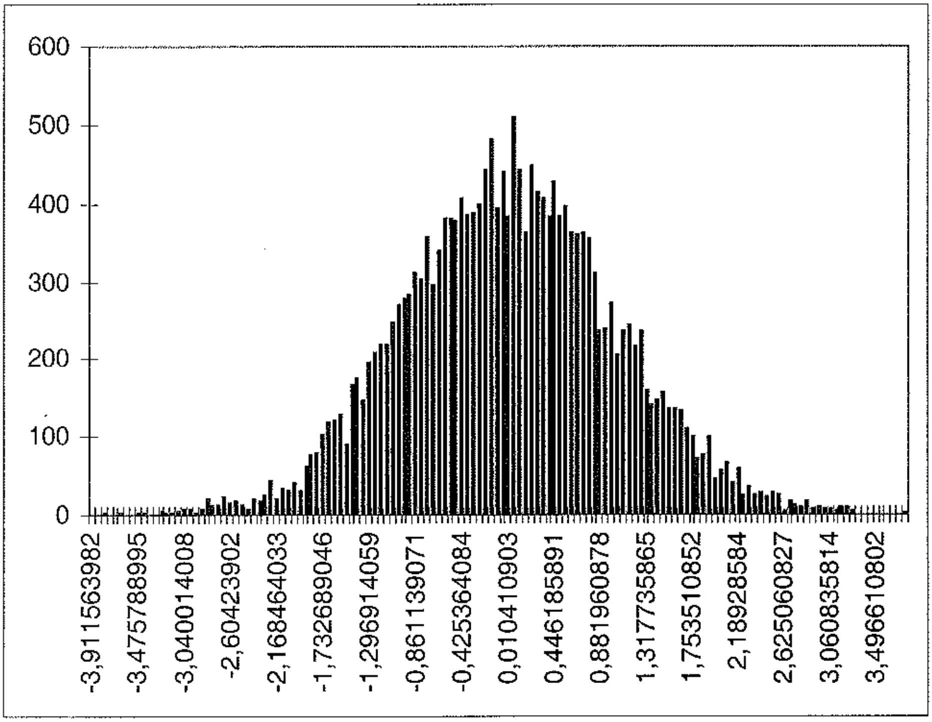

Figure 1: Distribution of τ_{shock} for (T=122 N=20000)

Table 8: Descriptive Statistics For All τ_{shock} (T=122 N=20000)

	τ_{shock}
Mean	-0,00065
Standard Error	0,007139
Median	-0,00619
Standard Deviation	1,009593
Sample Variance	1,019277
Kurtosis	0,119205
Skewness	0,04305
Minimum	-3,91156
Maximum	3,76897
Observation	20000

Table 9: Descriptive Statistics For τ_{shock} (T=40)

	$\hat{\tau}_{\beta 21}$	$\hat{\tau}_{\beta 31}$	$\hat{\tau}_{\beta 22}$	$\hat{\tau}_{\beta 32}$
Mean	0,039649	0,026644	0,035034	0,02561
Standard Error	0,02781	0,02615	0,02588	0,027084
Median	0,028545	0,053792	0,009324	0,071197
Standard Deviation	1,077083	1,012796	1,002321	1,048942
Sample Variance	1,160107	1,025756	1,004647	1,100278
Kurtosis	0,175485	0,278028	0,024721	0,301151
Skewness	0,133035	-0,02412	0,053231	-0,09524
Minimum	-3,36925	-3,7493	-3,39797	-3,61423
Maximum	3,610324	3,701123	3,343096	3,748701
Observation	1500	1500	1500	1500

Table 10: Equality Test For Means (Of All $\tau_{\beta_{ij}}$) (T=40)

Groups	*Observations*	*Total*	*Mean*	*Variance*
Column 1 $\hat{\tau}_{\beta 21}$	1500	59,47355	0,039649	1,160107
Column 2 $\hat{\tau}_{\beta 31}$	1500	39,96673	0,026644	1,025756
Column 3 $\hat{\tau}_{\beta 22}$	1500	52,55095	0,035034	1,004647
Column 4 $\hat{\tau}_{\beta 32}$	1500	38,41475	0,02561	1,100278

