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Comparing of Unit Root with and without Structural Breaks: A Monte Carlo Evaluation

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ABSTRACT

Background: The unit root became the most important feature that directed to the construction of new time series econometrics. **Objectives:** The study of time series structural breaks was a specific area of unit root research. **Methods:** Conventional procedures assume the break and apply a test accordingly. This leads to identification of spurious breaks, and therefore biased results, Lee and Strazicich, (2001). **Results:** We suggust an alternative strategy where we propose to test for structural breaks before applying unit root test. The debates of Structural breaks in unit root testing starts with Perron (1989). Nelson and Plossor (1982) found unit roots in 1 out of 14 macroeconomic time series of US economy and Perron (1989) taking the Nelson and Plossor's data set, reversed the findings for 11 out of 14 series. The later development in unit roots with structural breaks developed procedures for endogenizing structural breaks (Zivot and Andrew, 1992; Christiano 1992 etc). However, the original Perron's Procedures and the later development in unit root testing with structural breaks, assume that there is a structural break. The studies endogenizing structural breaks also assume the break and determine the break date endogenously. We propose that the structural breaks should be tested for existence. **Conclusion:** Our results are indicating that existing strategy is significantly suffering in power problems but the proposed strategy is better and significantly perform as compare to conventional or existing strategy.

INTRODUCTION

Structural breaks with unit root test are among the popular tools of the time series econometrics. The breaks are important because they can change the decision about existence of unit root. A major area of unit root research has been the study of structural breaks in time series. Perhaps the issue discussed most in the history of econometric literature is the debate on unit root initiated by Nelson and Plossor (1982). Ignoring stationarity can lead to spurious results and wrong asymptotic for traditional econometric techniques. This has led to a huge amount of research in the past 30 years, but consensus on several important issues and implications has not emerged to date. Even though vast numbers of unit root structural break tests have been proposed and studied, conflicting opinions exist on the simplest of problems. For example, there is a list of the conclusions of authors who have studied the USA annual GNP series:

Stationary structural break; Nelson and Plossor (1982),Trend Stationary structural break ; Perron (1989),Trend Stationary structural break; Zivot and Andrews (1992),Riechlin and Zivot Structural break (1992), Banerjee and Christiano structural break (1992),Trend stationary structural break; Diebold and Senhadji (1996),Lumsdaine and Papell structural break (1997), Difference stationary structural break; Murray and Nelson (2002), NG and Perron structural break (2001),Kilian and Ohanian structural break (2002).

In econometrics literature there is a long historical debate on the topic of nonsense correlation (spurious regression), at least looking back to Yule's wellknown analysis (1926). According to study he presented that during 1866 to 1911 the presence of a strong correlation of 0.95 between mortality rate and proportion of Church of England marriages to all marriages. According to Yule (1926) that the spurious regression was a result of relevant variables that were missing. This idea was also supported by Simon (1954) that the missing variable is a source of spurious correlation. If we are unsure as to whether the apparent correlation is spurious, we need to add new variable that might be found in the actual correlation explained by Simon.The results of experiment of Granger and Newbold (1974) showed that if the series were non-stationary the results would be significant. They generated independent, autoregressive series such as, x_t and y_t in their experiment. Where x_t and y_t both express their own values of the lag.

$$y_t = y_{t-1} + \varepsilon y_t \ldots (1)$$

$$x_t = x_{t-1} + \varepsilon x_t \ldots (2)$$

In development of both equation no third variable involued.They regressed x_t on y_t and y_t on x_t.

$$y_t = a + \beta x_t + \varepsilon y_t \ldots. (3)$$

$$x_t = a + \beta\, y_t + \varepsilon x_t \ldots (4)$$

They also found that there are spurious results and the alternative explanation of spurious regression become more common with in literature, and the rest of explanation went in darkness.

After that Nelson and plosser (1982) found that the majority of the U. S economy's macroeconomics series has unit root. The study of Nelson and Plosser is generally recognized as an important contribution which has theoretical and imperical implications. They used the Dickey Fuller test for detection of unit root for the U.S. economy on 14 historical macroeconomics series including GNP, wage employment prices, stock prices, and interest rates, and found that twelve out of fourteen series had unit root. In ormality, Nelson an Plosser's(1982) study is a significant contribution to time series econometric literature that increased the interest of researchers in unit root testing. That is why progress has been fashioned in unit root theory.

