

Business Cycle Decomposition and its Determinants: An evidence from Pakistan

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Abstract- The explanation of the potential sources of economic fluctuations has been the major concern in macroeconomics. We will analyze these alternations by decomposing time series of gross domestic production (GDP) of Pakistan into the long-run trend and business cycles. The purpose of the study is to identify the potential factors that impose permanent and transitory shocks to the economy. The former effects would contribute towards the trend component, whereas later would contribute towards the business cycle. The current study can be divided into two parts. First, the series of real GDP growth is decomposed into its components, by Hodrick-Prescott (HP) filter. The turning points chronology of these business cycles is identified by using both hp-filter and Markow switching model. Second, the study explores the relationship between components of real GDP growth with macroeconomic variables by using autoregressive distributive lag (ARDL) bound testing approach. So that we can identify the determinants of both short-term (business cycle) and long-term (permanent) fluctuations in the economy. It is found that balance of trade and external debt play important role in business cycle fluctuations. However, trend components of the GDP growth require GDP deflator additionally for a meaningful explanation. The sample period of the study is from 1951 to 2015. The results of the study would benefit policymakers by unraveling the characteristics of business cycles.

I. INTRODUCTION

The recurrence and intensity of the business cycle fluctuations draw out significant implications for the real economic activity. One characteristic of the business cycle is cycling asymmetry, whereby economy behaves differently in contraction and expansion phases of the business cycle. Understanding business cycle phases and their properties have long been the focus of macroeconomic research which can be traced back to the work of Watsun (1986). In the US, the

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National Bureau of Economics and Research (NBER) establishes the dating of turning point at which the shifts between recession and expansion occur. The growing need for addressing economic vulnerability requires one to understand profoundly the nexus between both short and longer-term sources of fluctuation in the path of economic growth to better inform policymakers on the alternate policy options. The condition is acute in the case of Pakistan because of two reasons. First, there is a lack of studies examining long-run relationship as well as causality between components of real GDP to provide sound economic lessons. Second, frequent political regime switches expose the economy to its own risk, there is an alarming need to identify business cycles for a better understanding of economy-wide movements.

The objective of this paper is twofold. First, is to date business cycle of Pakistan by comparing two alternative methods. We employ Hodrick-Prescott (hp) Filter (1997) and Markov-Switching model of Hamilton (1989) in this regard. The hp-filter first decompose series of real GDP growth rate into long-run trend and the short run or business cycle fluctuations. Markov-Switching models date the two phases of business cycle i.e. recession and expansion phases. However, MS model further allows estimating transition probabilities between two states and expected duration of each state. Although a variety of models have been employed to model various characteristics of the business cycle, linear models are not able to capture asymmetries [Hamilton (1989)]. Thus MS model is used here. Second is to identify determinants of transitory and perpetual shocks in the economy. For this purpose, the study models both long-term trend and the cyclic component of real GDP growth by using macroeconomic and financial variables. These series are extracted by applying hp-filter on real GDP growth rate.

In this study, the Pakistani business cycle will be dated by using MS and hp-filter so that comparison can be made. Mehmood and Arby (2005) used hp-filter for Pakistani business, our results are similar to them. The current study, however, extends the literature by employing MS model. Since there is no official outline or procedure that identifies phases of business cycles, there is an alarming need to fill this gap by providing a sophisticated statistical model that is aligned with economic theory as well. Another important contribution of the study is to explore potential determinants of cyclical and long-term trend component of the business cycle. Results of the study reveal that external debt and balance of trade are crucial in exploring business cycle

movements. However, GDP deflator is additionally required for examining the potential of real GDP growth.

The structure of the rest of the paper is as follows. Section II reviews the existing literature, section: III is a methodology and data, section: IV shows the results and section: V is the conclusion of the study.

II. LITERATURE REVIEW

The literature is quite rich in exploring aspects of the business cycle and their effects on the economy. Canova (1998) use alternative detrending procedures to decompose time-series into its components. Their study classifies the modelling techniques into statistical versus economic models. Aguiar and Gopinath (2007) compare business cycle characteristics of emerging and developed market. The study argued that frequent regime switches in emerging markets increase the frequency of business cycles. More volatile consumption than income and countercyclical nature of trade balance is the most striking feature.

