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The Cost of Low Inflation in Case of Pakistan

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Abstract. It is a debatable issue that high and variable inflation causes the well fare loss while on the other side reducing inflation generally has some cost and the amount of that cost is measured by the sacrifice ratio. Therefore inflation output trade off is important for central banks when formulating policy. Sacrifice ratio is the main indicator to measure the real cost of disinflation, calculated as the ratio of the cumulative percentage output loss (the difference between actual and potential output) to the size of disinflation. Thus, the sacrifice ratio measures the real output cost per unit of permanent decrease in inflation. Sacrifice ratio is basically divided into two main categories, time invariant sacrifice ratio and episode specific sacrifice ratio. In time invariant sacrifice ratio we took Philips Curve, structural VAR and in episode specific ratio we took Ball method of sacrifice ratio and Zhang method of sacrifice ratio. We found positive sacrifice ratio in almost all the methods but the magnitude of the sacrifice ratio is not large and the estimates of sacrifice ratio are sensitive to different estimation method.
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1. Introduction

During the last twenty years, price stability has taken a prominent place within the area of monetary policy worldwide and especially it has become the top most priority of central banks all over the world as well. To achieve price stability, central banks have availed different options from time to time which include monetary, exchange rate and inflation targeting. The Inflation targeting strategy gives utmost importance to output stabilization. It is considered that for sustainable growth and creating employment opportunities, price stability is a precondition. The strategy envisioned that by stabilizing the prices, sustainable and long run benefits for the public may be secured and increased growth rate of real output may be achieved. Empirical literature reflects that high inflation rates are detrimental to long run growth and entail welfare costs. But to control or to bring inflation to normal or down is a gigantic task and is usually associated with short run output losses as defined by Ball (1994). It is therefore important to understand sacrifice ratio (accumulated loss in output during disinflations divided by the overall fall in inflation). Central banks give utmost importance to inflation output trade-off while formulating policy. When high inflation is to be controlled, tight monetary policy is put in place which might in turn affect the economic activity.

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This sort of loss like the slowdown in economic activity can be interpreted as the sacrifice or the price paid for countering or targeting the inflation. Policy makers in such instances remain keen to assess the impact on economy in holistic terms. Hence, disinflation has always been a long standing issue, along with high inflation in Monterey economics

Thus, the *sacrifice ratio (SR)* calculates the cost of real output per unit of permanent reduction in inflation rate. This relationship between inflation and output has been extensively studied both empirically and theoretically. Okun (1978) introduced this concept of trade off between inflation and output. The cost of disinflation in terms of percentage output lost in a given time period is calculated mostly using the *Philips curve (PC),* but Ball (1994) specifies few deficiencies of the Phillips curve method like the output inflation trade off is supposed to be constant in all the period. Keeping the Phillips curve limitations in mind, Episode specific method is identified by Ball (1994) in which disinflationary episodes are identified and then sacrifice ratio is calculated as for each period as the cumulative sum of output gap divided by the fall in inflation. Ball (1994) approach was generalized by Zhang (2005) and he incorporates the persistence effect and long lived effects of inflation and found that the SR is larger when these effects are included. Cecchetti & Rich (2001) criticized the episode specific method of calculating sacrifice ratio. They are in favor of incorporating the structural shocks in the model and they used *SVAR* methodology for the calculation of the sacrifice ratio. Literature shows that results of sacrifice ratio vary significantly across countries, time periods, episodes and estimation techniques.

Keeping in view the importance of inflation targeting monetary policy, this study contributes to the scientific literature by measuring the cost of reducing inflation known as sacrifice ratio in case of Pakistan. The worth of this study is that it is the first attempt in case of Pakistan in which sacrifice ratio is measured by almost all methods at aggregate level.

Rest of the study is proceeds as. Section 2 reviews the literature of sacrifice ratio. Section 3 deals the methodology and data. Section 4 presents the empirical results and finally section 5 concludes the study.