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P- Value*	*F Critical*
Between Groups	0,205419	3	0,068473	0,063833	0,978948	3,784891
Within Groups	6431,893	5996	1,072697			
Total	6432,098	5999				

Table 11: Equality Test For Variance And Means (Of Merged τ_{β_i} Between Samples)

F-Test : For Two Samples Variances

	$\tau_{\beta 2}$	$\tau_{\beta 3}$
Mean	0,037342	0,026127
Variance	1,082022	1,062663
Observation	3000	3000
Df	9999	9999
F	1,018217	
P(F<=t) one-side	0,310558	
F Critical one-side	1,088695	
P(T<=t) two-sides	1,047632	

t-Test: Two Samples for Equal Variances

	$\tau_{\beta 2}$	$\tau_{\beta 3}$
Mean	0,037342	0,026127
Variance	1,082022	1,062663
Observation	3000	3000
Cumulated Variance	1,072342	
Provided Difference of Means	0	
df	59998	
t Stat	0,419423	
P(T<=t) one-side	0,337461	
t Critical one-side	1,645108	
P(T<=t) two-sides	0,674922	
T Critical two-sides	1,960361	

Table 12: Descriptive Statistics For All τ_{shock} (T=40 N=6000)

	τ_{shock}
Mean	0,031734
Standard Error	0,013368
Median	0,042218
Standard Deviation	1,035469
Sample Variance	1,072195
Kurtosis	0,207912
Skewness	0,019441
Minimum	-3,7493
Maximum	3,748701
Observation	6000

General variances of the τ-shock statistics are calculated as 1,072195 in annual time series and 1,019277 in monthly time series. Mean of the τ-shock statistics goes away from zero for annual time series. These results show that effects of the autoregressive process are clearer for finite sample than the others are. Because of this reason, standard normal distribution must not be used for testing annual shocks.

Distribution of τ-shock statistics is at the *Figure II,* for T is equal 40.Quantiles distributions of proposed τ-shock statistics are at the *Table XIII.* Differences between the quantiles distributions were tested by t-statistics about matched samples. It accepted that differences are significant for various T values. Additionally, powers of the τ-shock statistics were calculated for the various T values by accepting of the α type error as 0,05 . They are summarized at the *Table XIV* and *Figure III.* When the powers of test statistics were calculated the quantiles distribution of τ-shock statistics used for determining probabilities about annual and monthly arrays within which T were equal to 40 and 122.

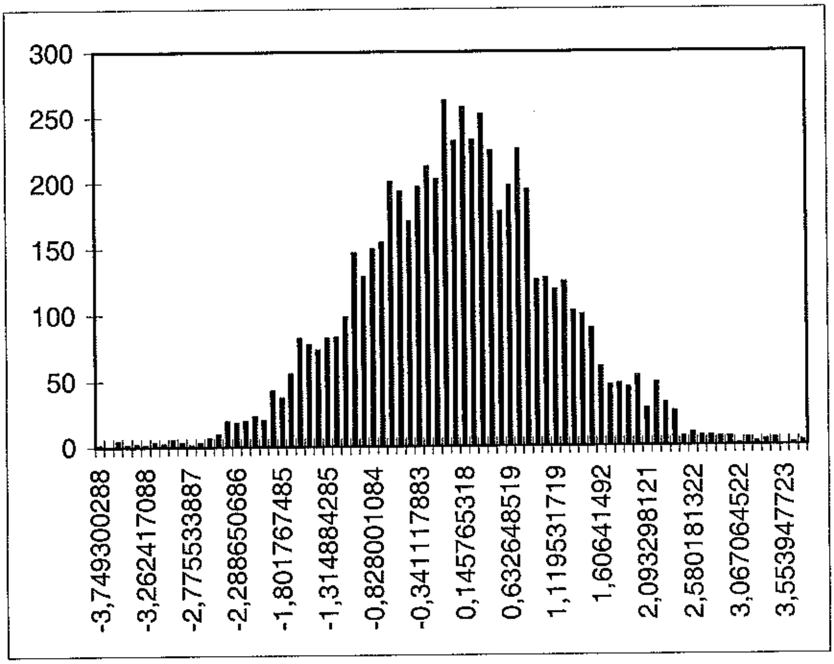

Figure 2: Distribution of τ_{shock} for (T=122 N=20000)