Recently, Koopman and Pacce (2016) forecasted the turning points in the business cycle using Bayesian approach for mixed frequency data for the US economy for the time period of 1959 to 2014. They carried out a tri-dimensional analysis in their study, estimation of recession probabilities, and identification of business cycle turning points and comparison of the model with the conventional linear autoregressive model. The study concluded that adding real GDP in the model provides better forecasts for the identification of turning points in the business cycle.

Iacoviello (2015) argued that business cycles are triggered by disruptions in the flow of resources between different agents, thus, they are intrinsically financial instead of being driven by technological shocks. For this purpose, he considered the transfer of wealth from savers to borrowers, maximum loan to value ratios and changes in the value of asset collateral in a discrete time framework Dynamic General Stochastic Equilibrium (DGSE) model for US for the time period of 1985 to 2010 with three agents, households, bankers, and entrepreneurs. He concluded that under DGSE framework, banks produce significant impacts on the business cycles on the back of its role in liquidity provision.

Moolman (2004) investigated the relationship between business cycles and interest rates using a Markov Switching regime model proposed by Hamilton (1989) for the South African economy

for the time period 1978 to 2001. He justified the usage of MS model on account of the non-linear nature of business cycles. The findings of his study suggest that yield spread – model by interest rates – acts as a leading variable for explaining the business cycle movements.

In the context of Pakistan, Mahmood and Arby (2012) attempted to determine the real GDP of the country through the decomposition of historical time series from FY50 to FY10 into its subcomponents. The results indicated various time periods in which the economy is embarked by recessions and expansions. Further, they forecasted that Pakistan economy will enter into an expansionary phase after 2012, a projection which is close to the state of economic development.

III. DATA AND METHODOLOGY

In the seminal work, Burns and Mitchel (1946) provide a standard definition of the business cycle:

“Business cycles are a type of fluctuation found in economic activity of nations that organize their work mainly in business enterprises: a cycle consists of expansions occurring at about the same time in many economic activities, followed by similarly general recessions, contractions, and revivals which merge into the expansion phase of the next cycle; in duration, business cycles vary from more than one year to ten to twelve years; they are not divisible into shorter cycles of similar characteristics with amplitudes approximating their own.”

In order to provide some evidence of the business cycle we mainly use two methods for dating business cycles which are described below.

This section devoted to the sample and the methodology employed in the study. It firstly tells about the sample and variable selection which is followed by the methodologies.

A. Sample and variable selection:

The time-series of macroeconomic variables are taken. Since the high frequency of data is not available in Pakistan, the Pakistani business cycle is modelled using real GDP growth rate over the period 1951-2015.

For the next part i.e. to isolate determinants of short and long-term variation in output, the study employed variables namely, taxes, GDP deflator, forex reserves, trade openness, foreign direct investment, balance of trade, and external debt. These variables are observed over 1979-2015.

All the data have obtained from Handbook of Statistics on Pakistan Economy 2015 published by State Bank of Pakistan.

B. Statistical Models:

The methodology consists of two steps; first to decompose real GDP growth into its components and date the business cycle, and second to model components with macroeconomic variables.

To dissect output into its components, the study employs two methods i.e. hp-filter and Markov regime switching model. Later, it uses autoregressive distributed lag model.

1. Hodrick-Prescott Filter:

We first use Hodrick Prescott (hp) filter to dissect real GDP growth into its time series components. Existing literature is quite rich and provides ample evidence to the widespread popularity of hp filter in the context real GDP growth decomposition [see Jaimovich and Rebelo (2006), Burnside (1997), Canova (1998) and others].

The series is assumed to be the aggregation of three components, i.e. secular trend, cyclical movements and irregular movements. Since, frequency of time-series is annual so seasonal variations are unidentifiable. The actual filtering methodology disintegrates the cycle by minimizing the fluctuations of the actual data around it, therefore, it minimizes the following function:

$$\sum [\ln y(t) - \ln y^*(t)]^2 - \lambda \sum \{ [\ln y^*(t+1) - \ln y^*(t)] - [\ln y^*(t) - \ln y^*(t-1)] \}^2$$

(1)

Where y^* is the long-term trend and λ is smoothness parameter. Hodrick and Prescott suggested $\lambda=100$ for annual frequency time series. The procedure is repeated again to isolate cyclical variation from irregular variations.