2. Review of Literature

According to Friedman (1968), the inflation and output relationship has been an essential object for monetary policy. Whereas it is a famous reality that low inflation is beneficial condition in the economy and there is also agreement on this view that disinflationary policies reason of short term output losses. Most of the empirical literature on disinflations focused on the *Sacrifice ratio (SR)*, sacrifice ratio defined as the costs in terms of output loss that must be faced to achieve a reduction in inflation.

There have been various attempts to estimate the sacrifice ratio in the literature. These can be separated in two main classes: Time- invariant sacrifices ratio (Okun, 1978; Gordon & King, 1978; Cecchetti & Rich, 2001), and Episode Specific methods (Ball, 1994; Zhang, 2001). While Ball's technique remains as the "standard" and important method.

In Time- invariant sacrifices ratio different methodologies like simple *Philips curve (PC)*, s*tructural vector auto-regression (SVAR)* and *New Keynesian Philips curve (NKPC)* are used for the calculation of sacrifice ratio. The pioneer of Time-invariant sacrifices ratio method is Okun (1978) who analyzed a set of Phillips curve models to estimate the cost of disinflation in terms of the percentage loss of output during a given period and he found 10% sacrifice ratio on average for the

United States. This mean, one % permanent decrease in inflation rate would cause 10% point loss in real *Gross National Product (GNP)*.

Using traditional as well as *VAR* models, Okun's was refined by Gordon & King (1982) to estimate the U.S sacrifice ratio and found that sacrifice ratio lies between 0 to 8 percent. For Economic and Monetary Union of the European (EMU) countries, sacrifice ratio in the time period of 1960 to 2001 was estimated by Cunado & Gracia (2003) using Philips curve.

Andersen & Wascher (1999) computed the sacrifice ratio for 19 industrialized countries and found that sacrifice ratio varies along the different time period and model specification. They showed that the average sacrifice ratio rose from 1.5% to 2.5% result of fell in average rate of inflation from the 80s to 90s and those lower rates of inflation made the aggregate supply curve flatter. A study by the Reserve Bank of India (RBI) (2002) estimates the Phillips curve and obtains a sacrifice ratio of 2% for India. Kapur & Patra (2003) estimate an alternative specification of aggregate supply function and provides estimates of a sacrifice ratio ranging from 0.3 to 4.7%.

Akbari & Rankaduwa (2006) estimate an output-inflation trade-off using OLS method to and find sacrifice ratio for Pakistan for the time period 1982-2004 and found that a one percent decline in inflation rate caused by a permanent reduction in monetary growth rate would result in a cumulative output (GDP) decline of 0.87 percent point.

On the other hand, Ball (1994) specifies few deficiencies of the Phillips curve method like the output inflation trade off is supposed to be constant in all the period. Keeping the Phillips curve limitations in mind, Episode specific method is identified by Ball (1994) in which disinflationary episodes are identified and then sacrifice ratio is calculated as for each period as the cumulative sum of output gap divided by the fall in inflation. This approach of calculating sacrifice ratio depends upon the disinflation episodes assumptions and how to determine the equilibrium output levels. This approach focused only disinflationary episodes not inflation episodes and more importantly no supply shocks and other polices is incorporated which affect the rate of inflation. Ball (1994) used this episode specific sacrifice ratio in 19 OECD countries from 1960 to 1991 and found 65 episodes. The calculated value of Ball (1994) sacrifice ratio varies from 0 % to 3.5%.

The sacrifice ratio is estimated using Ball (1994) technique by many authors over different time periods like the inflation output trade off is checked by Cetinkaya & Yavuz (2002) in case of Turkey. Analysis showed that, in case of Turkey disinflations are not described by huge output losses. Coffinet et, al (2007) estimate the sacrifice ratio for the euro area following the Ball (1994) technique and fond the value of the sacrifice is between 1.2% and 1.4% for the euro area over the period 1985 to 2004.

