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Abstract:
Gross domestic product may be considered, a combination of three processes viz., long-run trend, business cycles and short-run shocks. The series of GDP can be decomposed in to its three components by using some statistical method. Such a decomposition of real GDP of Pakistan reveals that the Pakistan's economy has a declining growth in long-run trend since early 1980s that however, is expected to start rising in 2001-02. Pakistan is also facing a recessionary phase of third business cycle, which is expected to end in 2004-05.

Views expressed in this Working Paper are the author's personal views and do not necessarily reflect those of the State Bank of Pakistan.

* The author of this paper welcomes comments & suggestions.

The path of economic growth for any country depends on a number of factors including structural changes in the economy, natural calamities, political instabilities, global recessionary trends, self-feeding business cycles, etc., and the combined effect of all these factors is most commonly represented in the country's Gross Domestic Product. In statistical terms, however, the annual data series of GDP can be considered a combination of three processes; a long-run trend, business cycles, and short-run shocks to the economy, which can be separated from each other by using statistical techniques. The objective of this paper is to decompose real Gross Domestic Product of Pakistan into its above-mentioned components, and also to project them for determining future path of real GDP. Such type of dialysis gives more insights to understand the changing pattern of economic growth. Although some very broad comments have been made in the paper on the behaviour of GDP components during the past decades, a more detailed investigation is left for future research[1].

In the literature, a number of methods have been proposed for separating the trend from the cyclical component of an economic time series. The most popular of these is the Hodrick-Prescott (1997); while others include Rotemberg (1999), Baxter-King filter (1995), etc. This study has used the Hodrick-Prescott filter[2]. A brief summary of the methodology used is provided in the following section. Results are presented and explained in section 3, while the last section concludes the paper.

2. Methodology

The methodology consists of two steps; first to dissect the real GDP to get its components, and second to project the components into future. It is assumed that annual series of real GDP is an

[1] The scope of this paper is limited to decompose the real GDP statistically and to project it into future. However, the results of the study raises a number of unanswered questions and pave way for future research in this area which may include use of alternate methods of decomposition, co-integration between trend and cycles exist in GDP, consumption, investment, M2, etc, and of course a detailed explanation of shocks, cycles and trends with respect to structural, political, social, and global events.

[2] See Pedregal & Young (2000), Pederson (1998), and Reeves et all (2000) for some useful comments on HP Filter.

aggregate of three components viz. Trend, Cyclical movements, and Irregular movements[3]. In symbolic form;

$$Y_t = T_t + C_t + I_t \qquad .1$$

where T_t = Long-run trend

C_t = Cyclical movements

I_t = Irregular movements (shocks)

All are in natural log form.

The HP filter is used in two stages to separate these components; first to extract the long-run trend (T_t) from the original series and then to filter out cycles (C_t) from the rest. The HP filter proceeds as follows;

It assumes that a series (say X_t) has two components; a smooth one (S_t) and deviations (D_t) from S_t, i.e.

$$X_t = S_t + D_t \qquad .2$$

such that over a long period of time the sum of deviations (D_t) is near zero.

In order to filter out S_t from X_t, it minimizes the following:

$$Min: \ \Sigma D_t^2 + \lambda \Sigma [\Delta^2 S_t]^2 \qquad .3$$

The parameter λ is a positive number, which penalizes variability in the smooth component (S_t). Δ is the difference operator, power of which shows the order of differentiation. The higher the value of λ, the smoother is the solution series. Hodrick and Prescott suggested $\lambda = 100$ for annual data.

We have applied the HP filter on the original series of real GDP to extract trend (T_t) component from it. By subtracting the trend from the original series (Y_t), we get a new series (Z_t) that contains cyclical and irregular components.

$$Z_t = Y_t - T_t = C_t + I_t \qquad .4$$

[3] This assumption is similar to that adopted by U.S. Bureau of Census in its seasonal adjustment program (the latest version of which is X-12-ARIMA). In a seasonal adjustment program, a series is usually assumed to have four components: long-run trend, business cycle, seasonal variations, and irregular movements. However, in case of annual data there will be no seasonal component, leaving only three types of variations.

