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THE BUSINESS CYCLE IN MALAYSIA: SOME EMPIRICAL EVIDENCE

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ABSTRACT

An economy business cycle has been generally conceptualised as fluctuations in an economic activity around some underlying secular trend rate of growth. The objective of this paper is to examine the phenomenon of the business cycle in selected Malaysian macroeconomics variables. For this purpose, non-stationary Dickey-Fuller (1979, 1981) test statistics and Cochrane variance ratio (1988) analysis were used to examine the characterisation of the series under consideration. This is followed by decomposing those series using Beveridge and Nelson (1981) technique and then estimating the relationship of those series using regression analysis. The results have showed that all variables were in favour of the stochastic trend alternative and a large proportion of the variability of changes in those variables arose from permanent shocks. The estimated results shown that both permanent and cyclical components of real gross domestic product (RGDP) are important for contributing to the Malaysian federal government revenue (RFGR) whereas the Malaysian federal government expenditure (RFGE) policy suggests a permanent characterisation regardless of cyclical characterisation. Hence, real and temporary factors that influence RGDP are important sources of RFGR whereas RFGE tend to be stable regardless of the level of economic activities.

ABSTRAK

Kitaran niaga sesebuah ekonomi secara umumnya telah dikonseptualkan sebagai turun naik dalam aktiviti ekonomi di sekitar arah aliran pertumbuhan sekular. Objektif kertas kajian ini adalah untuk menyiasat fenomena kitaran niaga di dalam pembolehubah makroekonomi Malaysia terpilih. Untuk tujuan tersebut, ujian statistik tidak pegun Dickey-Fuller (1979, 1981) dan analisis nisbah varians Cochrane (1988) telah digunakan untuk menguji percirian siri yang dipertimbangkan. Ini diikuti oleh pengasingan siri tersebut dengan menggunakan teknik yang dicadangkan oleh Beveridge and Nelson (1981) dan menggunakan analisis regresi untuk menguji hubungan antara siri tersebut. Keputusan menunjukkan bahawa semua pembolehubah adalah cenderung kepada alternatif arah aliran stokastik dan sebahagian besar daripada proposi perubahan dalam pembolehubah makroekonomi Malaysia terpilih berpunca daripada kejutan kekal. Keputusan anggaran menunjukkan bahawa kedua-dua komponen kekal dan pusingan keluaran dalam negeri kasar (RGDP) adalah penting untuk menyumbangkan kepada hasil kerajaan persekutuan Malaysia (RFGR). Sementara dasar perbelanjaan kerajaan persekutuan Malaysia (RFGE) mencadangkan suatu percirian kekal tanpa mengira percirian pusingan. Maka, faktor-faktor kekal dan sementara yang mempengaruhi RGDP adalah sumber penting RFGR sementara RFGE cenderung stabil tanpa mengira tingkat aktiviti ekonomi.

Key words: Business Cycle, Dickey-Fuller, ratio: Cochrane variance,, Beveridge and Nelson.

INTRODUCTION

An economy business cycle has been generally conceptualised as fluctuations in an economic activity around some underlying secular trend rate of growth. The secular growth can be viewed as the permanent component arising from factors that determine the real growth of certain economic activities. The factors include increase of capital formation, improvement of technology, growth of labour force, changes in taste, and way of life. On the other hand, the cyclical component is thought of as transitory in nature due to factors that influence the temporary movement of economic activities such as unanticipated fiscal and monetary shocks, rigidities in labour and product markets, imperfect information, co-ordination failures and sticky expectations. In the real world, many different sources or combination of sources may cause a business cycle. These sources may be regular or irregular (Zarnowitz 1991: 3-72).

A business cycle is principally an empirical phenomenon founded upon historical experience. In an empirical analysis, a stochastic trend characterisation of a time series can be viewed as in favour of secular growth component. Alternatively, a trend stationarity characterisation of a time series can be viewed as in favour of cyclical components. Most of the studies regarding to the business cycle try to distinguish these components in a time series.

The purpose of this paper is to examine the phenomenon of the business cycle in selected Malaysian macroeconomics variables. For this purpose, we firstly use the Dickey-Fuller (1979, 1981) test statistics and the Cochrane variance ratio (1988) analysis for examining the characterisation of the series under consideration. This is followed by decomposing those series using the Beveridge and Nelson (1981) technique. Lastly, we use the regression analysis (Yule-Walker method) to examine the relationship of those series.