Using episode specific and *SVAR* model, Serju (2009) found very low sacrifice ratio for Trinidad, Tobago and Jamaica. On average 0.029% and 0.113% points output loss due to 1% fall in inflation rate in Jamaica and Trinidad & Tobago respectively. The SR in Turkey, Brazil and Italy is calculated by Direkci (2011) using the Ball (1994) method and reasonable results are found. Mazumder (2012) estimate the sacrifice ratio of organization for economic cooperation and development (OECD) economies following Ball (1994) method over a roughly forty year period.

Ball (1994) approach was generalized by Zhang (2005) and he incorporates the persistence effect and long lived effects of inflation and found that the SR is larger when theses effects are included. The empirical study used the 1960 to 1990 unemployment, as well as real *GDP* data quarterly on G-7 countries. The average sacrifice ratio calculated by ball (1994) is 1.4 but when the Zhang (2005) incorporated the long lived effects, average sacrifice ratio increased to 2.5 in the same data set.

Cecchetti & Rich (2001) criticized the episode specific method of calculating sacrifice ratio. And they are in favor of incorporating the structural shocks in the model. Cecchetti & Rich (2001) used *SVAR* methodology for the calculation of the sacrifice ratio for the period 1959 to 1997 on quarterly US data, using three different identified models and then estimate the *SR* over 1 to 5 year horizon. Similarly Feve et,al (2007) used SVAR analysis, and provide an estimate of SR is 4.26% for the Euro zone.

Calculating sacrifice ratios using structural vector auto-regression (SVAR) for the twelve euro countries over the time period 1972:1 to 2003:4 Jacques et al. (2005) estimated the value of sacrifice ratio and found almost same SR in euro countries over the entire sample time. The value of sacrifice ratio is between 0.35% and 0.63% in eight of twelve countries. Luxembourg and Germany have high sacrifice ratios only; on the other side Belgium and Finland show low values, almost 0 and negative in the case of Belgium.

The *structural vector auto-regression (SVAR)* methodology also provides the dynamic effects of disinflation. The impulse responses in Cecchetti & Rich (2001) show that after a disinflation output falls and ultimately turns back, while inflation decreases permanently. However, variation in the size of sacrifice ratio depends on the timing of the disinflation across model specifications, identification assumptions and data sets.

3. Methodology and Data

3.1. Sacrifice Ratio Methodology

The primary objective of the monetary policy is to control inflation and stabilize the prices. Reducing inflation generally has some cost and the amount of that cost is measured by the sacrifice ratio. Thus the sacrifice ratio calculates the output cost per unit decline in inflation. This relationship between inflation and output has been extensively studied both empirically and theoretically. The origin of this relationship is the introduction of the Philips Curve and Okun (1978) introduced this concept of trade off between inflation and output. He derived the cost of disinflation in terms of percentage output lost in a given time period using the Philips curve model. After this the economists used different techniques to measure the cost of disinflation. In this section we explain different methodologies of sacrifice ratio.

3.1.1. Philips Curve Methodology

The theoretical foundations of the sacrifice ratio are based on the expectations augmented Phillips curve (Okun, 1978; Gordon & King, 1982). The basic equation of the Philips curve is as,

$$(Y_t - Y_t^p) = \alpha(\pi_t - \pi_{t-1}) + u_t \tag{1}$$

Here Y_t and Y_t^p are the actual output and potential output respectively and this means that $\left(Y_t - Y_t^p\right)$ is the output gap. The term π_t is the inflation in time t and π_{t-1} is last year inflation rate and disinflation occurs when $(\pi_t - \pi_{t-1}) < 0$. α is the parameter which measures the cost of disinflation. As the value of α gets larger, the cost of disinflation increases.

$$\alpha = \frac{dY_t}{d\pi_t} \tag{2}$$

3.1.2. Ball's Methodology

Sacrifice ratio estimated by Philips curve is criticized on the following two points; first, the sacrifice ratio is identical for decreasing inflation period as well as for increasing inflation period. Second the cost of disinflation is not time varying and this means that output inflation trade off is constant for all time period. Ball (1994) introduced the concept of episode specific measurement of output loss and incorporates the solution of the above problems.