Perron showed that the real GNP series used by Nelson and Plosser is no longer consistent with the unit root hypothesis if a change in level, occurring at 1929, is considered. Perron's conclusion is that from 1909 to 1970, there is only one permanent shock, a negative one, and the rest of the variation in output is transitory around a time trend. In Perron (1989),the date of the trend break, 1929, was assumed to be known a priori. This drew criticism originally from Christiano (1992) who suggested that Perron's results may be tainted by the assumption that the break date was known. Using both Monte Carlo and Bootstrap procedure, he found that if the break date is allowed to be data dependent, then the critical values are much larger (in absolute value) than those tabulated by Perron. Zivot and Andrews (1992) and Banerjee et al. (1992) derived the limiting distribution of the unit root statistic when the break date is endogenized. Zivot and Andrew (1992) found that Perron's conclusion that U.S. GDP is stationary around a broken time trend still holds once critical values are adjusted to reflect estimation of the break date. Peron and Zivot Andrew literature has been collected by papers which study the asymptotic distribution of unit root and/or Structural break statistics under various methods for selecting the break date. In this study they also mentioned the size distortion and power problem as well.

The literature studies are exploring that these are lead to spurious results in terms of size distortion and low power problems. The purpose of this study is to provide the Alternative solution for conventional econometrics when there is size distortion and power problem.

We offer the new procedure and called it proposed strategy. In proposed procedure where we first of all test the structural break then apply the unit root accordingly. Conventional procedure assumes the break and then apply the unit root accordingly.

As we have seen, unit root process often shows spurious breaks Lee and Strazicich, (2001). Therefore, the many series which are in fact unit root are treated as may be stationary with Structural Break (size distortion).

From theoritical econometrics literature we have found the gap that many unit root tests are facing the size and power problems. As we discussed in details in the above literature Peron (1989), and Zivot Andrew (1992), tests are not much reliable to tackle the problem of size distiortion and power problem in stationary time series. For this reason we offer an alternative procedure or proposed strategy for the treatment of significant size and power in stationary and non-stationary time series. Second section exploring methodology and third section exploring estimation results and conclusions.

MATERIAL AND METHODS

The testing unit root with structural breaks is a popular technique used in econometrics. The usual strategies for this purpose are of two types: first is Peron type strategy where one assumes known break date applies the test. Second is Zivot Andrew type strategy, where the researcher assumes that there is break and then chooses the break date endogenously. These two strategies do not test for the break. In fact, it is important to make sure that there is structural break and apply the unit root tests with breaks only if there is evidence of break. This would require testing for structural break first and then application of break point unit root test would be needed only if the evidence of breaks is found. Though this strategy makes sense, it has not been used with literature. The objective of this study is to apply this proposed or alternate strategy and compare its performance with the existing strategies. This section discussed, data generating process existing and proposed strategy data and simulation have the following hypothesis.

3.1 Brief sketch of existing and proposed methodology

1) Existing methodology: In existing or conventional methodology, the break assumed and then apply unit root test accordingly. If the break date known than applying Pierre Peron test. If the break date is not known than they apply the Zivot Andrew test. We introduced the new methodology proposed strategy is given below.

2) Proposed Strategy

Proposed strategy does not assume the break, rather, it asks to test the break. Therefore, following this strategy, first we apply the rolling chow test, if the break exists then we apply structural break test Pierre Peron type test, if the break does not exist then we apply the DF test.

The existing procedure and proposed procedure shall be compared on the basis of Size and Power through Monte Carlo simulation the Data generating process and the simulation design are mentioned as under.

2.2 Experiment design

The steps involved in comparison of existing and proposed methodology are summarized in the Fig 2.3 below.

2.4 Data generating process proposed by Peron (1989) existing strategy

Data generating process of Peron (1989) is as under:

Null hypothesis

Pulse dummy

Model A:

$$yt = u + dD(T_B)t + y_{t-1} + \epsilon t$$

Trend dummy

Model B:

$$yt = u_1 + y_{t-1} + (u_2 - u_1)DU_t + \epsilon t$$

Model C:

$$yt = u_1 + y_{t-1} + dD(T_B)t + (u_2 - u_1)DU_t + \epsilon t$$

$D(TB)_t = 1$ if $t = T_B + 1$ 0 otherwise

$DU_t = 1$ if $t > T_B$ 0 otherwise and

$$A(L)et = B(L)vt,$$

vt - i.i.d. $(0,\sigma^2)$,with $A(L)$ and $B(L)$ pth and qth order polynomials, respectively, in the lag operator L. The innovation series $\{et\}$ is taken to be of the ARMA (p, q) type with the orders p and q possibly unknown. This allows the series $\{yt\}$ to represent quite general process . More general conditions are possible and will be used in subsequent theoretical derivations.Instead of considering the alternative hypothesis that yt is a stationary series around a deterministic linear trend with time invariant parameters, we shall analyze the following three possible alternative models:

