Declining trend in rural credit delivery in India: A trend break analysis of univariate series

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Abstract
The basic analysis in this paper is to test Perron (1989) hypothesis on trend break in univariate series. This paper applies Perron’s procedure to the data on rural credit delivery in India and concludes that the hypothesis, which states that most of the macro-economic time series, initially exhibiting unit root process, become trend-stationary if one allow one time trend break in it at some suitable time, does not hold good with this series. Instead, the paper concludes that the unit root in the data persists even after allowing one time trend break, despite the fact that the trend break was found to be statistically significant.

Keywords: Trend Break, Time-series, Rural Credit.

JEL Classification: C32, G21.
1 Introduction

1.1 Introduction of the Study

The rural sector is still the largest employer in Indian economy with more than two third of the population depending on agriculture, while the contribution of agriculture and allied services to national GDP is around 25 percent (1999 – 2000). These facts underline the importance of the rural economy in India. Despite having enough room for development in the rural sector, it has been largely ignored in the recent years of economic growth.

This paper discusses one particular aspect of the rural economy and institutions, rural credit, in the context of the present day financial reforms. Development of rural sector is largely dependent on the availability of financial services in the area. Insuring proper reward for the deposits by the people as well as reasonable cost for the credit available to them would be an important issue. In the rural areas, where formal financial institutions are not performing these jobs, the informal institutions such as indigenous money-lenders are operating and in those areas, low rate of return on the savings as well as high cost of borrowings are the common features. Though there are approaches which sometimes justify the higher rate of borrowings charged by those informal institutions by propagating the idea of monitoring cost or the cost of better information, but whatsoever be the justification, high cost of borrowings causes the development of rural sector to be adversely affected. In this context Kumar (2004) has emphasized the financial reform and the interest rate de-regulations for the lack of motivation of the commercial banks towards the credit delivery in rural areas.

Even though the utmost importance of rural credit delivery we are witnessing a declining trend in rural credit delivery from formal financial institutions viz. commercial banks. In this study the above hypothesis about the declining trend in rural credit delivery is kept under trial using trend break analysis in univariate time series models. This approach of analysis is primarily due to Perron (1989), discussed in section 1.2.
1.2 Data and Methodology

The paper follows the process of analyzing the trend break in a univariate time series with the exogenously given timing of break. The process is originally due to Perron (1989) and this paper, in some sense, attempts to replicate the process for the data collected on rural credit delivery in India. Perron (1989), in context of Nelson and Plosser (1982), argued that the series which exhibit unit root process in full sample, may exhibit trend stationary process if allowed for a one time trend break at some suitable time point. In this connection, relevant is to refer the extension of Perron (1989) work by Zivot and Andrews (1992), which makes the timing of trend break endogenous to the model.

The data used in the study is the “proportion of credit delivered in rural sectors to total credit delivered (expressed in percent)”. The frequency of the data is yearly and is collected for the period of thirty five years starting from 1969 and goes to 2003. The data source is the web-site of Reserve Bank of India and the EPWRF (2004).

**Timing of trend break:** The year of trend break is assumed in 1991. The reason attributed for this trend break is the change in RBI’s guidelines to schedule commercial banks regarding opening of new branches. Earlier it was obligatory to all schedule commercial banks to open four branches in rural sectors against opening one urban branch. From this year onwards this regulation was released. Therefore it is a reasonable point to hypothecate a declining trend in the percentage of rural credit delivered from schedule commercial banks. Also from 1991 onward the process of financial liberalization put pressure on the rural branches to be more profitable and sustainable. Therefore for further references the timing of the trend break ($T_B$) is 22 where the total sample period ($T$) is 35.
Figure 1: Fig 1A: Plot of the series

2 Testing for one-time trend break

2.1 Perron’s procedure for uncorrelated errors ($e_t$’s)

The key feature in Perron’s work was the exogenity of the time of the trend. In his analysis the fraction $\lambda = \frac{T_B}{T}$ was given from outside, where $T_B$ was the expected time of break and $T$ was the total sample period. He assumed three models under the null:

$$z_t = \alpha + z_{t-1} + D(T_B)_t e_t$$  \hspace{1cm} (1)

$$z_t = \alpha_1 + z_{t-1} + (\alpha_2 - \alpha_1) D U_t e_t$$  \hspace{1cm} (2)

$$z_t = \alpha_1 + z_{t-1} + dD(T_B)_t + (\alpha_2 - \alpha_1) D U_t e_t$$  \hspace{1cm} (3)

where $D(T_B)_t = 1$ if $t = T_B + 1$ and 0 otherwise; $D U_t = 1$ if $t > T_B$ and 0 otherwise.

The first model permits an exogenous change in the level of the series, the second model allows an exogenous change in rate of growth, and the third model admits both changes.
The respective alternative hypothesis for trend stationary process were represented as:

$$z_t = \alpha_1 + \delta t + (\alpha_2 - \alpha_1)DU_t + e_t$$  \hspace{1cm} (4)

$$z_t = \alpha_1 + \delta t + (\delta_2 - \delta_1)DT_t + e_t$$  \hspace{1cm} (5)

$$z_t = \alpha_1 + \delta t + (\alpha_2 - \alpha_1)DU_t + (\delta_2 - \delta_1)DT_t + e_t$$  \hspace{1cm} (6)

where $DT_t = t - T_B$ if $t > T_B$ and 0 otherwise; $DT_t = t$ if $t > T_B$ and 0 otherwise. Also $e_t \sim iid(0, \sigma^2)$.