Ball's definition of sacrifice ratio is as,

$$SR = \frac{\sum_{t=s}^{E+1}(y_t - y_t^*)}{\pi_t - \pi_{t-1}} \quad (3)$$

The numerator is the output gap which is the sum of the difference between the actual output (y_t) and potential output (y_t^*)in specific disinflationary episodes. The denominator is the change in the inflation rate from the start to the end of the identified disinflation episode. *SR* is interpreted as the cost of reducing one percentage point of inflation in terms of aggregate demand reduction, which is similar to α in the Philips Curve.

The definitions of the variables used in Ball's study are as:

The trend inflation is calculated using 3 year centered moving average for annual data. A point where trend inflation is high than the last year and the next year in the time period is called Inflation Peak. A point where trend inflation is low than the last year and the next year in time period is called Inflation Trough. The time starts from an inflation peak to an inflation trough with 1.5 percentage points less than the peak in annual data is known as Disinflation Episode.

Ball (1994) calculates potential output using following three basic assumptions:

• It is assumed that output is in its potential level at the inflation peak.

• Output comes back to its natural level after one year in annual data.

• Trend output increases log linearly between the two points when actual output and potential output are same.

3.1.3. Zhang Methodology

The issue with the Ball's method is that its assumptions are subject to criticism. The assumption that output is at its potential level when inflation rate is at its peak is generally accepted but the problem arises when the output come back to its potential level. Is there any long-lasting effects or persistence effects? and if these effects exist, how long have the effects of the recession last?

However Zhang (2001) introduced a new method to calculate the sacrifice ratio *(SR)* that incorporates persistence effect which is absent in Ball (1994) method. The most important problem in the calculation of SR is the measurement of trend output because little variation in trend output affect the size of *SR*. Potential output is calculated by Zhang in the following way,

- Output is assumed to be at its potential at the inflation peak.
- *HP* filter is used to calculate potential output.
- First *HP* filter of the log real output is calculated and after this growth rates of *HP* filter are found.
- The potential output is assumed to grow at the rate calculated by *HP* filter at the start of the episode.

3.1.4. Structural Vector Auto Regressive (SVAR) Methodology

The Ball (1994) and Zhang (2001) methods of calculating sacrifice ratio don't incorporate the monetary policy effects. To check the consequence of monetary policy shocks on the output-inflation relationship, Cecchetti's (1994) structural

VAR approach seems to be suitable, since it provides an appropriate calculation of the *SR*.

We use the following bi-variate unrestricted *VAR* in first differenced form.

$$\Delta y_t = \sum_{i=1}^{n} \emptyset_{11}^{i} \Delta y_{t-i} + \sum_{i=1}^{n} \emptyset_{12}^{i} \Delta \pi_{t-i} + \mu_t^1 \quad (4)$$
$$\Delta \pi_t = \sum_{i=1}^{n} \emptyset_{21}^{i} \Delta y_{t-i} + \sum_{i=1}^{n} \emptyset_{22}^{i} \Delta \pi_{t-i} + \mu_t^2 \quad (5)$$

Where y_t is the log of *GDP* at time t, π_t is the inflation rate and μ_t is the vector of innovations includes the shocks that affect the vector of endogenous variables $X_t = [\Delta y_t, \Delta \pi_t]$ at time t. It is assumed that$\mu_t \approx Niid\ N(o, \sigma^2)$.