The organisation of this paper is divided into five sections. The introduction of this paper appears in section one. In section two, the discriminating among alternative trend characterisations is described. In section three, a stochastic trend model of the Malaysian business cycle is presented and is followed by the response of some Malaysian time series data to the business cycle in section four. Finally, the conclusion is in section five.

DISCRIMINATING AMONG ALTERNATIVE TREND CHARACTERISATIONS

An important question pertaining to numerical measurement of the business cycle is whether the trend component can be characterised by a deterministic linear time trend or by a stochastic trend. The trend stationarity characterisation assumes that the trend component is completely deterministic. In this context, the trend line is usually estimated as a constant, log linear function of time, and consequently, the transitory or cyclical component can be approximated by deviation from the trend line. An alternative approach is to assume the trend and the cyclical components are both stochastic. Beveridge and Nelson (1981) and Nelson and Plosser (1982) proposed an estimate of the trend line based on assumption that the trend follows a random walk process with drift. This trend plus a stationary process has been characterised by Beveridge and Nelson (1981) as a *difference stationary* series.

Various views regarding trend characterisations are embedded in the following presentation due to DeJong et al. (1992) and Layton (1993)

[1] $Y_t = a + bt + x_t$

and

[2] $x_t = \alpha x_{t-1} + u_t$

where Y_t is the time series and u_t is assumed to be a stationary process.

If $|\alpha| < 1$, x_t in [2] is stationary and could be expressed as $X_t = S^{¥}_{j=0}\, a_j u_{t-j}$. Thus, Y_t in [1] consists of a stationary fluctuations around a deterministic linear time trend and hence $Y_t = a + bt + S^{¥}_{j=0}\, a_j u_{t-j}$. This means that the series is characterised by a linear time trend plus a stationary component. In such a case, the presentation is consistent with the trend stationarity characterisation which assumes that the long run evolution of the economic time series is completely deterministic. This characterisation also implies that any shock to the course of the series may be expected to be temporary in the sense that the series will revert back to the path it would have been in the absence of the shock.

On the other hand, if the economic time series is dominated by a stochastic trend, then the movements of the series will be characterised by random unforecastable shifts with no tendency for the series to revert back to its original trend line. In such a case, it implies that any shock to the course of the series may be expected to alter the path permanently. One way to represent such a series is to have a stochastic trend, which means its trend is changing continuously. The variance of a non-stationary series grow without bound, as such, derivation of Y_t in [1] from any constant linear trend will grow arbitrarily large. Thus, the idea of Y_t having any kind of deterministic trend becomes meaningless (Layton 1993: 696).

Thus, tests on whether it is a deterministic or stochastic trend characterisation of an economic time series could be based on the presentation in [1] and [2]. In particular, if [2] is substituted into [1], and rewriting, yields

[3] $Y_t = \mu + \beta t + \alpha Y_{t-1} + u_t$

where $\mu = a[(1-\alpha) + b\alpha]$ and $\beta = a(1-\alpha)$. Hence, it is clear that test on the null hypothesis of stochastic trend (against the alternative of deterministic trend) in Y_t is equivalent to test on the joint hypothesis H_o: $\alpha=1$ and $\beta=0$.

To formally test for the presence of a stochastic trend component in several Malaysian time series data, the Dickey-Fuller (1979, 1981) test procedure is employed. The procedure involves the estimation of a slightly different version of [3], namely

[4] $Y_t = \mu + \beta t + \alpha Y_t + \Sigma^{p}_{i=1}\, \phi \Delta Y_t + e_t$

where Y_t is the logarithm of the series, t is a linear time trend, Δ is the first difference operator and e_t is the residual terms, assumed iid . $N(0,\sigma^2)$. The inclusion of the autoregressive lag Dy_{t-i}, where

$i = 1,...,\rho$. is to ensure that the residuals are white noise, a condition for which the Dickey-Fuller (1979, 1981) test procedure would be appropriate. The test on the null hypothesis, H_0: $\alpha=1$ and $\beta=0$ or equivalently the existence of a unit root, is based on the Dickey-Fuller likelihood ratio statistic. The critical values for this test statistic are tabulated in Dickey-Fuller (1981). Rejection of the null hypothesis implies that the series under consideration follows a trend-stationary process. On the other hand, failure to reject the null would be taken as evidence of the validity of the stochastic trend characterisation.