Table 13: Quantiles Disstributions For τ_{shock} Statistics [a]

Quantiles	T=40	T=122
0,001	-3,39797	-3,19168
0,005	-2,61306	-2,70473
0,01	-2,38512	-2,38439
0,02	-2,09337	-2,02913
0,025	-1,96877	-1,9066
0,03	-1,90753	-1,83116
0,04	-1,77051	-1,72096
0,05	-1,67307	-1,62619
0,1	-1,30436	-1,27082
0,5	0,042395	-0,00609
0,9	1,347303	1,285365
0,95	1,794228	1,676883
0,96	1,914442	1,790481
0,97	2,033316	1,918121
0,975	2,122551	2,023503
0,98	2,206255	2,124549
0,99	2,458148	2,419072
0,995	2,857753	2,729591
0,999	3,431149	3,189729

a-Calculated t-test value for difference is 13,77886

Table 14: Power Of τ_{shock} Test Statistics And Normal

Shock Value for H1 Hypothesis	Power of τ T=122	Power of τ T=40	Power of normal [a]
-5	0,998125	0,995	0,9986
-4,5	0,9931	0,989	0,9937
-4	0,977	0,958	0,9773
-3,5	0,9375	0,909	0,9338
-3	0,855	0,815	0,8448
-2,5	0,719	0,665	0,6972
-2	0,5258	0,4692	0,50834
-1,92489	0,49855	0,4347	0,47885
-1,9	0,49405	0,4237	0,46897
-1,5	0,34105	0,2927	0,318336
-1,2	0,2406	0,2039	0,221
-1	0,1845	0,1504	0,1677
-0,9	0,1604	0,1265	0,1452
-0,5	0,0869	0,078	0,0787
-0,4	0,0729	0,0645	0,0684
-0,3	0,0651	0,0522	0,0603
-0,2	0,057	0,0436	0,0548
-0,1	0,0518	0,037	0,0511
0	0,05	0,03051	0,05
0,1	0,0508	0,0274	0,0512
0,2	0,0551	0,0243	0,0547
0,3	0,0596	0,0238	0,0603
0,4	0,0666	0,0226	0,0681
0,5	0,077	0,0227	0,0785
0,9	0,1349	0,0445	0,1448
1	0,1563	0,0521	0,1678
1,2	0,1963	0,0663	0,2211
1,5	0,2926	0,1061	0,316936
1,9	0,4395	0,18006	0,46897
1,92489	0,4494	0,18616	0,47885
2	0,4794	0,20606	0,50835
2,5	0,67	0,36066	0,69715
3	0,826	0,573	0,84475
3,5	0,9275	0,734	0,93375
4	0,977	0,868	0,97725
4,5	0,9911	0,935	0,99365
5	0,9925	0,979	0,99855