2. Markov switching regime technique:

Many macroeconomic time series occasionally exhibit dynamic breaks in their behavior. Hamilton (1989) first proposed Markov switching model, which is a stochastic regime model, in the context of business cycle dating process. Models like regime-switching allow for

nonlinearities by involving the discrete state variable. This framework is particularly useful for business cycle dating process.

Assume that there are two regimes, represented by unobservable process denoted by S_t . If $S_t=1$, then the process is in regime 1 while $S_t=0$ means that the process is in regime 2. Following Hamilton (1989), assume that S_t is a first-order Markov-process, which means that current regime (S_t) only depends on the regime of preceding period (S_{t-1}).

$$P\{S_t = j \mid S_{t-1} = i\} = p_{ij} \quad i, j = 0, 1 \quad (2)$$

Note that, since $p_{01} + p_{00}=1$ and $p_{10} + p_{11}=1$, the transition probabilities are completely defined by p_{00} and p_{11} . The model takes the following form:

$$y_t = \alpha_{S_t} + \sum_{i=1}^p \beta_{i,S_t} y_{t-i} + \sigma \epsilon_t \quad (3)$$

Where: S_t stands for the state at time t , it takes either 0 or 1;

α_{S_t} stands for the state-specific intercept coefficient;

σ is the standard deviation, which is assumed constant;

β_{i,S_t} shows autoregressive coefficients for lags 1 to p for each state;

ϵ_t are the residuals characterized by a zero mean and variance equal to 1.

The model presented here is characterized by constant transition probabilities and variances in two regimes. Results can also be improved by introducing time-varying probabilities. Recent studies like Moolman (2004), Chauvet and Piger (2005), etc. extended the framework to include time-dependent transition probabilities.

3. Auto Regressive Distributed Lag Model and Bound Test:

Following the empirical literature in demand of exploring potential business cycle determinants, we form a relationship between components of GDP and macroeconomic variables. Separate modelling of the cyclical component would be helpful to identify pro-cyclical and counter-cyclical indicators. Furthermore, modelling of trend components in isolation would also assist practitioners to view long-term growth path.

This paper follows ARDL bound testing approach to test cointegration developed by Pesaran et al. (2001) to analyze factors cointegrated with aforementioned components. The advantage of the approach is that it can be applied irrespective of whether the variables are cointegrated of order zero $I(0)$ or integrated of order one $I(1)$. It can be used with the mixture of $I(0)$ and $I(1)$. Furthermore, it has better small sample properties. The ARDL bound testing approach involves estimating the following unrestricted error correction model (also called conditional ECM),

$$\Delta y_t = \beta_0 + \sum \beta_i \Delta y_{t-i} + \sum \delta_j \Delta x_{pt-j} + \theta_0 y_{t-1} + \theta_1 x_{pt-1} + \theta_2 x_{pt-2} + \theta_3 x_{pt-3} \dots + \mu_t \quad (4)$$

Where Δ is the difference operator; β_0 is constant; β_i and δ_j represent short-run dynamics, and θ 's are long-run coefficients. Y_t represents components of GDP and X_t represents macroeconomic variables described above. In previous studies, the optimal lag structure is determined by Akaike Information Criteria, however, due to lack of availability of data the current study can only afford lags not more than two. The current study uses Wald or F-test for the joint null hypothesis $H_0: \theta_0 = \theta_1 = \theta_2 = \dots = 0$. Since the asymptotic distribution is non-standard in this regard, we will use critical bound values provided by Pesaran et al. (2001). According to Pesaran et al. (2001), if the F-test statistics exceeds upper bound, null hypothesis is rejected and there is an evidence of the long-run relationship. Alternatively, statistics below the lower bound mean that null hypothesis cannot be rejected. However, if statistics lies between the bound then the results are inconclusive.

