# Welfare Costs of Inflation in Nepal: An Empirical Analysis

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*This paper empirically examines the welfare losses arising from the currently rising inflation rate of Nepal using the method introduced into the literature by Bailey (1956) and the demand for real balance function put forward by Deaver (1970). Utilizing annual time series ranging from 1973 to 2009, the result obtained here supports the theoretical underpinning that the rise in inflation is leading to decrease in real balance and hence increase in welfare loss. It is also found that the rate of increases in welfare cost as a result of significant rises in inflation is sluggish. Further, the finding also leads one to conclude that the significant fraction of real income as welfare cost in the year 2010 corresponds to other factors affecting real balance rather than anticipated inflation. However, the evidence is consistent with the view that such cost may change under the relaxation of restrictions imposed corresponding to government's motivation in raising inflation tax revenue (seigniorage), investment decisions of the economic agents, inflation uncertainty affecting the behavior of money holders and optimal rate of inflation specified.*

## I. INTRODUCTION

A central question concerning public policy towards inflation is whether or not the costs of reducing inflation exceed the benefits of the consequent lower rate of inflation. The costs in eliminating inflation are the retardation of economic efficiencies and hence decline in output and employment (Tobin, 1972). The argument is that a small amount of inflation provides a necessary mechanism for lowering real wages without cutting nominal wages (Akerlof, Dickens, and Perry 1996, and Tobin, 1972). Nominal pay cuts are relatively rare (Card and Hyslop, 1996). The cost of reduced output and employment would more than offset the benefits from maintaining price stability (Lucas 1989, 1990, Fortin 1990, Peters 1990, and Scarth 1990). Therefore, the consensus exists among the economists that inflation is costly and bad so that macroeconomic policies should be geared toward its outright control without disrupting economic efficiency (Gavin and Stockman 1988, Gavin 1990, Howitt 1990, Selody 1990a, 1990b, and Hoskins 1990, 1992).

The measurement of the cost of inflation is one debated issue among the economists and the policy makers. The formers base their analysis by examining surplus of real money holders whereas the latters consider the rate of sacrifice of output as a result of stabilizing inflation into desired level (Dowd, 1994). In light of these differentiated approaches, one widely examined cost of inflation is the welfare loss arising from a rise in inflation which leads economic agents to reduce their real money balances. Inflation is said to create welfare loss to the economic agents when they devote more time and energy (increase in

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work and decrease in leisure) to purchase goods and services for any given level of spending so that there is a decrease in utility (Cooley, and Hansen, 1991). Such a cost is known by examining the reduction of real income corresponding to a fall in real balance as a result of inflation.

The argument is that, the level of real money balances depends negatively on the prevailing inflation rate, as the rate of interest must rise *pari passu* with the rate of inflation, which thereby depresses the real demand for money balances (Tower, 1971). A relatively low level of real money balances implies a reduction in the transaction-facilitating services provided by money which hence increases time and energy that must be devoted to purchasing goods and services for a given level of spending. Since this must be at the expense of leisure which is desired by individuals, it follows that higher inflation leads to lower utility level for the individuals and hence yielding higher welfare cost. Therefore, rise in inflation reduces the volume of monetary services and consequently decrease in the welfare of money-holders.

If we think of the benefits that real balances provide as given by the area under the demand curve for money-holders, the loss from inflation can be represented by the reduction in the area under the curve resulting from an inflation-induced fall in real balance holdings (Driffil, Mizon and Ulph, 1990). In the light of the foregoing argument, it is of considerable interest to develop a technique for measuring the magnitude of the welfare cost of inflation. Section II attempts a review of literature on welfare cost of inflation while Section III presents objective and approach of the study. Methodology section is given in Section IV followed by estimation and results of the analysis in Section V. Conclusions of the paper are given in Section VI.