Alternate hypothesis
Level dummy
Model A:

$$yt = u_1 + \beta t + (u_2 - u_1)DU_t + \epsilon t$$

Trend dummy
Model B:

$$yt = u_1 + \beta t + (\beta 2 - \beta 1)DT^* + \epsilon t$$

Model C:

$$yt = u_1 + \beta t + (\beta 2 - \beta 1) + (u_2 - u_1)DU_t + \epsilon t$$

Where $DT^* = t - T_B$, and $DT_t = t$ if $t > T_B$ and 0 otherwise

Here, T_B refers to the time of break, i.e., the period at which the change in the parameters of the trend function occurs. Model (A) describes what we shall refer to as the crash model. The null hypothesis of a unit root is characterized by a Pulse dummy variable which takes the value one at the time of break. Under the alternative hypothesis of a "trend-stationary" system, Model (A) allows for a one-time change in the intercept of the trend function. We called it Level dummy, For the empirical cases we have in mind, T_B is the $u_2 < u_1$. Model (B) is referred to as the "changing growth" model. Under the alternative hypothesis, a change in the slope of the trend function without any sudden change in the level at the time of the break is allowed. Under the null hypothesis, the model specifies that the drift parameter, u changes from u_2 *to* u_1 at time T_B .Model (C) allows for both effects to take place simultaneously, i.e., a sudden change in the level followed by a different growth path.

H_0: $\delta = 0$ And $\rho = 1$ non stationary

H_1: $\delta = 1$ And $\rho < 1$ stationary

2.5 Data generating process proposed by Zivot and Andrew (1992) existing strategy

Data generating process of Zivot Andrew is as under:

With the Zivot Andrew test the TB (time of the break) is chosen to minimize the statistics of α=1 in equations below. In other words, a break point is selected which is the least favorable to the null hypothesis. The Zivot Andrew model endogenises one structural break in a series such as yt as follows.

Null hypothesis

$$yt = \mu + y_{t-1} + \epsilon t$$

Alternate hypothesis

Level dummy

Model A: $\Delta yt = \mu + \beta t + \theta DU1_t + \alpha y_{t-1} + \sum_{i=0}^{n} ci\Delta y_{t-1} + \epsilon t$

Trend dummy

Model B: $\Delta yt = \mu + \beta t + \theta DT1_t + \alpha y_{t-1} + \sum_{i=0}^{n} \boldsymbol{ci\Delta y_{t-1}} + \epsilon t$

Model C:

$$\Delta yt = \mu + \beta t + \theta DT1_t + \gamma DT1_t \alpha y_{t-1} + \sum_{i=0}^{n} ci\Delta y_{t-1} + \epsilon t$$

Model A allows for a one-time change in the intercept. Model B is used to test for stationarity of the series round a broken trend, in broken trend and finally, Model C accommodates the possibility of a change in the intercept as well as a broken trend. DU_t is a Level dummy variable capturing a shift in the intercept, and DT_t is another dummy variable representing a shift in the trend occurring at time TB is called trend dummy. The alternative hypothesis is the series, Y_t, is with one structural break *TB* is the break, and $DU_t = 1$ if $t > TB$ and zero otherwise DT_t is equal to *(t-TB)* if *(t > TB)* and zero otherwise. The null is rejected if the □□coefficient is statistically significant.

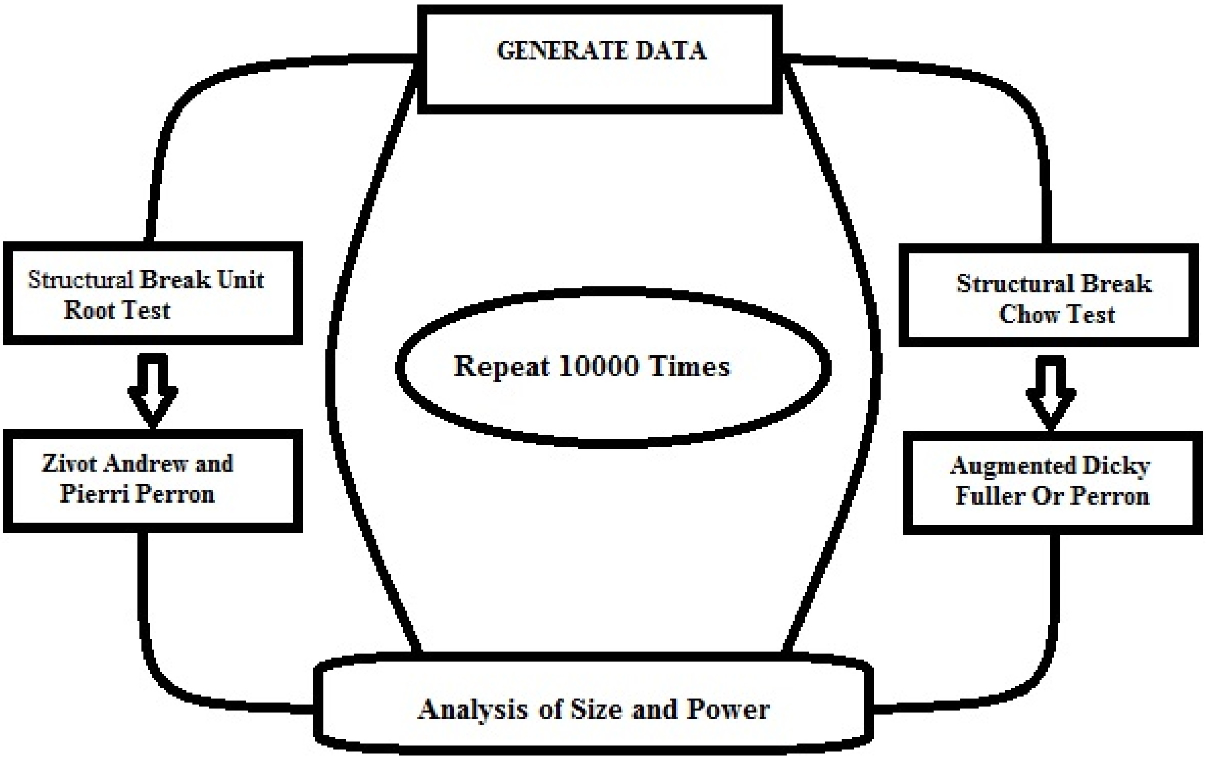
$$yt = \mu + \beta t + \alpha y_{t-1} + \epsilon t$$