In this unrestricted version, the innovations μ_t^1 and ì$_t^2$ do not describe any economic explanation. Since the rationale here is to clearly calculate the effect of a demand shock on inflation and real output, that's why we relate the unrestricted *VAR* model to its basic structural form.

$$(1-L)y_t = \Delta y_t = \sum_{i=1}^{n} b_{11}^{i} \Delta y_{t-i} + b_{12}^{0} \Delta \pi_t + \sum_{i=1}^{n} b_{12}^{i} \Delta \pi_{t-i} + \epsilon_t^y \quad (6)$$
$$(1-L)\pi_t = \Delta \pi_t = \sum_{i=1}^{n} b_{21}^{i} \Delta y_{t-i} + b_{21}^{0} \Delta y_t + \sum_{i=1}^{n} b_{22}^{i} \Delta \pi_{t-i} + \epsilon_t^\pi \quad (7)$$

Here ϵ_t^y and ϵ_t^π are innovation processes that include the respective shocks to aggregate supply and aggregate demand. It is assumed that shocks have zero mean and are uncorrelated and have unitary variance. Our objective of the study is to check how much the structural shocks effects inflation and output over time and to assess these magnitudes vector moving averages *(VMA)* representation of *VAR* model is used, which give responses of the system to the shocks,

The *VAM* representation of *VAR* is given as,

$$(1-L)y_t = A_{11}(L)\epsilon_{t-i}^y + A_{12}(L)\epsilon_{t-i}^\pi = \sum_{i=0}^{\infty} a_{11}^{i} \epsilon_{t-i}^y + \sum_{i=0}^{\infty} a_{12}^{i} \epsilon_{t-i}^\pi \quad (8)$$
$$(1-L)\pi_t = A_{21}(L)\epsilon_{t-i}^y + A_{22}(L)\epsilon_{t-i}^\pi = \sum_{i=0}^{\infty} a_{21}^{i} \epsilon_{t-i}^y + \sum_{i=0}^{\infty} a_{22}^{i} \epsilon_{t-i}^\pi \quad (9)$$

The calculation of the *Sacrifice ratio (SR)* is based on the structural impulse response function from the equation (8) and (9). A set of assumptions are made in order to move to the structural representation from the reduced *VAR*. It is assumed that μ_t is the linear combination of ϵ_t. We also used additional identifying restriction for the model that aggregate demand shocks have no permanent effect on the level of output, following Blanchard & Quah (1989).

The summation of the coefficients $A_{22}(L)$ measures the shocks of monetary policy on its level. The cumulative effect of output resulting from monetary policy shocks is shown as a function of the coefficients $A_{12}(L)$. The *Sacrifice ratio (SR)* over the time horizon (τ) is calculated as,

$$S(\tau) = \frac{\sum_{j=0}^{\tau} \left(\frac{\partial y_{t+j}}{\partial \epsilon_t^\pi}\right)}{\left(\frac{\partial \pi_{t+\tau}}{\partial \epsilon_t^\pi}\right)} = \frac{(\sum_{i=0}^{0} a_{12}^{i}) + (\sum_{i=0}^{1} a_{12}^{i}) + \ldots\ldots + (\sum_{i=0}^{\tau} a_{12}^{i})}{(\sum_{i=0}^{\tau} a_{22}^{i})}$$
$$= \frac{(\sum_{i=0}^{\tau} \sum_{j=0}^{i} a_{12}^{i})}{(\sum_{i=0}^{\tau} a_{22}^{i})} \quad (10)$$

The output loss is measured in the numerator and the difference in the level of inflation is measured in the denominator.

3.2. Data

The annual data ranging from 1971 to 2011 are obtained from the Pakistan Economic Survey, Pakistan statistical bulletin. The following variables are used.

Inflation is measured as percentage change in *GDP* deflator as well as the percentage change in *CPI* at aggregate level, obtained from the Pakistan Economic Survey. *GDP* deflator is calculated as the ratio of the nominal and real product. Data on the real *GDP* at factor cost adjusted in millions of national currency are also taken from the Pakistan Economic Survey.