We again apply the HP filter on Z_t. In this second stage the HP filter wheedles out oscillations around the smooth component that is nothing but Cycles C_t. The difference between Z_t and C_t represents shocks or Irregular component (I_t)

The next step is to project trend and cycles into future over a ten-years' period. For this purpose, ARIMA models have been used. Following the usual procedure of selecting a time series model[4], we have identified the following models for components;

For trend component (T_t)[5]:

$$(1-\alpha_1 L-\alpha_2 L^2-\alpha_3 L^4)(1-L)^2 T_t = \alpha_0 + (1+\beta_1 L+\beta_2 L^4)\varepsilon \qquad .5$$

For cyclical component (C_t)

$$(1-\phi_1 L-\phi_2 L^2-\phi_3 L^3-\phi_4 L^4) C_t = \phi_0 + (1+\pi_1 L+\pi_2 L^2+\pi_3 L^3)\,\varepsilon \qquad .6$$

Data of real GDP at prices of 1980-81 for years 1949-50 to 2000-01 has been used[6].

3. Results

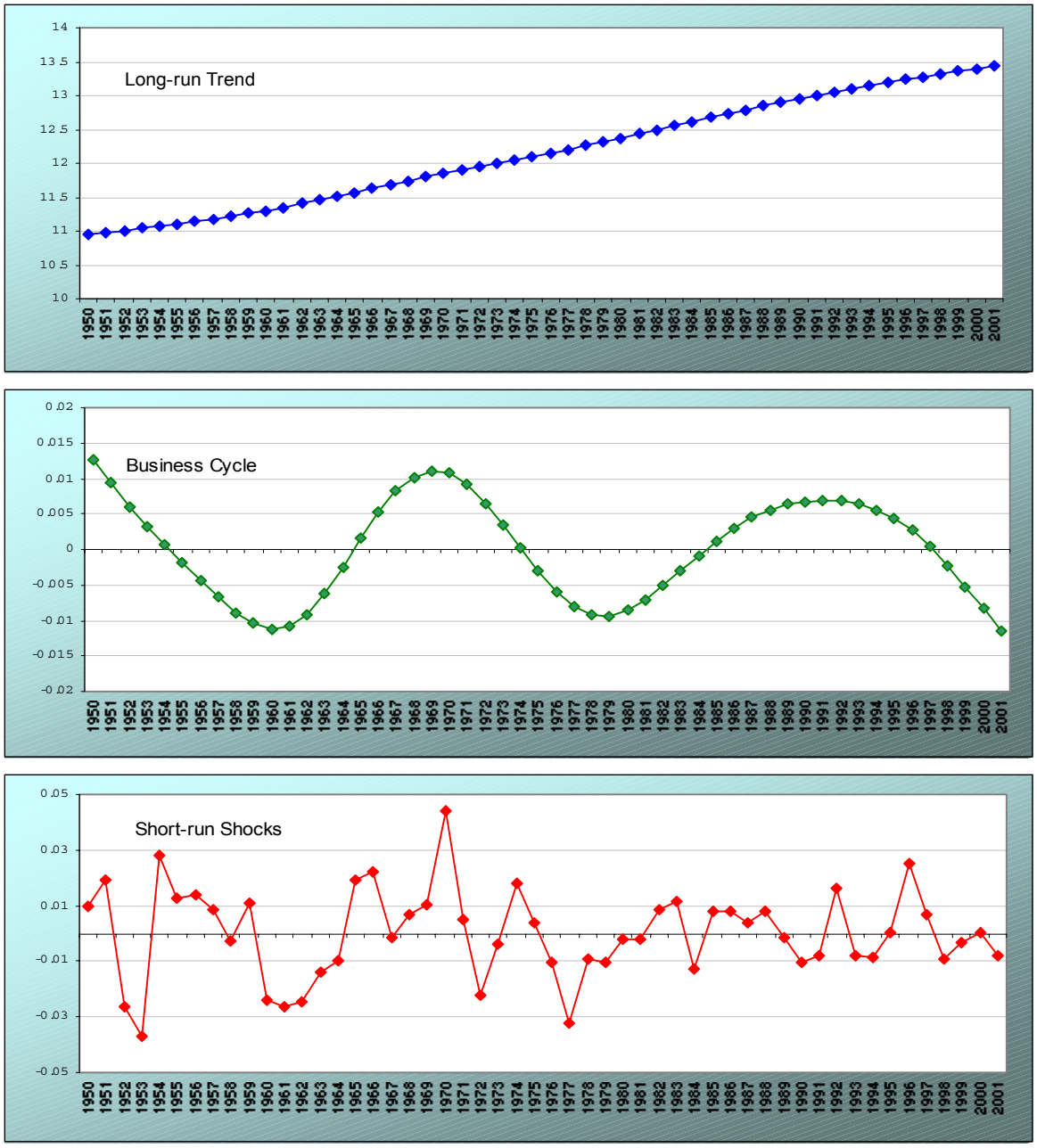
The three components of Pakistan's real GDP have been shown in Figure-1. As expected, it has a positive long-run trend throughout the period. However, it may be noted that though trend GDP is increasing over time, its rate of increase as depicted in Figure-2 has different behaviour in different periods. During the first half of 1960s, the growth of trend component was rising while the second half witnessed a slow down. This pattern of growth has some bearings on structural developments in early 60s including the green revolution, the industrial revolution, the development of financial institutions, etc., and the impact of 1965 war on the later half of the 60s.