## II. REVIEW OF LITERATURE

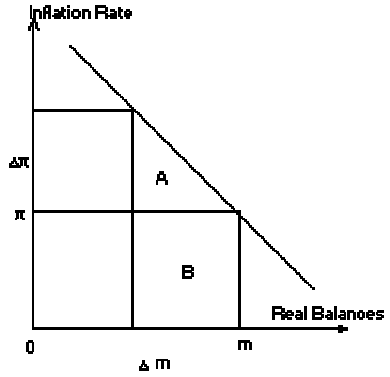
One widely examined cost of inflation is the welfare loss arisen when the anticipated inflation leads economic agents to reduce their real money balances (Dowd, 1994) In examining the cost of inflation, a distinction between anticipated and unanticipated inflation is important (Foster, 1972). Anticipated inflation has no real costs except two qualifications: one is rise in costs of holding currency arising from the inconvenience in making more trips to banks to cash smaller checks than they did before as a result of rise in inflation, popularly known as shoe-leather cost of inflation; and another is rise in cost of holding currency due to menu cost of inflation, that is, additional cost incurred as a result of substitution of old menu printing by new ones due to changes in price quotation (Dornbusch, Fischer and Startz, 2000).

The welfare cost of inflation in the economic system is transmitted via interest rate. The cost to the individual of holding currency is the interest foregone by not holding an interest-bearing asset (McNabb and McKenna, 1990). When the inflation rate rises, the nominal interest rate rises, the interest lost by holding currency increases, and the cost of holding currency therefore increases. The demand for currency accordingly falls that qualifies minimization of utility in holding real balances. Therefore, such a fall in demand for currency holding is associated with rise in inflation and consequent increase in nominal interest rate in the system.

The cost of fully anticipated inflation seems to be small which does not disrupt the functioning of payments system for the economy provided that the rate of inflation is low as well as moderate (Fischer, 1993, Chari, Jones and Manuelli, 1996, Burno and Easterly, 1996, and Barro, 1996). However, the cost of unanticipated inflation is arisen as a result of asymmetry of information, money illusion, long memory of economic agents, lack of rational expectation, etc. that fall on the parties to transactions in credit or resource market, fixed income recipients and taxpayers in general (McCulloch, 1975).

So far as the technique of measuring welfare loss is concern, a popular method is to describe the magnitude of welfare triangle. The welfare loss from inflation can be represented by the reduction in that area resulting from an inflation-induced reduction in real balance holdings, given the benefits that real balances provide represented by the area under the real balance curve.

**Figure 1: Inflation and the Demand for Real Balances**




As depicted in Figure 1, if inflation rises from $\pi$ to $\Delta\pi$ it results to a decrease in real balance from $m$ by an amount $\Delta m$ and hence creating welfare loss represented by the area A+B. Therefore, current-period loss of an increase in inflation is noting that this loss is equal to the inflation-induced fall in the area under the demand curve for real balances. The magnitude of welfare loss is determined by the elasticity of real demand function. If the real balance function is more inelastic, then the welfare loss happens to be small because a significant increase in inflation is associated with relatively small decrease in real balance and hence possesses small welfare loss.

A number of empirical investigations relating to the cost of perfectly anticipated inflation to the holders of real money balances are found in the literature of welfare cost of inflation. The seminal article on the welfare cost of inflation by Bailey (1956) is "The Welfare Cost of Inflationary Finance". He examined the cost of perfectly anticipated inflation to holders of real money balances in a stationary economy. Bailey also identified the revenue from inflationary money creation which accrues to the government that produces fiat money. This revenue is a transfer from money owners to all households through the government. Therefore, he argued that the social cost or excess burden of an inflation tax is the total cost to money owners less the transfer to government. His analysis is identical to the analysis of the welfare cost of an excise tax.

Using the traditional Bailey approach, Dowd (1994) empirically examined the welfare cost of inflation by means of a semi log model of a demand for real money balance for U.S. economy. The estimated cost of inflation at a rate of zero percent, zero to 5 percent, zero to 10 percent and zero to 20 percent are found to be 0.0043, 0.021, 0.026 and 0.029 percent of GDP respectively. Similarly, for zero to 10 percent inflation rate the estimated welfare loss for the United States are 0.28 percent of GDP according to McCallum (1989), 0.3 percent of GDP according to Fisher (1981), 0.12 percent of GDP according to Lucas (1981), 0.39 percent of GDP according to Cooley and Hansen (1989) and 0.034 percent of GDP computed by Garfinkel (1989). Foster (1972) found such cost as 0.034 percent of GDP at the inflation rate between zero to 10 percent.