The OLS regression equation including the drift and trend for all three models. Where yt is the data generating process having μ, drift βt trend α is the coefficient of the AR and ϵt is the error term.

3) Brief sketch of Experiment design

According to experiment flow chart, first we generate data following the data generating processes mentioned in the 3.2.

Figure 2.3: Author's own source of for two strategies.



1) Under the Null hypothesis, there is no structural break in the Data Generating Process,
2) Under Existing strategy generating the DGP H_0 null hypothesis, it means that series is unit root with one exogenous break. Under $H_1$the alternate hypothesis generating the DGP it means that series is stationary with one exogenous break for Pierre Peron test.
3) Existing strategy assume the break if the break exists and the break date known than apply Peirre Peron type test, if the does not exist than apply simple Dickey Fuller test.
4) Under Existing strategy generating the DGP H_0null hypothesis, it means that series is unit root with one endogenous break. Under $H_1$the alternate hypothesis generating the DGP it means that series is stationary with one endogenous break for Zivot Andrew test.
5) Existing strategy assume the break if the break exists but the break date unknown than apply Zivot Andrew type test.
6) Checking the Null and alternate hypothesis, significance level and decision on the basis of critical value and probability value.
7) Generate the data under H_0 : compute the test statistics. Compute the critical values for very large number of times and that are significance level (α) it shows the size of the tests.
8) Generate the data under H_1 : apply the test and simulate the number for many times then count rejection region that tells us the power of test.

We generate the random data and we apply proposed strategy,

1) Proposed strategy does not assume break. First we apply the *rolling chow* test, if the break exist then apply structural break test Pierre Perron type test, if the break does not exist then we apply the Dickey Fuller test.
2) Test for Structural Break; apply the rolling chow test. If test accepts Structural Break, apply Perron test with known Structural Break.
3) If test rejects Structural Break, apply Dickey Fuller unit root test.
4) Generate the data under H_0 : compute the test statistics. Compute the critical values for very large number of times and that are significance level (α) it shows the size of the tests.
5) Generate the data under H_1 : apply the test and simulate the number for many times then count rejection region that tells us the power of test.
6) Checking the Null and alternate hypothesis, significance level and decision on the basis of critical value and probability value.

For this objective we compare the empirical size and power calculates from existing methodology and proposed methodology. That is simulated for 10000 times. Now selection of the test is on the basis of performance of size and power.

2.6 Testing and simulation

We will evaluate the performance of unit root through Monte Carlo simulation and compare on the basis of size and power of Pierre Peron and Zivot Andrew between the existing and proposed Methodology. The size analysis is performed to quantify the distortion in probability of type I error. It can be expressed in following way; Size = Prob (reject H_0| when$H_0$is true) as well as Power analysis is executed to evaluate the probability of rejection the null hypothesis, when the alternative hypothesis is true. As the statistical power of test increases, the probability of type II error is decreased. It can be expressed in following way: Power = Prob (reject H_0 | whenH_1 is true).

RESULTS & DISCUSSION

Size and Power: The Monte Carlo Results

In this section we briefly discuss the size and power, where we have calculated the size for proposed strategy but not for existing strategy, and the power is calculated for both strategies.