Data utilised in the test consists of annual series of consumer price index (CPI, 1978=100), deflated gross national product (RGNP), gross national product per capita (RGNPPC), real gross domestic product (RGDP), the deflated Federal government revenue (RFGR) and the deflated Federal government expenditure (RFGE). All series except GDP and CPI are obtained from *Money and Banking in Malaysia*, 1994 Bank Negara Malaysia whereas GDP and CPI are obtained from *Various Publication*, Statistic Department of Malaysia and *Yearly Statistic Book*, International Monetary Fund respectively. The use of CPI-deflated series is to remove one possible source of non-stationary that is due to general price increases. Those variables are then transformed in logarithmic form. The study sample spanned the period from year 1959 to year 1992.

The estimates of the Dickey-Fuller likelihood ratio statistic, F_Φ, are reported in table 1. Also included are the estimates of the Dickey-Fuller t-statistic, t_α which serves as test statistic for the null hypothesis that $\alpha=1$ (The critical values for this test statistic are tabulated in Fuller (1979)). The test results indicated that the null hypothesis, H_0: $\alpha=1$ and $\beta=0$, cannot be rejected at 5% significant level in each of the series under consideration. The test based on t_α statistic also failed to reject the null hypothesis that $\alpha=1$ at 5% level.

Table 1 Dickey-Fuller Unit Root Test Results

	t_α	F_Φ
RGNP	-2.558	3.3185
RGNPPC	-2.431	3.0072
RGDP	-2.260	2.5725
RFGR	-1.732	1.6480
RFGE	-1.278	2.5827

Notes: The t_α and F_Φ test statistics which reported above are based on including first three lags differences in the model [4]. The critical values for t_α and F_Φ at 5 percent are 3.50 and 6.73 for sample sizes 50 respectively.

Since it is known that the Dickey-Fuller test statistics tend to have a low power against series which have an $\alpha < 1$ but reasonably close to one (Kwiatkowski et al. 1991), the next stage is to proceed to analyse the null hypothesis that the series is stochastic using the procedure suggested by Cochrance (1988). The idea behind the procedure is that a series with a unit root (non-stationary) may be represented as the sum of a random-walk component and a stationary component. Thus, test for a unit root are attempts to distinguish between series that have no random walk component (or for which the variance of series to the random walk component is zero) and series that have a random walk component (or for which the variance of shocks to the random walk component is non zero). Cochrance's variance ratio measure is as follows:-

$$[5] \qquad V_k = \sigma^2_k / k\sigma^2_1$$

where σ^2_k and σ^2_1 are the variance of the k-difference and the first-difference of the series Y_t, provides an estimate of the proportion of the conditional variance of the change in Y_t that is explained by the permanent unit root component. If Y_t is dominated by a random walk, then V_k is closer to 1, and if Y_t is stationary, then $V_k = 0$, for a sufficiently large k.

The estimates of the σ^2_k and the Cochrane's variance ratio measure are reported in table 2. The σ^2_k seem to be constant for various k from k=2 to k=12 for all series. Furthermore, the variance ratios for all series do not become zero as k is increased to 12, suggesting that the variance of the period-to-period changes in each of the series is still dominated by the variance of the random-walk component up to the horizon of 12 years. Those results further support for the existence of a stochastic component in all series under study.