[4] The procedure includes establishing order of integration by unit root test, identification of model with the help of autocorrelation and partial autocorrelation functions, and diagnostics etc.

[5] L is lag operator and ε is error term, normally distributed around constant mean.

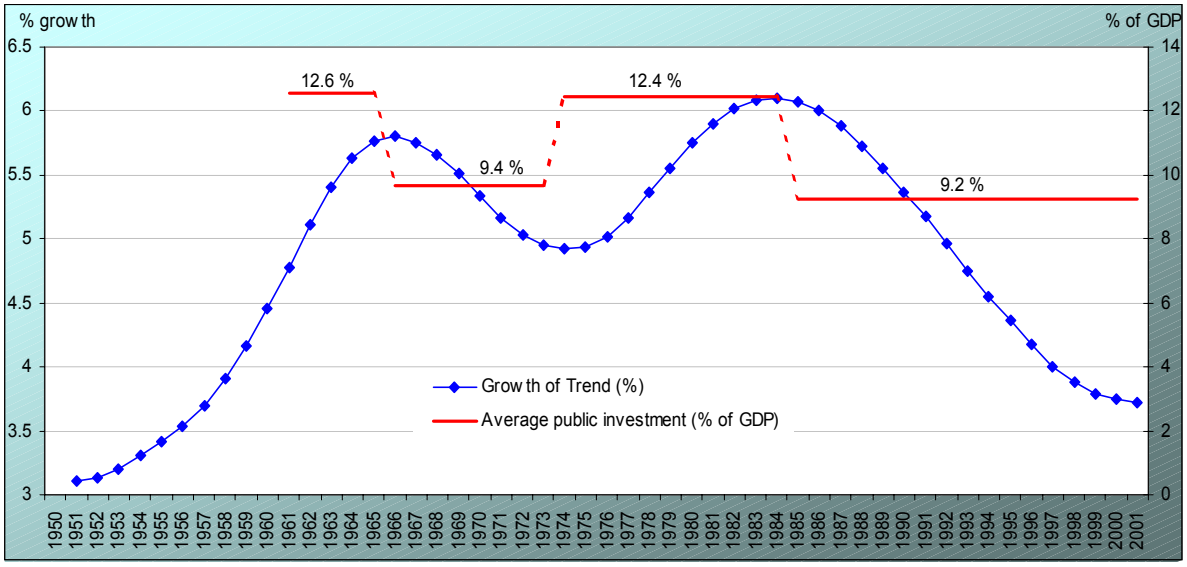
[6] Data source for 1949-50 to 1994-95 is '50 Years of Pakistan, Volume 1 – Summary, by Federal Bureau of Statistics (June 1998); for 1995-96 onward Economic Survey – 2000-01, by Economic Affairs Division, Ministry of Finance (June 2001).