The long-run relationship can be estimated using the selected ARDL model. It will take the following form:

$$GDP_{(cyc)t} = GDP_{(cyc)t-1} + TAX_t + GDPDEF_t + FXRESERVES_t + FDI_t + BOT_t + EXTDBT_t + TRD_t + e_t \quad (5)$$

$$GDP_{(trend)t} = GDP_{(trend)t-1} + TAX_t + GDPDEF_t + FXRESERVES_t + FDI_t + BOT_t + EXTDBT_t + TRD_t + e_t \quad (6)$$

Where $GDP_{(cyc)}$ and $GDP_{(trend)}$ is the cyclical and long-term trend components of real GDP growth, TAX is the growth in taxes, GDPDEF is the growth in GDP deflator index, FXRESERVES is the growth in Forex reserves, FDI is the growth in foreign direct investment, EXTDBT is the growth in external debt, and TRD is trade openness

IV. EMPIRICAL RESULTS

This section provides the empirical estimates of both dating procedures and ARDL estimates. A useful starting point for our empirical analysis would be to disintegrate real GDP growth into its components. As these components are needed to be utilized in the subsequent analysis. Techniques are therefore summarized below:

1. *Results of Hodrick-Prescott Filter:*

We derive business cycle (short-run) and trend (long-run) component of the real GDP in this section which is further used to analyze determinants responsible for both long and short run fluctuations of real GDP.

It can be seen from Figure-1 that there exist four business cycles and fourth business cycle is currently going on. The third business cycle (1985-2005) was the longest among all. Recessions can be seen the result of adverse events. For instance, the 1970s, 1990s and 2006 or later periods are identified as recessions. The separation of East Pakistan, Asian Financial Crisis of 1998 and Global Financial crisis of 2006-07 could have adversely affected the economy.

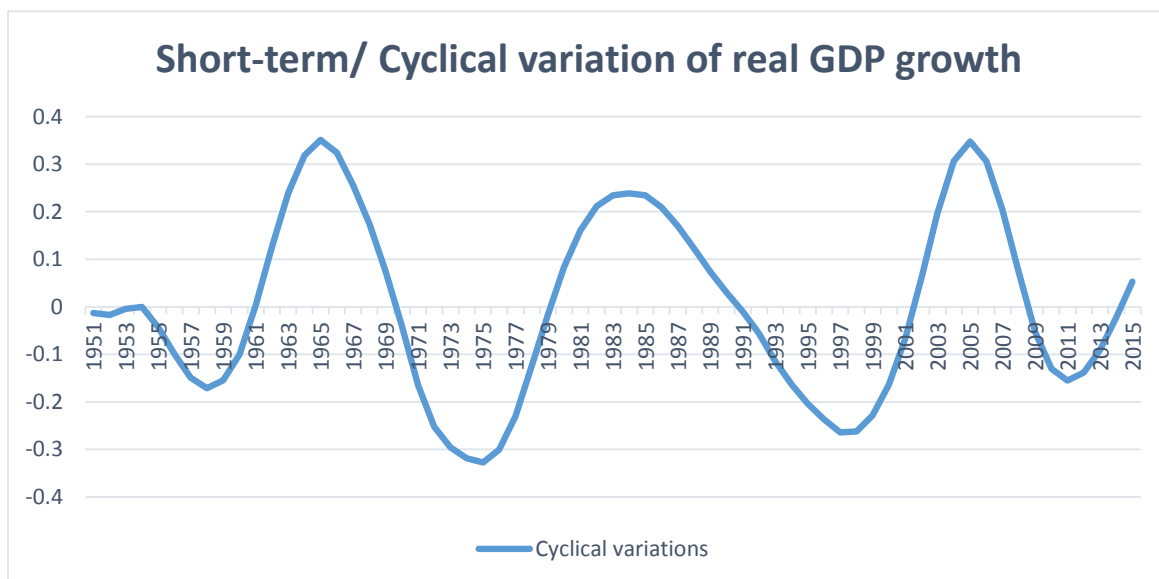
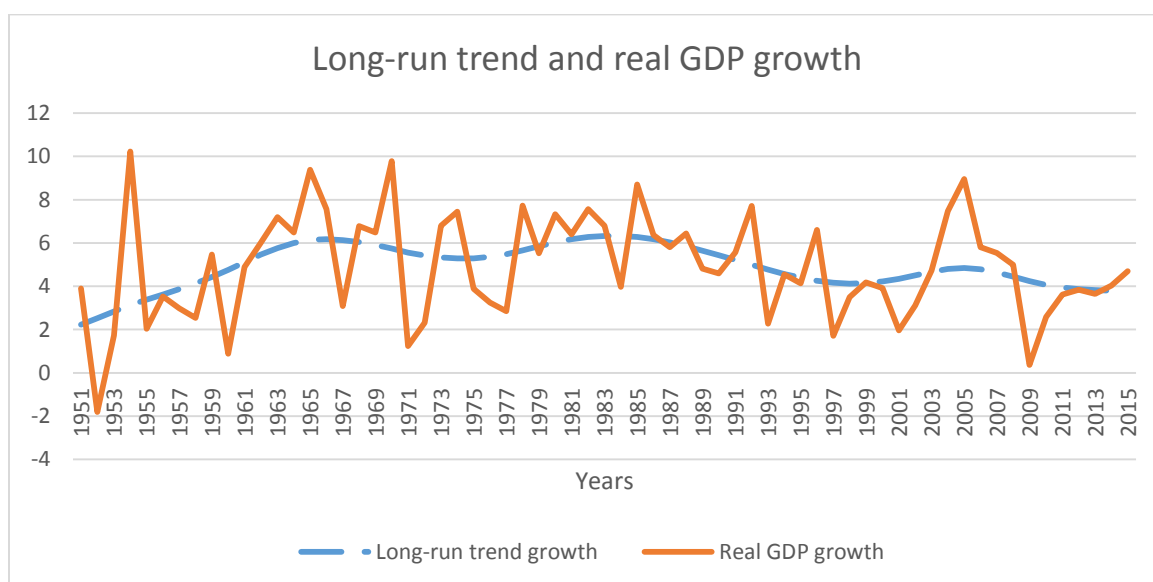