From the intuition generated from the plot of the data (figure 1), and for allowing generality to the analysis the third model was accepted for further workings.

2.1.1 Procedure for testing

Following are the steps undertaken to test trend break in the series ($T_B = 1990$).

- We selected model (6), and by regressing it we de-trend the raw data in order to remove the possible non-stationarity due to deterministic factors.

- Generated the residuals. (assume it as $e_t$)

- Again run OLS regression on following model:

$$e_t = \rho e_{t-1} + u_t$$

- Computed the test statistics as $T(\hat{\rho} - 1)$ and compare it with the critical values given in Perron (1989) paper in table 6A.

Following is the table showing test statistics and Perron’s critical values for $\lambda = 0.675$. 

\[\begin{array}{|c|c|}
\hline
\lambda & T(\hat{\rho} - 1) \\
\hline
0.675 & 4.12 \\
\hline
\end{array}\]


<table>
<thead>
<tr>
<th>Test Perron’s statistics</th>
<th>Perron’s critical value</th>
<th>Perron’s critical value</th>
<th>Perron’s critical value</th>
</tr>
</thead>
<tbody>
<tr>
<td>-15.037274</td>
<td>-43.02</td>
<td>-33.11</td>
<td>-28.14</td>
</tr>
</tbody>
</table>

It can be clearly visible from the table that null of unit root is not rejected. Now it would be better to think of the other possibility about error terms. Therefore in next part, the case of correlated $e_t$s is discussed.

### 2.2 Perron’s procedure for correlated errors ($e_t$s)

In this case Perron nested the models, null and the alternative, in one, and formulated it as the ADF type test. He took only one model as the null

$$z_t = \alpha + z_{t-1} + e_t$$

and following three models as alternatives for three respective cases:

$$z_t = \hat{\alpha}^A + \hat{\beta}^A t + \hat{\theta}^A DU_t + \hat{\rho}^A z_{t-1} + \sum_{i=1}^{p-1} \hat{\phi}^A \nabla z_{t-1} + \hat{\epsilon}_t$$  \hspace{1cm} (7)

$$z_t = \hat{\alpha}^B + \hat{\beta}^B t + \hat{\gamma}^B DT_t + \hat{\rho}^B z_{t-1} + \sum_{i=1}^{p-1} \hat{\phi}^B \nabla z_{t-1} + \hat{\epsilon}_t$$  \hspace{1cm} (8)

$$z_t = \hat{\alpha}^C + \hat{\beta}^C t + \hat{\theta}^C DU_t + \hat{\gamma}^C DT_t^* + \hat{\rho}^C z_{t-1} + \sum_{i=1}^{p-1} \hat{\phi}^C \nabla z_{t-1} + \hat{\epsilon}_t$$  \hspace{1cm} (9)

Here also, we will take the third model for the reason explained above.

#### 2.2.1 Procedure for testing

Following are the steps undertaken to test trend break allowing $e_t$s to be correlated.

- Run an OLS regression on model (9). In this case we need to test following restrictions under the null: $\hat{\rho}^C = 1$ and $\hat{\delta}^C = 0$. 

• The number of lags \((p)\) is decided using the rule of thumb. We proceed the test for \(p = 1, 2, 3\) and 4, and select the lag with smallest test statistics.

• The critical values to be used in this variant of test is same as the previous i.e, given in Perron (1989) paper in table 6A.

Following is the table showing test statistics and Perron’s critical values for \(\lambda = 0.675\).

<table>
<thead>
<tr>
<th>Lags</th>
<th>Test statistics</th>
<th>Perron’s 5% critical value</th>
<th>Perron’s 1% critical value</th>
<th>Perron’s 10% critical value</th>
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<td>-28.14</td>
</tr>
</tbody>
</table>

It is easy to see the that even after incorporating the serial correlation between the \(e_t\)s, the test does not reject the null hypothesis of existence of unit root in the process. The result is also true for other values of \(\lambda\)s.

### 3 Conclusion

In the light of above discussion, we can draw inferences on two spheres.

- Examining the Perron (1989) trend break hypothesis in context of given dataset.

- Determining the significance of trend breaking the series at the stipulated point of time.

Perron (1989) has forwarded a hypothesis that most of the macro-economic series which allow unit root at first instance, may come out to be \(I(0)\) processes if estimated after allowing one time trend break in it. He has done his study with wide range of macro-economic data and over a long span of time, and he found pro-hypothesis result in most of the cases. This study could be interpreted as a verification exercise of Perron (1989) hypothesis for the
rural credit data collected over 35 years.

The results of the study can be understood as the study of the case where Perron (1989) hypothesis is no longer valid. In this particular case, even though the trend break is coming out to be very significant, allowing one time trend break is not reducing the order of the process. Here we can conclude that

1. There is a significant downfall observed after the year 1991 in percentage of rural credit to total credit disbursed from commercial banks.

2. Despite of this, allowing trend break in the process is not helpful in reducing the integrity of the model.
References