3.1 Analysis of size under proposed strategy for models A.B and C

There is no need of size analysis in existing strategy we only calculated critical values for existing procedure. But we calculated the size analysis for proposed strategy. We generated the random series and apply the rolling chow test to detect the break, if break exist than we apply the Pierre Peron type test if the break does not exist then we apply the Dickey Fuller test. Empirical size of the proposed strategy is 1- step test where we match the nominal size with actual size and count the rejection of the test and called it total size. The data generating process is discussed in third chapter for both tests.

$$yt = \mu + \beta t + \alpha y_{t-1} + \epsilon t$$

3.1.1 The OLS regression in 4.1.1equation including the drift and trend for all three models . Where yt is the data generating process having μ, drift βt trend α is the coefficient of the AR process and ϵt is the error term. We constructed the three models (A,B,C) for proposed strategy. We test the null hypothesis for H_0 (1): $\mu = 0$, H_0(2): $\beta = 0$, and H_0 (3) $(\mu\,, \beta) = 0$ since all three hypothesis are true. Probability of rejection of three null hypotheses should not exceed the nominal size. The size analysis is performed to quantify the distortion in probability of type I error. It can be expressed in following way; Size = Prob (reject H_0| when$H_0$is true). For this analysis, the autoregressive non-stationary time series are being generated with different models; with drift with trend, with drift and trend both. The probability of getting significant α would be the actual size and it is different from nominal size. It would be considered as size distortion.

The data generating process are simulated for 10000 times the results are summarized in the below graph figure 3.1

figure 3.1 summarized the average empirical size results of proposed strategy for three Models (A,B,C) where we have the equation for Model (A) $yt = u + dD(T_B)t + y_{t-1} + \epsilon t$ equation Model A for Proposed Strategy states the level change where pulse dummy for intercept change and call it crash model. We can see the vertical bar model (A) shows the average empirical size 8% at the sample of 100. So on the basis of nominal size 5%, the probability of size distortion is 3 %. For model (B) proposed strategy $yt = u_1 + y_{t-1} + (u_2 - u_1)DU_t + \epsilon t$ equation states that permits one time change in the slope, where we can see the model B shows the average empirical size 8% at the sample of 100, so on the basis of nominal size 5%, the probability of size distortion is 3%. Both models A and B show the same size distortion and affected by size distortion. Model (C) proposed strategy equation $yt = u_1 + y_{t-1} + dD(T_B)t + (u_2 - u_1)DU_t + \epsilon t$ states that both permit the change in intercept and slope. Vertical bar model C shows the average empirical size distortion 7% at the sample of 100. So on the basis of nominal size 5%, the probability of size distortion is 2%. By visual inspection of the graph model (A) and (B) have more size distortion than model (C). by this graph we concluded that proposed strategy has no a hug size distortion. The data generating process are simulated 10,000 times and the results are summarized in table 3.2.

3.2 Analysis of Power of existing strategy and proposed strategy

The main objective of this study is to evaluate the performance of existing methodology and proposed methodology and compare them on the basis size and power.

We constructed the three models (A,B,C) for Pierre Peron and Zivot Andrew in section three. We estimate $yt = \mu + \beta t + \alpha y_{t-1} + \epsilon t$. We test the null hypothesis for H_0 (1): $\mu = 0$, H_0 (2): $\beta = 0$, and H_0 (3) $(\mu\,, \beta) = 0$ since all three hypothesis are not true. So they should be rejected. Power analysis is executed to evaluate the probability of rejection the null hypothesis, when the alternate hypothesis is true. As the statistical power of test increases, the probability of type II error is decreased. It can be expressed in following way:

Power = Prob (reject H_0 | when H_1 is true)

In this study, we use power analysis to compare the power of conventional or existing methodology Pierre Peron and Zivote with proposed methodology. The Monte Carlo simulations have been used in this analysis. All the results in the tables and graph given below have been summarized after 10000 times simulations.