Figure- 1

The long-run trend of real GDP growth is illustrated in Figure-2. It is evident from the plot that it

first rises sharply till the 1960s and in last two decades real GDP growth is touching its lower potential. Furthermore, deviations between actual and potential real GDP growth are all the time high which indicates alarming conditions in the economy. As in volatile economic conditions, investments seem to be riskier and foreign investors are reluctant to put their money in such economies.

Figure- 2



The Table-1 below represents the classification of all four business cycles.

Table-1

Business Cycle	Recession	Trough	Recovery	Peak
First Cycle: 1950-1965	1950-1958	1958	1959-1965	1965
Second Cycle: 1966-1984	1966-1975	1975	1976-1984	1984
Third Cycle: 1985-2005	1985-1998	1998	1999-2005	2005
Fourth Cycle: 2006-	2006-2011	2011	2012-	

Our results of business cycle decomposition using hp-filter are similar to that of Mahmood and Arby (2012). The re-estimation is mainly to compare the cycles by two methods and to separate out components of real GDP growth rate.

2. Results of Markov switching regime technique:

Based on the smoothed probabilities for both regimes (recession and expansion), the current study derived Pakistani business cycle. Following Hamilton (1989), this study utilizes Markov regime switching model with four auto-regressive terms i.e. MS-AR(4).

The table-2 below summarizes the results obtained from MS-AR(4). Intercept coefficients in both regimes are highly significant which suggest that two regimes have highly distinguishable features. As recession and expansion phases are the two extremes of the economy thus possess distinct characteristics. Furthermore, only two auto-regressive schemes are found significant which means that momentum of the real GDP changes after each two-year period. On the other hand, an average duration of the economy to remain in recession and expansion phases are nearly 4.2 and 4.3 years. This is an interesting result, however, showing the vulnerability of the country's economy. Short business cycles show how volatile the economy is. It is an adverse feature of the Pakistan's economy which might have brought by frequent political regime switches, terrorist attacks, threats to wars and many others.