4. Results

For the calculation of sacrifice ratio, first we estimated the Philips curve using output gap as a proxy of real economic activity. The output gap measured by quadratic time trend and HP filter is preferred to the output gap measured by the linear trend because it follows the pattern of the Pakistan business cycle, as mentioned by the Arby (2001). The results of sacrifice ratio estimated by PC at aggregate level are given in Table-1

Table 1. *Sacrifice Ratio by PC*

Output gap methods	Philips curve	Sacrifice Ratio
Quadratic trend	$\pi_t = 0.06y_t + 0.54\pi_{t-1}$	0.13
HP filter	$\pi_t = 0.67y_t + 0.54\pi_{t-1}$	1.46

The results show that sacrifice ratio is positive with reasonable magnitude. The sacrifice ratio measured by the PC also validate by the sacrifice ratio estimated for India ranges from 0.3 to 4.7 by Patra & Kapur (2000).

The first step in episode specific sacrifice ratio method is to identify the different disinflationary episodes- episodes in which trend inflation falls considerably. So first we identify the disinflationary episodes on the basis of fall in trend inflation and trend inflation is calculated by the three years moving average of inflation series in annual data. The details of the constructed disinflationary episodes are shown in the Table-2

We found three disinflation episodes in the data and the length of time periods of disinflation range between 4 to 7 years in both CPI based inflation rate and *GDP* deflator based inflation rate. The maximum decline in inflation is 14.08 in case of CPI and 12.09 in case of *GDP* deflator.

Table 2. *Disinflationary Episodes*

	Based on CPI			Based on *GDP* deflator		
	Episode 1	Episode 2	Episode 3	Episode 1	Episode 2	Episode 3
Start	1974	1980	1995	1973	1980	1995
End	1978	1985	2002	1978	1985	2002
Duration	4 years	5 years	7 years	5 years	5 years	7 years
Decline in inflation rate	14.08	6.84	8.13	12.09	6.13	7.68

We use *GDP* at factor cost as well as *GDP* at market price along with the two measures of inflation rate by CPI and *GDP* deflator for the robustness of the results. The results of sacrifice ratio measured by the CPI inflation rate are in Table-3

Table 3. *Sacrifice Ratio Using CPI Based Inflation Rate (Ball's method)*

Disinflation Episodes	Inflation Decline	Output loss using *GDP*(FC)		Sacrifice ratio	
		Method 1	Method 2	Method 1	Method 2
Episode 1	14.08	7.12	3.43	0.51	0.24
Episode 2	6.84	-0.65	-0.31	-0.10	-0.05
Episode 3	8.13	13.05	4.36	1.61	0.53
		Output loss using *GDP*(MP)			
Episode 1	14.08	5.03	1.84	0.36	0.13
Episode 2	6.84	-0.79	-0.23	-0.11	-0.03
Episode 3	8.13	11.42	5.86	1.40	0.72

Output loss is measured by two methods for comparison purpose. HP filter is used in method1 to find out the output loss and in method 2 Ball's technique of output loss is used. The results support each other. Episode 1 and episode 3 indicate the positive sacrifice ratio. In these episodes one percent falls in inflation leads to 0.24 and 0.13 percent output loss in first disinflation episode and 0.53 and 0.72 percent output loss in third episode using *GDP* at factor cost and market price respectively.

It is usually believed that economic growth can take place in the presence of political stability but in case of Pakistan this conventional wisdom is contradicted. This is also shown in episode 2 which is the military regime. Sacrifice ratio is negative in case of episode 2. The negative sacrifice ratio means that growth rate of *GDP* was not fallen. The growth rate of the *GDP* in 1980's remained at 7.1% on average and the inflation rate remained at 7.6% on average as compared to 12.2% in 1970s.