However, Feldstein (1979) and Tatom (1976) extended the traditional approach of loss calculation model popularly known as consumption-smoothing model by incorporating the impact of the expected future growth in real balances under liquidity constraints. The results obtained by them showed further increase in the magnitude of welfare loss then those found in earlier studies. If Dowd's (1994) calculation is reexamined by incorporating latter approach, a present-value inflation cost ratio increased to be 0.42 percent of GNP (or $27.3 billion). He also found that inflation uncertainty (as proxied by the conditional variance of inflation) had no significant impact on output growth.

Instead of Cagan-style semi-log specification of demand for money function, Eckstein and Leiderman (1992) used Sidrauski's (1967) monetary model in estimating welfare loss applying Israeli data. The simulation of the welfare loss function for an inflation rate of 10 percent yielded a current-period welfare loss of about 1 percent of national income. Further, Cooley and Hansen (1989, 1991) Benabou (1991) and Howitt (1990) instigated a distinct quantitative technique to measure cost of inflation arising from reduction of investment with regard to inflation. The effect of capital stock on welfare loss was found to be increased by a factor of 10, which is much more important than the money-holding losses emphasized by traditional studies. Lopez (2000) computed welfare cost of inflation rate of Colombia using Sidrauski (1967) type model and found that welfare loss of inflation equivalent to 2.3 percent of GDP for an increase in the inflation from 5% to 20% and 1.2% of GDP for the inflation ranging from 10% to 20%. He also found welfare loss of around 1.3 percent of GDP when inflation increases from zero to 10 percent in Colombia and Israel.

The assumptions regarding the way that money can enter into the economy will have differential magnitude of welfare cost of inflation. The first assumption is that newly created money is turned over by the monetary authority to the government, which then distributes it to households as transfer payments paid in a lump-sum fashion (McCallum, 1989). In such a situation behavior of households has no influence on the amount they receive and inflation cost is measured with respect to inflation reducing the volume of monetary services and decreasing the welfare of money holders. The second assumption is that the government uses money creation as a source of revenue popularly known as inflation tax revenue. Differential sizes of the welfare cost of inflation are obtained in terms of the interaction of money with fiscal policy.

In light of the foregoing assumptions, Rao (1991) examined two aspects of welfare costs of inflation in India in line with the assumptions described above. Firstly, he examined

the magnitude of welfare loss under the steady inflation reducing the volume of monetary services and decreasing the welfare of money-holders and found just three-tenths of projected National Domestic Product (NDP) as welfare cost of inflation in India. If the government is motivated in inflation tax revenue under the assumption that the government uses newly printed money to finance part of its purchases of goods and services, social cost works out to be approximately 72 paise per rupee earned from inflation tax revenue.

In summing up, the literature examined so far emphasizes two particular welfare costs of inflation: the costs of reduced holdings of real balances, and the cost of inflation-induced reductions in investment. The most conservative estimates suggested cost ratios ranging from 0.026 to 0.39 percent of national income for the inflation rate ranging zero percent to 10 percent. The cost of inflation arising from reduction of investment found to be increased by a factor of 10. Using a Sidrauski (1967) monetary simulations model, current-period welfare loss rose to 1 percent of national income. Lopez (2000) found that welfare loss of inflation equivalent to 1.3 percent of GDP for an increase in the inflation from zero to 10 percent for Colombia. Rao (1991) found just three-tenths of the projected National Domestic Product (NDP) of India as welfare cost of inflation in terms of money holdings and social cost equivalent to two-third of inflation tax revenue. In the light of the foregoing reviews of literature, this paper has set following objective to measure the welfare cost of inflation in Nepal.