Table-2
Maximum likelihood estimates of MS-AR(4) model

State parameters	Coefficients		Transition Probabilities	Estimates
	Regime-1	Regime-2		
α	6.676***	3.124***	P_{11}	0.761
	Common		P_{12}	0.238
β_1	-0.359*		P_{21}	0.230
β_2	-0.376*		P_{22}	0.769
β_3	-0.215		Expected Duration	
β_4	-0.148		Regime-1	4.2
Log(sigma)	0.375		Regime-2	4.33

*** Significant at 1%

** Significant at 5%

* Significant at 10%

Based on the smoothed probabilities for expansion and recessions, the study has figured out business cycles of Pakistan. The results are comparable to those identified in the previous section. However, turning points of the business cycle are different in some cases.

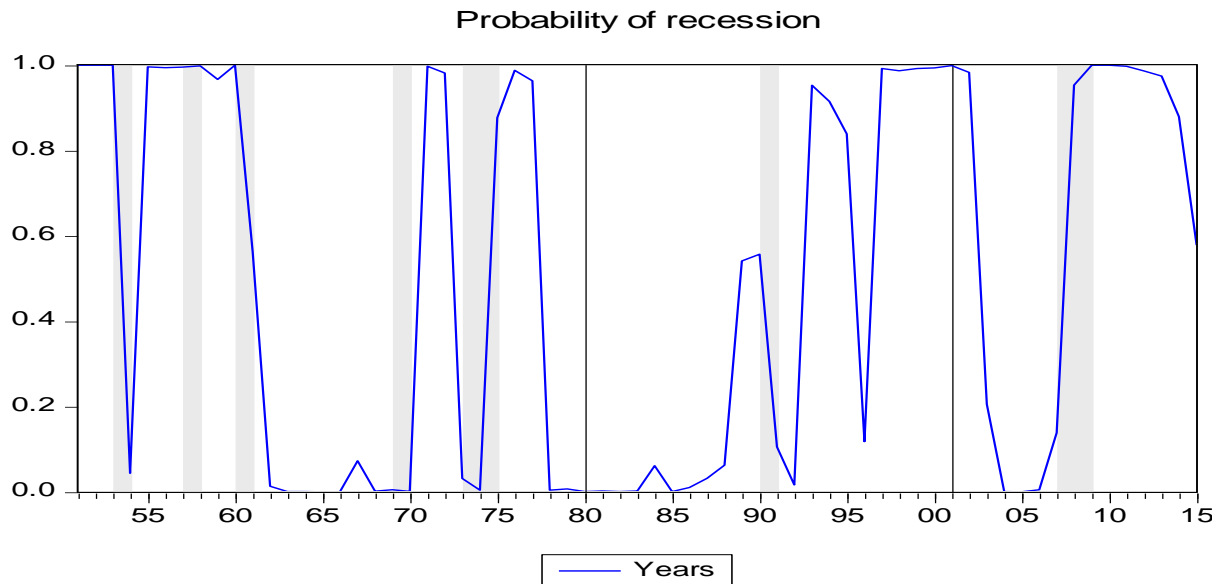
Table-3
Business Cycle Dating using MS-AR(4) model

Business Cycle	Recession	Expansion
First Cycle: 1951-1970	1951 - 1961	1962-1970
Second Cycle: 1971-1988	1971-1977	1978-1988
Third Cycle: 1989-2007	1989-2002	2003-2007
Fourth Cycle 2008-	2008-2015	2016-

The Figure-3 below shows the smoothed regime probabilities of recession. The shaded area represents the recession as it corresponds to the high probability of this regime.

Figure-3

Smoothed Regime Probabilities



3. Results of ARDL/Bound Test model:

Before modelling time-series, a preliminary step is to check unit root but the Bound testing approach does not require this step. We still reported unit root results in Table-7. The table-4 and table-5 below show the cointegration coefficients corresponding to transitory and permanent components of GDP.

The results below presented in Table-4 represents the long term relationship between GDP Trend and the considered variables. According to the obtained results GDP trend in the previous year has the largest and positive impact on current period's GDP. The positive sign shows that if the GDP is positive in the previous year then there is high possibility of upward trajectory in current year's GDP. The other significant variables of the model are balance of trade and external debt which are negatively linked with current year GDP. It implies that exposure to international economies may impart a negative impact on country's GDP.