Table 2 Cochrane Variance Ratio Analysis

	k	2	4	6	8	10	12
RGNP	σ^2_k	0.002	0.003	0.004	0.004	0.004	0.003
	$\sigma^2_k/k\sigma^2_1$	1.13 (0.33)	0.92 (0.39)	0.89 (0.48)	0.69 (0.44)	0.53 (0.40)	0.36 (0.31
RGNPPC	σ^2_k	0.002	0.003	0.004	0.004	0.004	0.003
	$\sigma^2_k/k\sigma^2_1$	1.12 (0.32)	0.94 (0.39)	0.89 (0.48)	0.71 (0.45)	0.58 (0.43)	0.40 (0.34
RGDP	σ^2_k	0.002	0.003	0.004	0.004	0.004	0.003
	$\sigma^2_k/k\sigma^2_1$	1.09 (0.31)	0.83 (0.35)	0.81 (0.43)	0.69 (0.44)	0.55 (0.41)	0.38 (0.32
RFGR	σ^2_k	0.003	0.005	0.008	0.010	0.010	0.009
	$\sigma^2_k/k\sigma^2_1$	1.07 (0.30)	1.06 (0.44)	1.13 (0.60)	1.08 (0.69)	0.89 (0.66)	0.64 (0.55
RFGE	σ^2_k	0.002	0.004	0.005	0.005	0.006	0.005
	$\sigma^2_k/k\sigma^2_1$	1.14 (0.33)	0.91 (0.38)	0.77 (0.41)	0.63 (0.40)	0.58 (0.43)	0.39 (0.33

Notes: σ^2_k is the k-difference sample variance.

$k\sigma^2_1$ is k-multiply the sample variance of the first differences.

Figures in parentheses are asymptotic standard errors computed as $(\sigma^2_k/k\sigma^2_1)[4k/3T]^{0.5}$ where T is number of observation.

A STOCHASTIC TREND MODEL OF THE MALAYSIAN BUSINESS CYCLE

Beveridge and Nelson (1981) propose a method of decomposing economic time series into a permanent and a cyclical component which allows both components to be stochastic. The permanent component is characterised by a random walk with drift and the cyclical or transitory component follows a stationary process with mean zero. The computational procedure is based on the difference stationary model of the following forms

$$[6] \qquad Y_t - Y_{t-1} = a + e_t$$

and

$$[7] \qquad (1 - \phi_1 L^1 - \dots - \phi_p L^p)e_t = (1 - \hat{o}_1 L^1 - \dots - \hat{o}_q L^q)u_t$$

where Y_t is the economic time series, L is the lag operator and u_t is white noise. It is also assumed that e_t is a stationary process. Stationary requires that the characteristic roots of the AR(p) component in equation (7) are less than 1 in absolute value.

Define $W_t = Y_t - Y_{t-1}$. Hence, it could be expressed in rational form

$$[8] \qquad W_t = a + \frac{1 - \hat{o}_1 L^1 - \dots - \hat{o}_q L^q}{1 - \phi_1 L^1 - \dots - \phi_p L^p} \times u_t$$

where "a" is the long-run mean of the W series. From this, it can be shown that using the derivation technique outline in Beveridge and Nelson (1981: 154-157), the expressions for the permanent component and the cyclical component are respectively

$$[9] \qquad YP_t - YP_{t-1} = a + \frac{1 - \hat{o}_1 L^1 - \dots - \hat{o}_q L^q}{1 - \phi_1 L^1 - \dots - \phi_p L^p} \times u_t$$

and

$$[10] \qquad C_t = \lim_{k \to \infty} \{[\hat{W}_t(1) + \dots + \hat{W}_t(k)] - ka\}$$

where $\hat{W}_t(k)$ is the conditional k-period ahead forecast of W given information up to period t. Furthermore,

$$[11] \qquad YP_t = Y_t + C_t$$

The procedure for numerical measurement of the cyclical or the permanent component involves several steps. The first step is to identify and estimate the ARIMA model in [6] and [7]. Once the estimates of the parameters ϕ's, $\hat{o}$'s, then "a" and the residual u_t are obtained, the changes in the permanent component can be computed using [9]. The procedure described here is the simpler computational method due to Cuddington and Winter (1987). Beveridge and Nelson (1981: 159) procedure requires computations of period by period cyclical component implied by the formula in

[10]. In order to obtain the levels rather than the changes in the permanent component, a level at some time t is required. This can be accomplished using [10] to obtain the cyclical component at some time t; this initial value is then used to solve [9] for the remaining values of the permanent series YP_t. In computing the cyclical component, the limit in [10] can be replaced by a large forecasts, say k=100, such that $[\hat{W}(k) - a]$ is trivially small.