[a] Variance was accepted as the same with T=122 for Normal

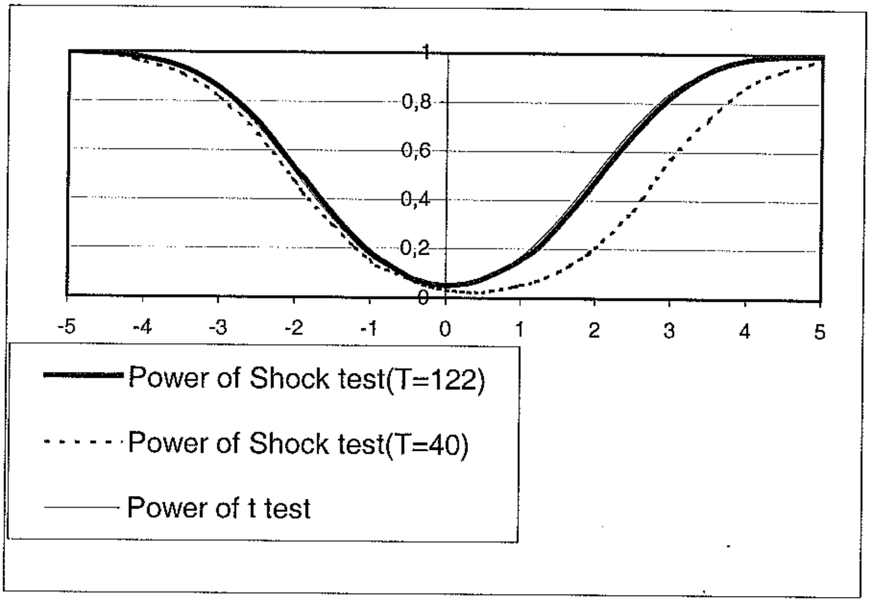

Figure 3: Distribution of τ_{shock} for (T=122 N=20000)

Additionally, the power of normal distribution was calculated with the experimental variance of τ-shock within which T was equal to 122.

Approximately maximum power limits of each distribution are different because of their skewness and confidence intervals are different. That is why, their maximum power limits must discuss between their confidence intervals. Maximum power of τ-shock statistics is approximately 0,469 for negative shocks and 0,573 for positive shocks when T is equal to 40. Maximum power of τ-shock statistics is approximately 0,525 for negative shocks and 0,4795 for positive shocks when T is equal to 122. Power of t-statistics is symmetric and approximately equal to 0,5. These results show that, τ-shock statistics are applicable for testing shocks. Specially, researchers must be careful about increase of α type error, as well. In summary, the known test statistics bias to increase α type and β type errors for determining shock. The experimental quantiles distribution of τ-shock statistics decreases biases. Therefore, the new test statistics can help researchers for truly determining the probabilities of being shock of any interventions. Additionally, this study shows that it can be easily applied for determining innovation of shock persistence, because of it can easily determine the ratio of shock even if it is small then one.

4. CONCLUSION

The results of this study show that τ-shock tests are clearly essential when the number of observations is about 40. When, T is greater then 125 and goes to infinite, its distribution approach to standard normal distribution. The standard error of τ-shock statistics approaches to one, its mean approaches to zero, and it is leptokurtic, while the sample size T goes to infinite. Hence, using of t statistics causes smaller biases in monthly time series than it does in annual time series for testing positive shocks. It is known, the distribution of τ-shock statistics are positively skewed. Left side confidence interval is less then right side confidence interval. Because of this situation, power of shock statistics is greater than the standard normal t-statistics for negative shocks. Namely, τ-shock statistics are briefly essential for negative shocks. Additionally, using the t-statistics causes to increase α type error for positive shocks. In summary, the t test tends to accept the false null hypothesis in left side and to reject the true null hypothesis in right side. The results of the other well-known tests will also be similar to above discussed for example, Dickey Fuller Test for drift tends to accept the false hypothesis, which accepts the parameter of shock as zero, Yin and Maddala (1998).