Table-4
ARDL coefficients of business cycle model

Variable	Coefficients
GDP TREND (-1)	0.844***
TAXES	0.008
GDP DEFLATOR	0.001
FX RESERVES	0.004
FDI	0.003
BOT	-0.027**
EXTERNAL DEBT	-0.0133

TRADE OPENESS	-0.040
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*** Significant at 1%
 ** Significant at 5%
 * Significant at 10%

Transitory trends as depicted in Table-5 of the considered model are quite similar to that of long term trend with GDP trend emerging as the largest contributing factor for short term fluctuations. Similarly, negative and significant sign of balance of trade is also showing same trend of the said variable as that in long term. However, the impact of external debt is found non-prevalent in short term.

Table-5
 ARDL coefficients of business cycle model

Variable	Coefficients
GDP TREND (-1)	1.595***
TAXES	-0.001
GDP DEFLATOR	0.000
FX RESERVES	0.004
FDI	0.003
BOT	-0.016***
EXTERNAL DEBT	-0.127**
TRADE OPENESS	-0.075

*** Significant at 1%
 ** Significant at 5%
 * Significant at 10%

A table-6 below is devoted to depicting results of ARDL bound test. For both models, it is evident that F-statistics is well above the upper bounds provided by Pesaran et al. (2001). Thus, the model suggests that variables explained above are cointegrated.

Table-6
 ARDL/Bound testing to cointegration- Results

	Long-term trend model		Business Cycle model	
	Lower bounds	Upper bounds	Lower bounds	Upper bounds
F-statistics	13.4512		16.58	
10%	2.03	3.13	2.03	3.13
5%	2.32	3.5	2.32	3.5
2.5%	2.6	3.84	2.6	3.84
1%	2.96	4.26	2.96	4.26

R-squared	0.99	0.98
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Table-7
Unit root test of Augmented-Duckey Fuller
Null hypothesis; H_0 : Unit root exist

Variables	ADF test Coefficients
Balance of Trade	-0.839***
Δ Exchange rate	-3.215*
External Debt	-0.9457***
FDI	-0.23*
Foreign reserves	-1.224***
Δ GDP (cyclic)	-0.123*
GDP deflator	-0.65***
Δ GDP Trend	-0.189***
M2	0.205
Remitances	-0.64***
Taxes	-1.04***
Δ Trade openness	-1.41***

*** Significant at 1%

** Significant at 5%

* Significant at 10%

V. CONCLUSION:

This paper examines the two business cycle dating methods in order to identify the economic phases of Pakistan. Both approaches figure out four business cycles of Pakistan. We further analyze real GDP growth and its two components. These two components are then modeled with macroeconomic variables by using ARDL model in order to analyze sensitivities within each component.

Business cycle volatility reflects country's exposure to the shocks and vulnerability, is considered crucial in exploring determinants for a wide range of economic outcome including growth [Solomous et al. (2013)]. The paper has first attempted to compare business cycle identified by two dating techniques. Results for both proposed approaches are similar, however, Markov regime switching model identifies relatively short business cycles. Expected duration for both recession and expansion phases are derived from MS model. Average duration for expansion and recession are 4.3 and 4.2 years respectively. It suggests that although Pakistan's

economy does not have intensifying characteristics of recession, however, the frequency of regime switches is high which is endorsed by both dating procedures.

In the second part of the paper, we identified balance of trade, lagged balance of trade and external debt are countercyclical. This is very much in line with the economy condition of Pakistan. As the negative balance of trade is the hurdle in the path of economic prosperity [Nishat (2010)]. Moreover, previous year cyclical component of real GDP growth is found significantly procyclical. However, the double lagged cyclical component is countercyclical. It suggests that business cycle maintain its momentum for at most one year and the phase reversal may occur in the following year. In explaining potential predictors of long-run trend component of the real GDP growth, the factors are similar to those of cyclical component. However, lagged GDP deflator turn out significant in this regard. It also makes sense as economy is not flexible enough to respond inflationary or deflationary pressure abruptly. This must be the potential reason for the significance of GDP deflator when modelled on long-term component of real GDP growth.

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