Table 4. *Sacrifice Ratio Using GDP Deflator (Ball's method)*

Disinflation Episodes	Inflation Decline	Output loss using *GDP*(FC)		Sacrifice ratio	
		Method 1	Method 2	Method 1	Method 2
Episode 1	12.09	8.51	3.93	0.70	0.32
Episode 2	6.13	-0.65	-0.31	-0.11	-0.05
Episode 3	7.68	13.06	4.37	1.70	0.57
		Output loss using *GDP*(MP)			
Episode 1	12.09	4.57	4.32	0.37	0.36
Episode 2	6.13	-0.79	-0.23	-0.12	-0.04
Episode 3	7.68	11.42	5.87	1.49	0.76

The estimated results of sacrifice ratio using *GDP* deflator are given in Table-4. The results are almost similar to the CPI case. Episode 1 and episode 3 have positive sacrifice ratio while the episode 2 experienced negative sacrifice ratio and the magnitudes of the sacrifice ratio are almost similar.

The most critical issue for the estimation of the sacrifice ratio is the calculation of trend output, as minor change in fitted output makes large differences in sacrifice ratios. The Zhang's method includes the possible persistence effect. This method makes flexible assumption about output that it can return to its potential at any time after the trough. The size of the sacrifice ratio measured by Zhang method is greater than that of the ball's method. The results confirm that episode 1 and episode 3 have positive sacrifice ratio while the episode 2 has still negative sacrifice ratio. Along with the signs of the sacrifice ratio it also confirms that the size of the sacrifice ratio measured by the Zhang's technique is larger than the size estimated by Ball's method

Table 5. *Sacrifice Ratio using CPI (Zhang's method)*

Disinflation Episodes	Inflation Decline	Output loss using *GDP*(FC)	Sacrifice Ratio
Episode 1	14.08	10.949	0.778
Episode 2	6.84	-6.759	-0.988
Episode 3	8.13	28.621	3.519
		Output loss using *GDP*(MP)	
Episode 1	14.08	2.378	0.169
Episode 2	6.84	-0.153	-0.022
Episode 3	8.13	35.31	4.34

The sacrifice ratios calculated by the *GDP* at factor price and at market price have also similar results in both cases of inflation rate calculated by *GDP* deflator and CPI. The results of the sacrifice ratio calculated using CPI based inflation rate and *GDP* deflator based inflation rate are given in Table-5 and Table-6 respectively.

Table 6. *Sacrifice Ratio using GDP Deflator (Zhang's method)*

Disinflation Episodes	Inflation decline	Output loss using *GDP*(FC)	Sacrifice ratio
Episode 1	12.09	17.670	1.461
Episode 2	6.13	-6.759	-0.988
Episode 3	7.67	28.62	3.519
		Output loss using *GDP*(MP)	
Episode 1	12.09	11.099	0.918
Episode 2	6.13	-0.153	-0.025
Episode 3	7.67	35.31	4.340

The results of sacrifice ratio by Ball and Zhang methods robust each other and confirms that during the period of 70's economy fell into recession, separation of East Pakistan, nationalization of industrial, financial and other institutions adversely affect the economy output and this is also explained by the disinflationary episode 1. The disinflationary episode 2 shows that economy moves to the recovery period but the process of recovery is not fast and it also shows that no clear cut tradeoff between inflation rate and output rather both output and inflation rate are high. The disinflationary episode 3 again lies in the period of recession. In this period inflation rate was at double digit and economy was facing poor economic growth and there exist a tradeoff between inflation rate and economic growth.

Ball and Zhang's methodology doesn't permit to consider the effects of monetary policy shocks into the calculation of the sacrifice ratio. To the see the effect of monetary shocks Cecchetti's (1994) structural VAR modelling approach seem more suitable.

We use annual data on real output and inflation rate, defined as the annual growth rate of the *Consumer Price Index (CPI)* and the *GDP* deflator as well. *GDP* data have been converted into logarithms. Initially stationarity analysis of the series (through correlogram, *Augmented Dickey-Fuller (ADF)* and *Phillips-Perron* tests) suggests that real output and inflation rate are both I(1) processes i.e., real *output* and inflation rate both contain a unit root. The next step in our estimation procedure requires choosing the optimal lag length in *VAR* model. For this selection, we use information criteria like *Akaike* and *Schwarz* information criteria and *likelihood ratio* tests. The criteria used suggest that three lags are to be taken for this model. The estimated *VAR* model is as