Figure 1: Components of Real GDP



Note: Unit of Y-axis is natural log of million rupees.

Figure 2: Trend Growth rate (%) & Public Investment (% of GDP)



Another very intriguing result is the increasing trend growth during 1970s – a poorly rated decade by economists. There may be more explanations to it; one is the role of public fixed investment. Public fixed investment was 12.4 percent of GDP during 1973-74 to 1983-84 compared with 9.7 percent and 9.4 percent during the two adjacent periods (Figure-2). It suggests that some positive structural changes occurred during this period. However, as mentioned below, the 1970s also witnessed a recession of second business cycle, which may have some fainting effects on the overall economic performance.

Since 1983-84, the trend growth is declining, despite high overall GDP growth of 1980s. It suggests that high growth of 1980s may have been due largely to some transitory factors, including large inflow of remittances and foreign aid, instead of structural changes in the economy that could support long run growth.

As regards the cyclical movements, it is shown that real GDP in Pakistan has completed at least two business cycles; *one* ending with a peak in 1968-69, and a *second* ending in 1990-91. Since 1991-92, the economy is in recessionary phase of a *third* business cycle. The following table gives a time frame of phases of business cycles in Pakistan.

Table 1: Time Frame of Business Cycles in Pakistan

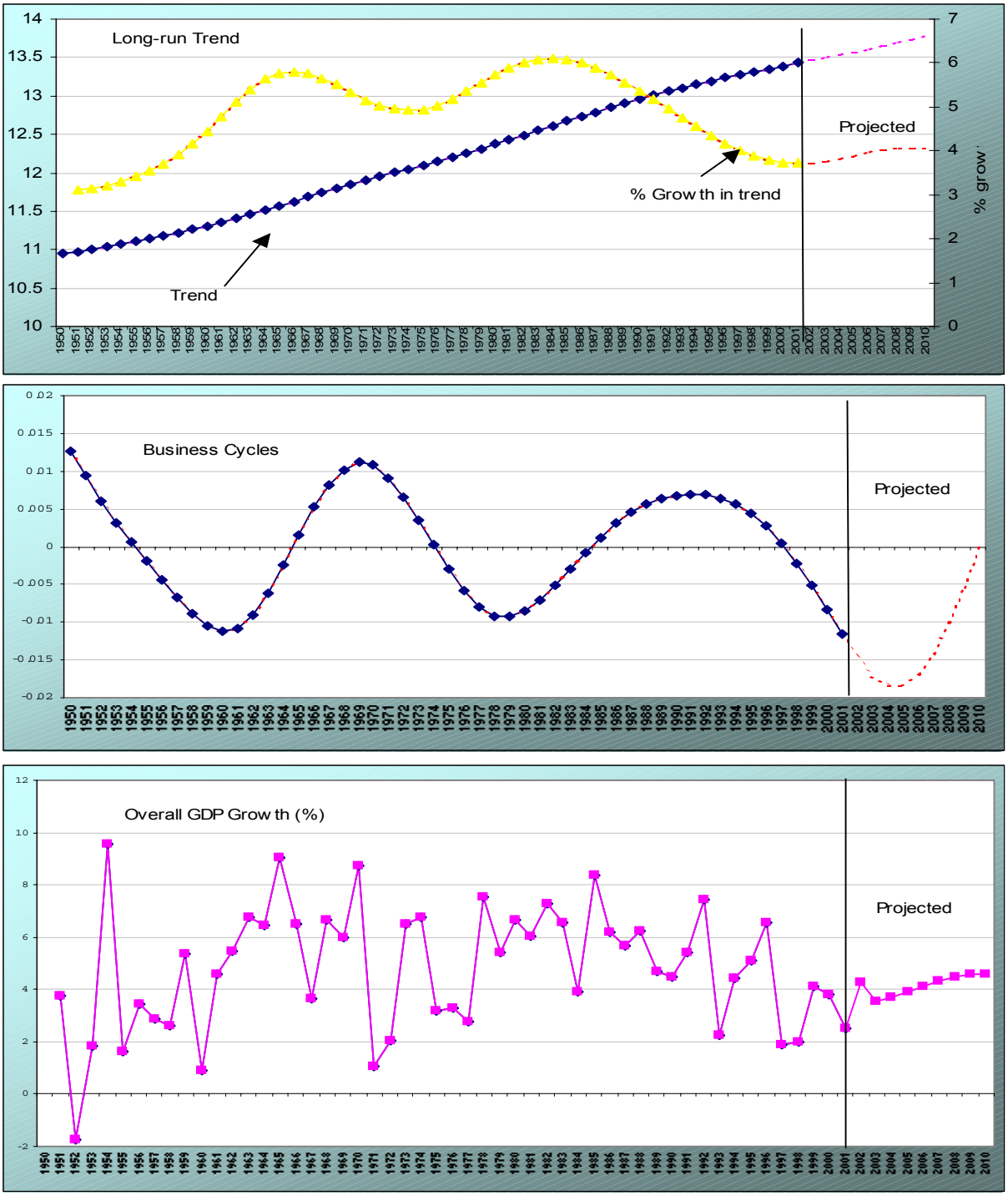
Business Cycle	Recession	Trough	Recovery	Peak