Figure 3.1 Average empirical Size of proposed strategy Model A, B and C

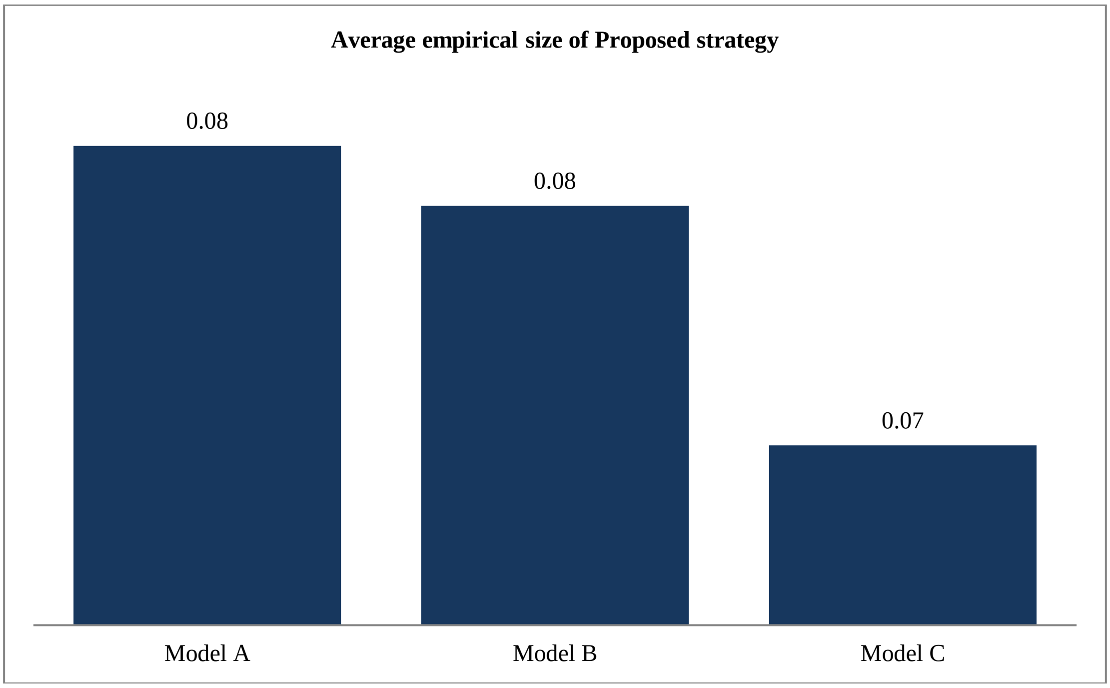


Table 3.1 Empirical size of Proposed Strategy for models A ,B and C

Coefficient of size	Empirical size of Proposed strategy		
α=0.1,α=1	ModelxA	ModelxB	ModelxC
0.1	0.02	0.01	0.01
0.2	0.05	0.03	0.02
0.3	0.06	0.05	0.04
0.4	0.07	0.07	0.06
0.5	0.08	0.08	0.07
0.6	0.09	0.09	0.08
0.7	0.09	0.10	0.09
0.8	0.10	0.10	0.10
0.9	0.11	0.12	0.11
1	0.12	0.13	0.16

Figure 3.2 Analysis of Power of Zivot Andrew, Pierre Perron existing strategy and proposed strategy for Model A

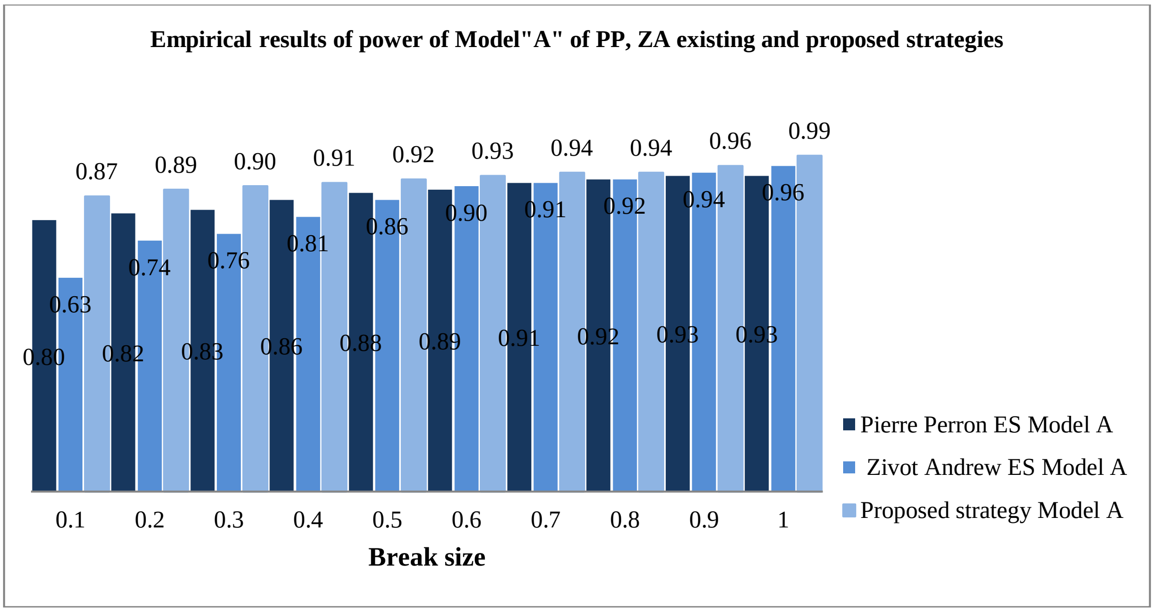


Figure 3.3 Analysis of Power of Zivot Andrew, Pierre Perron existing strategy and Proposed strategy for Model B