APPENDIX

QUANTILES DISTRIBUTION OF τ- SHOCK STATISTICS

QUANTILES	τ- SHOCK T=122	τ- SHOCK T=40	τ- SHOCK T=40	τ- SHOCK T=122	QUANTILES
0,9995	3,229595	3,693271	-3,59364	-3,43022	0,0005
0,999	3,189729	3,431149	-3,52745	-3,19168	0,001
0,995	2,729591	2,857753	-2,6146	-2,70473	0,005
0.99	2,419072	2,458148	-2,3871	-2,38439	0,01
0,98	2,124549	2,206255	-2,09448	-2,02913	0,02
0,975	2,023503	2,122551	-1,97033	-1,9066	0,025
0,97	1,918121	2,033316	-1,90791	-1,83116	0,03
0,96	1,79	1,914442	-1,77177	-1,72096	0,04
0,95	1,676883	1,794228	-1,67332	-1,62619	0,05
0,94	1,588489	1,649962	-1,59866	-1,53265	0,06
0,93	1,507752	1,539594	-1,52295	-1,45762	0,07
0,92	1,435087	1,463937	-1,45244	-1,3982	0,08
0,91	1,359026	1,413773	-1,38282	-1,32559	0,09
0,90	1,282365	1,347303	-1,30564	-1,27082	0,10
0,89	1,233463	1,29222	-1,22786	-1,21978	0,11
0,88	1,188691	1,22849	-1,16959	-1,17293	0,12
0,87	1,137368	1,176806	-1,11138	-1,12149	0,13
0,86	1,093444	1,135548	-1,07257	-1,08049	0,14
0,85	1,047381	1,087618	-1,03074	-1,04028	0,15
0,84	0,994714	1,033695	-0,98223	-0,9987	0,16
0,83	0,953061	0,982018	-0,94631	-0,96249	0,17
0,82	0,914149	0,940082	-0,90451	-0,92147	0,18
0,81	0,862293	0,897864	-0,88209	-0,88864	0,19
0,80	0,819402	0,848802	-0,82192	-0,85045	0,20
0,79	0,784495	0,800571	-0,7809	-0,81605	0,21
0,78	0,750259	0,770567	-0,74479	-0,78391	0,22

QUANTILES	τ- SHOCK T=122	τ- SHOCK T=40	τ- SHOCK T=40	τ- SHOCK T=122	QUANTILES
0,77	0,721763	0,746182	-0,71356	-0,75312	0,23
0,76	0,692022	0,724208	-0,68858	-0,71826	0,24
0,75	0,663625	0,698927	-0,65253	-0,68015	0,25
0,74	0,632475	0,670387	-0,62294	-0,65009	0,26
0,73	0,601943	0,644572	-0,59458	-0,61554	0,27
0,72	0,57223	0,623487	0,56825	-0,59167	0,28
0,71	0,542167	0,593026	-0,53574	-0,56502	0,29
0,70	0,516067	0,554722	-0,50293	-0,53525	0,30
0,69	0,488195	0,530477	-0,4649	-0,50536	0,31
0,68	0,464288	0,513595	-0,43278	-0,47714	0,32
0,67	0,433936	0,461866	-0,40014	-0,44939	0,33
0,66	0,411287	0,430796	-0,37139	-0,42446	0,34
0,65	0,379226	0,401304	-0,344	-0,39545	0,35
0,64	0,350547	0,369494	-0,31458	-0,36868	0,36
0,63	0,324557	0,349471	-0,28665	-0,33937	0,37
0,62	0,300096	0,326568	-0,25787	-0,31123	0,38
0,61	0,271755	0,305487	-0,23531	-0,28379	0,39
0,60	0,243761	0,281453	-0,20762	-0,25689	0,40
0,59	0,219922	0,259501	-0,18029	-0,22903	0,41
0,58	0,194528	0,235138	-0,14549	-0,20941	0,42
0,57	0,171245	0,210412	-0,11804	-0,18863	0,43
0,56	0,140945	0,186932	-0,09554	-0,1655	0,44
0,55	0,112207	0,160681	-0,07679	-0,13851	0,45
0,54	0,084817	0,136838	-0,0565	-0,011026	0,46
0,53	0,061773	0,1146	-0,03495	-0,08307	0,47
0,52	0,03761	0,093448	-0,01008	-0,06191	0,48
0,515	0,028792	0,080736	-0,00178 *	-0,04767	*0,4835\ 0,485
0,51	0,019912	0,070403	0,019109	-0,03128	0,49
0,50	-0,00609	0,042395	0,042395	-0,00609	0,50

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