First B. Cycle (1949-69)	1949-50 to 1959-60 (11 years)	1959-60	1960-61 to 1968-69 (9 years)	1968-69
Second B. Cycle (1969-1991)	1969-70 to 1978-79 (10 years)	1978-79	1979-80 to 1990-91 (12 years)	1990-91
Third B. Cycle (1991 - ?)	1991-92 to 2004-05 * (14 years)	2004-05 *	2005-06 to ?	

* Estimated

The above chart reveals the following features of business cycles in Pakistan.

1. Pakistan's economy went into recession soon after the independence. The whole decade of 1950 witnessed economic sluggishness that may be attributed to communal upsets, lack of infrastructure, weak (or virtually absent) industrial base, lack of private sector confidence on the infant economy, etc.
2. The economy started recovering by 1960. Interestingly, the recovery period is shorter than the recession. It may be postulated that appropriate economic planning and its effective implementation helped the economy recover quickly.
3. During 1970s the economy fell into recession almost as quickly as it had recovered during the last decade. Separation of East Pakistan and the nationalization of industrial, financial and other institutions could have adversely affected the business confidence during this period.
4. It took 12 years for the economy to recover from second recession compared with a 9-year recovery period in the first cycle. Particularly, the economy slowed down in late 1980s, and did not achieve even the peak level of last cycle that it fell into next recession.
5. Third recession started in early 1990s and is projected to continue till 2004-05. According to our projection, it will be the deepest recession of all. (Figure-3).