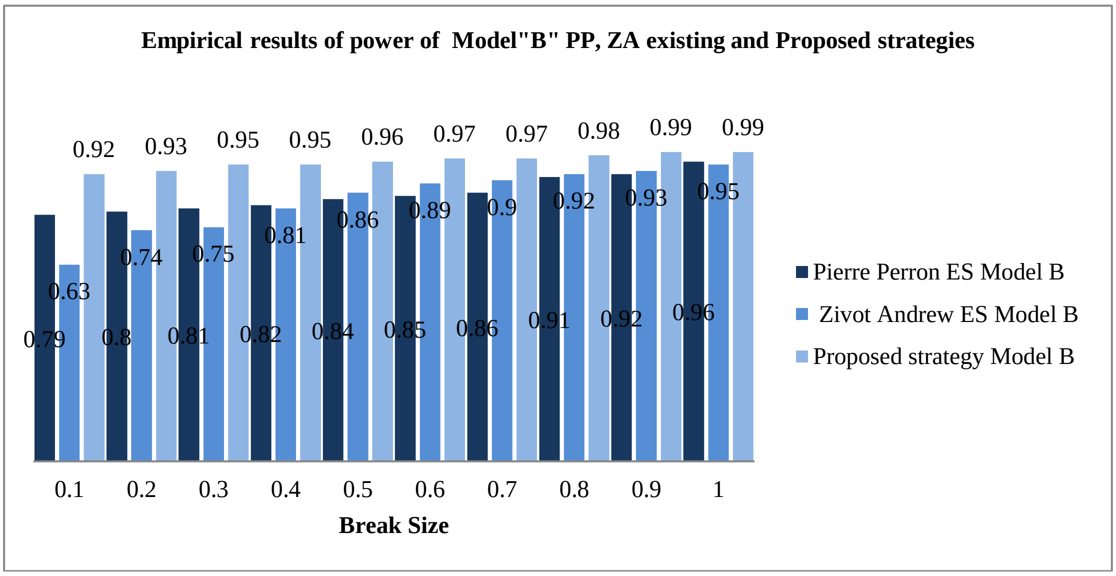


Figure 3.4 Analysis of Power of Zivot Andrew, Pierre Perron existing strategy and Proposed strategy for Model C

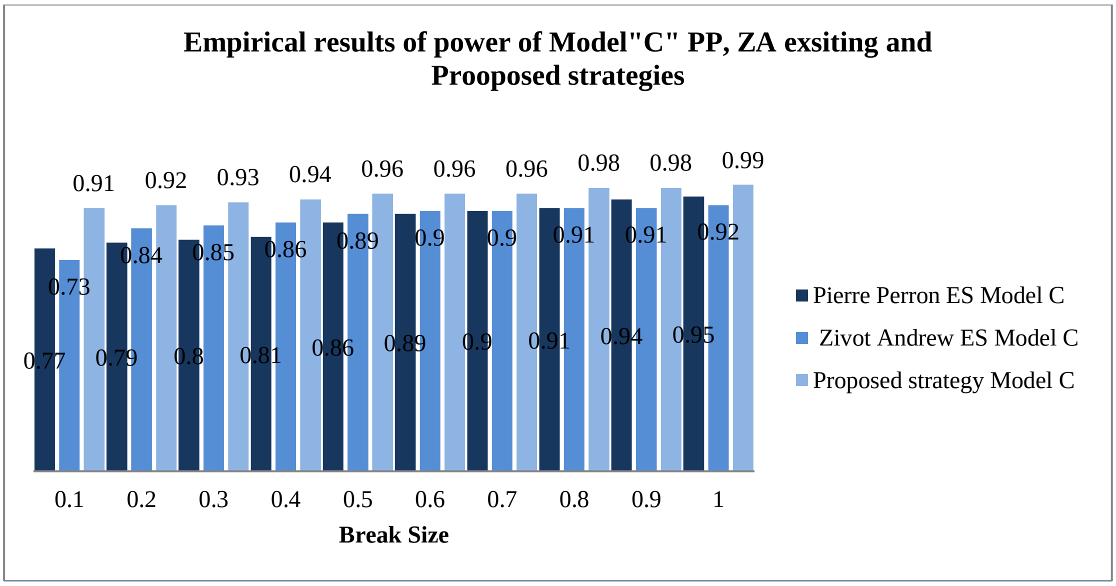


Table 3.2 Comparing the empirical results of model A Pierre Perron existing strategy and Proposed Strategy

Break Size	Power of Pierre Perron existing strategy and proposed strategy for model A	
α=0.1,α=1	Pierre Perron existing strategy Model A	Proposed strategy Model A
0.1	0.80	0.87
0.2	0.82	0.89
0.3	0.83	0.90
0.4	0.86	0.91
0.5	0.88	0.92
0.6	0.89	0.93
0.7	0.91	0.94
0.8	0.92	0.94
0.9	0.93	0.96
1	0.93	0.99