$$\Delta y_t = 0.28\Delta y_{t-1} + 0.37\Delta y_{t-2} + 0.20\Delta y_{t-3} + 0.001\Delta\pi_{t-1} + 0.002\Delta\pi_{t-2} + 0.002\Delta\pi_{t-3} \quad (14)$$

$$\Delta\pi_t = 22.79\Delta y_{t-1} + 28.32\Delta y_{t-2} + 10.10 y_{t-3} + 0.67\Delta\pi_{t-1} + 0.13\Delta\pi_{t-2} + 0.10\Delta\pi_{t-3} \quad (15)$$

After estimating the *VAR* model we precede to the identification of the supply and demand shocks from the VMA representation. The detail of all these restrictions is discussed in the chapter 3 on theoretical framework. Structural shocks are not directly measureable so these are calculated using additional identifying restrictions of Blanchard-Quah (1989). The demand shock have no long run impact on the level of real output following the Cecchetti & Rich (1999) and the final estimated form of the sacrifice ratio is as,

$$S(\tau) = \frac{\sum_{j=0}^{\tau}\left(\frac{\partial y_{t+j}}{\partial \epsilon_t^{\pi}}\right)}{\left(\frac{\partial \pi_{t+\tau}}{\partial \epsilon_t^{\pi}}\right)} = \frac{\left(\sum_{i=0}^{\tau}\sum_{j=0}^{i} a_{12}^{i}\right)}{\left(\sum_{i=0}^{\tau} a_{22}^{i}\right)} \quad (16)$$

τ is the time limit for the calculation of the effects of shock ϵ_t^{π}. For quarterly data 20 quarters are used as a time limit of the shock effect and for the annual data 5 years are used for the calculation of the effect of shock in economic literature. In this study we use 5 years as time limit because we are using annual data. Sacrifice ratio is interpreted as the ratio of cumulative output loss due to one percentage point decrease in inflation. The estimated results of Sacrifice ratio calculated by the SVAR are given in the Table -7.

Table 7. *Sacrifice Ratio using SVAR*

	Model 1	Model 2
τ	5	5
Sacrifice Ratio	0.051	0.053

In model1 we construct the inflation rate using CPI and in model2 inflation rate is constructed by the *GDP* deflator. The results are almost similar in both cases.

5 . Conclusions and Policy Recommendations

For the empirical analysis of the study we used the annual time series data from 1971 to 2011. We found three disinflationary episodes in episode specific method at aggregate level. Sacrifice ratio in one episode is negative and the time duration of this episode is the Zia's regime. Monetary policy during military regime is contractionary. This mean reducing inflation has no output loss in this case. The other two episodes lie in the period of civilian government. The first disinflationary episode which started from 1974 till 1978 have positive sacrifice ratio, in this ear expansionary Monterey policy was adopted and government faced lot of internal and external problems for example partitioning of East Pakistan, oil price shocks, decline in the aid flows and crop failures. These events hit the economy badly and enforced the government to opt for the deficit financing to correct the fiscal imbalance.

The third disinflationary episode starts from 1995 and end in 2002. This time period consist of two civilian governments and a military government that started from 1999. The contractionary Monterey policy which stared from 1991 continued until 1999 when the military government took office and in military regime expansionary policy was adopted. In this time period growth rate was decelerated and the main reason of slow down of the growth was the direct results of poor performance in manufacturing sector and stagnation in agriculture sector.

This study shows that estimates of sacrifice ratio are sensitive to different estimation method. The main reason of output loss in different disinflationary episodes are not only due to tighter monetary policy but the government instability, institutional and structural factors in labour and product market also play major role.

The analysis shows that tighter monetary policy has small welfare loss and the key policy implication from this study is that the comparatively smaller sacrifice ratio makes it helpful for policy makers to try to cut inflation to single digit without fear of considerable output reduction.

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