Figure 3: Projections of Trend and Business Cycle



Note: : Unit of primary Y-axis is natural log of million rupees

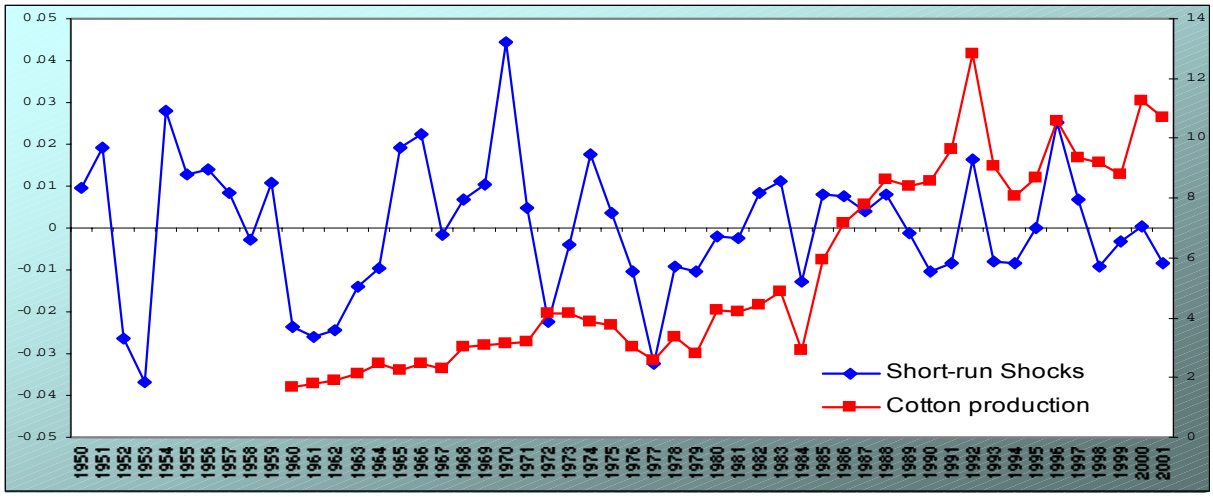
Figure-3 also shows the projection of long-run trend. It is estimated that the trend growth will start rising from year 2001-02. Although the cyclical component of the GDP is projected to decline further in coming years, the dominance of trend will drive the overall GDP growth up (Table-2)[7]. The projection is based on the assumption that the economy will not suffer from positive or negative shocks during that period.

Table2: Projected real GDP Growth

Year	% Growth
2001-02	4.251
2002-03	3.528
2003-04	3.692
2004-05	3.897
2005-06	4.111
2006-07	4.308
2007-08	4.464
2008-09	4.564
2009-10	4.601

Figure-4 shows the irregular component of the GDP that represents short-run shocks to the economy. Pakistan's economy has witnessed number of positive and negative shocks during the

Figure 4: Irregular Component of GDP and Cotton Production



Primary Y –axis = natural log of million rupees; Secondary Y-axis = million bales

past decades. Although explaining each and every shock is outside the scope of this study, one important source of shocks is identified as cotton production in Pakistan. When there was a bumper cotton crop, the growth rose sharply (as in 1992 and 1996); and when it failed, growth

[7] The projection shows a sharp jump in GDP growth during 2001-02, which comes down then to the onset of a smooth path. The reason may be very nature of the time series models, which keep in memory the past data generating process. Sharp rise in growth during 2001-02 is possibly the lagged impact of some previous process, which is smoothed out subsequently.

was depressed. A comparison of cotton production and irregular component of the GDP (Figure-4) clearly shows co-movements[8] of both the series indicating the power of cotton of driving the real GDP above/below its trend and cyclical path.

4. Conclusion

The paper has decomposed, statistically, the real GDP of Pakistan into three components viz., long-run trend, business cycles and short-run shocks. It also projected GDP growth on the basis of projected trend and business cycle. It is found that trend growth of real GDP, though positive, is declining since early 1980s. The reversal of trend growth is however, expected from year 2001-02. The results also show that the economy of Pakistan has undergone two complete business cycles since its independence, and is now facing the recessionary phase of a third business cycle, which began in the early 1990s. It is projected that the current recession will continue until 2004-05, and then recovery will take place. However, since the dominant component of real GDP, the trend is projected to gain strength from 2001-02, the overall GDP growth is projected to rise gradually in coming years. The paper identifies a number of positive and negative shocks to the economy during past decades, and also finds a significant correlation between cotton production and shocks.

[8] Correlation coefficient of cotton production and irregular component is +0.21.

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