Table 3.3 Comparing the empirical results of model A Zivot Andrew existing strategy and Proposed Strategy

Break Size	Power of Zivot Andrew existing strategy and proposed strategy for model A	
α=0.1,α=1	Zivot Andrew existing strategy Model A	Proposed strategy Model A
0.1	0.63	0.87
0.2	0.74	0.89
0.3	0.76	0.90
0.4	0.81	0.91
0.5	0.86	0.92
0.6	0.90	0.93
0.7	0.91	0.94
0.8	0.92	0.94
0.9	0.94	0.96
..1	0.96	0.99

Table 3.4 Comparing the empirical results of Model B Pierre Perron existing strategy and Proposed Strategy

Break Size	Power of Pierre Perron existing strategy and proposed strategy for model B	
α=0.1,α=1	Pierre Perron existing strategy Model B	Proposed strategy Model B
0.1	0.77	0.92
0.2	0.79	0.93

0.3	0.80	0.95
0.4	0.81	0.95
0.5	0.86	0.96
0.6	0.89	0.97
0.7	0.90	0.97
0.8	0.91	0.98
0.9	0.94	0.99
1	0.95	0.99

Table 3.5 Comparing the empirical results of model B Zivot Andrew existing strategy and Proposed Strategy

Break Size	Power of Zivot Andrew existing strategy and proposed strategy for model B	
α=0.1,α=1	Zivot Andrew existing strategy Model B	Proposed strategy Model B
0.1	0.66	0.92
0.2	0.70	0.93
0.3	0.73	0.95
0.4	0.79	0.95
0.5	0.80	0.96
0.6	0.85	0.97
0.7	0.89	0.97
0.8	0.90	0.98
0.9	0.91	0.99
1	0.95	0.99

Table 3.6 Comparing the empirical results of Model C Pierre Perron existing strategy and Proposed Strategy

Break Size	Power of Pierre Perron existing strategy and proposed strategy for model C	
α=0.1,α=1	Pierre Perron existing strategy Model C	Proposed strategy Model C
0.1	0.77	0.91
0.2	0.79	0.92
0.3	0.80	0.93
0.4	0.81	0.94
0.5	0.86	0.96
0.6	0.89	0.96
0.7	0.90	0.96
0.8	0.91	0.98
0.9	0.94	0.98
1	0.95	0.99

Table 3.7 Comparing the empirical results of model C Zivot Andrew existing strategy and Proposed Strategy

Break Size	Power of Zivot Andrew existing strategy and proposed strategy for model C	
α=0.1,α=1	Zivot Andrew existing strategy Model C	Proposed strategy Model C
0.1	0.73	0.91
0.2	0.84	0.92
0.3	0.85	0.93
0.4	0.86	0.94
0.5	0.89	0.96
0.6	0.90	0.96
0.7	0.90	0.96
0.8	0.91	0.98
0.9	0.91	0.98
1	0.92	0.99

CONCLUSION

We concluded following results from this research that the unit root and commonly used the existing strategy ordinarily provide misleading results. This procedure provides unreliable results due to assuming the break exogenously and endogenously decisions in data generating process. Under the proposed strategy they provide optimal size and power but in case of size they undergo in size distortion. The reason behind it might be in case of data generating process.so the selection of the two strategies such as existing and proposed on the basis of size and power. We can see size of proposed strategy in figure 3.1 size of proposed strategy of three models results are indicating that initially empirical size is less than nominal size 5% that means there is no size distortion, as the coefficient of size increasing from 0.3 to 1 the results of three models indicating that there is size distortion. In the figures 3.2, 3.3 and 3.4 the power of two strategies results are indicating that proposed strategy better perform than existing strategy in case of three models with drift, with trend and with drift and trend both. We compare Pierre Perron and Zivot Andrew separately with Proposed strategy. In tables 3.2, 3.4 and 3.6 the results are indicating that power of Pierre Perron model A, B and C are not significantly perform as compare to proposed strategy. Proposed strategy provides significant and better results in case of model A, B and C. In the case of Zivot Andrew model A, B and C see tables 3.3, 3.5 and 3.7 the results shows that the power of test is highly suffers as compare to proposed strategy, the power of proposed strategy is highly significant and better perform in the case of model A, B and C.

The commonly used existing strategy Pierre Perron and Zivot Andrew having sever power problem in case of drift trend and with drift trend both the results are spurious. But proposed strategy power perform well in case of drift trend and with drift trend both as compare to existing strategy but in case of size, proposed strategy suffers in size of all three models drift trend and with drift trend both.

CONFLICT OF INTEREST

None.

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