The technique is now used to decompose the CPI - deflated series: RGNP, RGNPPC, RGDP, RFGR, and RFGE. Data utilised are all in logarithmic form and the Box-Jenkins procedure is used to identify and estimate the model. The results are shown as below:-

a) CPI - deflated GNP (RGNP)

$$\text{Ln } RGNP_t - \text{Ln } RGNP_{t-1} = \underset{(0.0053)}{0.02769} + e_t$$

$$[1 + \underset{(0.0403)}{0.99547}L]e_t = [1 + \underset{(0.1623)}{0.58756}L]u_t$$

$Q(12) = 11.10 \quad s = 0.02$

b) CPI - deflated GNP per capita (RGNPPC)

$$\text{Ln } RGNPPC_t - \text{Ln } RGNPPC_{t-1} = \underset{(0.0052)}{0.01684} + e_t$$

$$[1 + \underset{(0.0512)}{0.98249}L]e_t = [1 + \underset{(0.1633)}{0.64710}L]u_t$$

$Q(12) = 9.84 \quad s = 0.03$

c) CPI - deflated GDP (RGDP)

$$\text{Ln } RGDP_t - \text{Ln } RGDP_{t-1} = \underset{(0.0053)}{0.02825} + e_t$$

$$[1 + \underset{(0.0634)}{0.97188}L]e_t = [1 + \underset{(0.1705)}{0.64218}L]u_t$$

$Q(12) = 9.49 \quad s = 0.03$

d) CPI - deflated Federal Government Revenue (RFGR)

$$\text{Ln } RFGR_t - \text{Ln } RFGR_{t-1} = \underset{(0.0065)}{0.03585} + e_t$$

$$[1 + \underset{(0.4154)}{0.22074}L]e_t = [1 + \underset{(0.4485)}{0.14837}L]u_t$$

$Q(12) = 7.85 \quad s = 0.04$

e) CPI - deflated Federal Government Expenditure (RFGE)

$$\text{Ln RFGE}_t - \text{Ln RFGE}_{t-1} = \underset{(0.0062)}{0.03448} + e_t$$

$$[1 + \underset{(0.3377)}{0.76190}L]e_t = [1 + \underset{(0.4315)}{0.55595}L]u_t$$

$Q(12) = 10.08 \quad s = 0.03$

where L is the lag operator, Q is the Ljung-Box (1978) Q statistic (distributed as a chi-square with 12 degrees of freedom) and "s" is the standard error of regression. Figures in the parentheses are standard errors of the estimates.

Figure 1 through 5 present the plot of permanent component and the actual values for each RGNP, RGNPPC, RGDP, RFGR, and RFGE series. In figure 1, the plot of the RGNP permanent component shows that its value is not constant over time. The movements of this permanent series suggest that the sample period could be divided into three phrases. The first phrase, from 1960 to 1973 is characterised by a slow growth in permanent RGNP. During this period the permanent RGNP had not experienced any drastic shift. The second phrase, covering the 1974 to 1984 periods, shows the permanent RGNP that was shifting often. The series experience a decline in the early 1975, before increasing slowly from 1981 to 1984. The decline in the permanent RGNP coincided with the first oil shock of 1974/1975. This shock is real and thus is expected to have a drastic impact on the permanent component of the RGNP. The stochastic trend characteristic also implies that it is in favour of the view that the permanent component arises from slowly evolving real factors, that is it is consistent with the real business cycle theory. In this regard, the economy also experienced the second oil shock in 1979/1980. However, this shock seemed not to have a significant impact on the permanent RGNP. The observed RGNP which was above the permanent RGNP may have indicated an active fiscal measure undertaken by the government in response to the shock.

The permanent RGNP, however, experienced a sharp increase beginning in 1985 and sustained up to 1992 (the last of our sample period). Structural changes in response to the shock on productivity and to inflationary pressure in the early 80's together with concerted effects by the government to industrialised the economy could be among factors contributing to the sustained growth in the permanent RGNP. Thus, eventhough there was a recession during the period of 1984 to 1986, the permanent RGNP was still growing. The slow down in the RGNP growth could possibly be explained by lacks of aggregate demand.

Figure 2 and 3 depict that the movements of RGNPPC and RGDP and its permanent component had characteristics like RGNP in figure 1. The explanations about these series could be referred as above. Figure 3 shows that the plot of the permanent RFGR could be divided into three phrases as permanent RGNP. The first phrase is characterised by a relative high growth in permanent RFGR. In second phrase, permanent RFGR is lower than RFGR. This may be due to various stabilised policies taken by the government in conjunction with the first oil shock whereas in the third phrase, permanent RFGR turns to be higher but increasing more slowly than RFGR. This could be explained by the discovery of Malaysian economy and successfulness of various economy policies implemented by the government. As a result, those factors contribute more revenue to the federal government.

Figure 4 shows the plot of the permanent RFGE which seemed to be lower than RFGE for all consideration periods. The split of permanent RFGE and RFGE was large from 1974 to 1984 compare to years before 1974 and years after 1984. The closer gap between permanent RFGE and RFGE could be interpreted that the federal government spent relatively less than its ability to afford. This seemed to be true especially at the end of the 80s and early 90s when Malaysia enjoyed a high economic growth. This made the federal government try to cut its expenditure to prevent from pressure of demand pull inflation.

RESPONSE OF RFGR AND RFGE TO THE BUSINESS CYCLE

The nature of the government revenue and expenditure is a function of GDP. In this section, the question of the relationship between the Malaysian federal government revenue and expenditure and the GDP (especially the relationship with the permanent and cyclical components of GDP) is looked into.

To see how the Malaysian federal government revenue is contributed, real Federal government revenue (RFGR) on permanent and cyclical components of real GDP (RGDP), indicating as PRGDP and CRGDP respectively are estimated by using Yule-Walker estimation method. This method takes into account the serial correlation. The estimation results and Ljung-Box (1978) Q statistic are reported as follow

$$RFGR_t = -1556.76 + 0.2816\ PRGDP_t + 0.2851\ CRGDP_t + e_t$$
$$(-5.793)^{**}\ (45.696)^{**}\qquad (14.385)^{**}$$

$$e_t = -\ 0.2909\ e_{t-1} + u_t \quad Q(18) = 13.79$$
$$(-1.6653)^{*}$$

The description of the data used is the same as in section two. The values in parentheses are the t-statistics. The one and two stars (*, **) indicated significant at 5% and 1% levels respectively. The e_t is the regression residual. The Box-Ljung (1978) Q statistic computed using 18 lags of the regression residuals and is distributed as $c^2(18)$. The effect of cyclical and permanent components of RGDP on RFGR is statistically significant. The coefficients value of PRGDP and CRGDP seen to be same. This suggests that both PRGDP and CRGDP are equally important in contributing to the RFGR.

To examine how the Malaysian federal government expenditure (RFGE) reacted over the business cycle, the Yule-Walker estimation method was used to regress RFGE on PRGDP and CRGDP. The estimation results and Ljung-Box (1978) Q statistic are reported as follows (See section three for explanations):-

$$RFGE_t = -1092.55 + 0.2405\ PRGDP_t + 0.1141\ CRGDP_t + e_t$$
$$(-3.143)^{**}\ (30.368)^{**}\qquad (5.829)^{**}$$

$$e_t = -0.9604\, e_{t-1} + 0.3911\, e_{t-2} + u_t \quad Q(18) = 28.93$$
$$(-5.6193)^{**} \quad (2.2885)^{**}$$

The effect of cyclical and permanent components of RGDP on RFGE is statistically significant. The coefficient value of PRGDP is seen to be twice greater than CRGDP coefficient value. This means that PRGDP is more important than CRGDP in term of contributing to the RFGE. The regression results suggest that the Malaysian federal government expenditure basically depends on the permanent component of RGDP rather than the cyclical component of RGDP.

CONCLUSION

In this paper, the Dickey-Fuller (1978, 1981) test statistics are applied to several Malaysian time series data and evidence is found in favour of the stochastic trend alternative. A non-model-based variance ratio test, suggested by Cochrane (1988), is used and the results show that a large proportion of the variability of changes in Malaysian time series data arises from permanent shocks.

The Beveridge and Nelson technique was also presented and used for decomposing the Malaysian time series data. This technique is useful for examining the secular and cyclical movements in a time series data. Finally, the Yule-Walker estimation method was employed to see the relation between the RFGR and RFGE and the permanent and cyclical components of RGDP. The estimation results have shown that both permanent and cyclical components of RGDP are important for contributing to the Malaysian federal government revenue whereas the Malaysian federal government expenditure policy suggests a permanent characterisation regardless of cyclical characterisation. Hence, real and temporary factors that influence RGDP are important sources of RFGR whereas RFGE tends to be stable regardless of the level of economic activities.

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