## III. OBJECTIVE AND APPROACH OF THE STUDY

The objective of this paper is to estimate the magnitude of welfare cost of inflation in Nepal on different rate of inflation corresponding to the reduction of volume of monetary services and hence decrease in the welfare of money holders. Estimation is undergone with the assumption that the newly created money is distributed to households as transfer payments paid in a lump-sum way (McCallum, 1989) as against the interaction of money with fiscal policy shocks of the government and investment decisions of the economic agents affecting the behavior of money holders. Estimation under such topic in the context of developing country like Nepal is a first attempt and lacks sufficient literature. This study has been undertaken under the assumption that there is prompt adjustment of expected and contemporaneous rate of inflation (Koirala, 2008). In the light of said assumption, the welfare cost of inflation calculated in this paper is based on the view that inflation expectation is anticipated.

## IV. METHODOLOGY

The methodology of estimation that is adopted in this paper is in line with the technique introduced into the literature by Bailey (1956). An examination of welfare costs of inflation is conducted utilizing the demand for real money balance function estimated, where the latter function is estimated by employing Deaver's (1970) model that it assumes that the demand for real balances $(MD/P)_t$ depends upon the actual rate of inflation $(\pi_t)$ and real income $(Y_t)$. The cost of inflation is assumed to be the fall in real income corresponding to the decrease in the area of real balance due to an increase in

inflation. Since this analysis assumes money market equilibrium, demand for money is deemed equal to supply of money.

Secondary data are used in the analysis. Annual time series ranging from 1973 to 2009 consisting of 36 observations are taken for the analysis. The main sources of data for the present study are Quarterly Economic Bulletin of the Nepal Rastra Bank (the central bank of Nepal), Various Economic Survey of the Government of Nepal (GON), Ministry of Finance, International Financial Statistics, etc. The coefficients of regression equation of the model are estimated by using Ordinary Least Square (OLS) method. If required, variables are transformed to logarithm before running regression to eliminate variability of the variables so as to interpret estimated coefficients as elasticity coefficients. ARIMA (p,d,q) terms as well as dummy variables are introduced in the demand for real money balance equation to make resultant systematic residuals white noise so that the coefficients are made unbiased and consistent.

## V. ESTIMATION AND RESULTS OF THE ANALYSIS

An analysis of the phases and amplitudes of inflation business cycles is an important issue for the formulation of macroeconomic polices in general and monetary policy in particular. Economic fluctuations turn into a severe problem in the absence of stabilization policies. The inflation business cycle of Nepal as shown in Figure 1 has completed one cycle followed by an inflationary phase at present. However, inflation behaves downward trending over the long run with least square growth rate of 8.5 percent per annum as depicted in Figure 2.

Figure 1: Business Cycle of Inflation
(1973-2009)

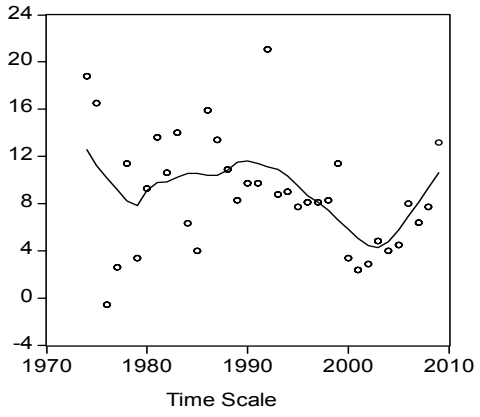
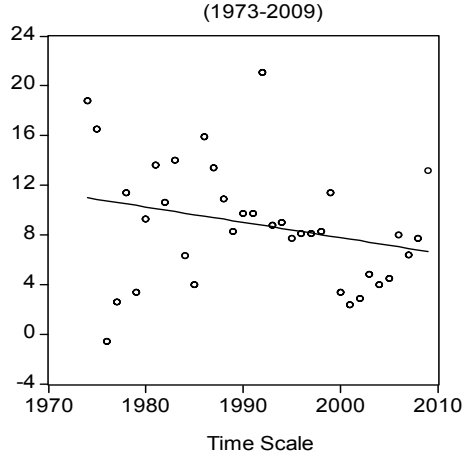
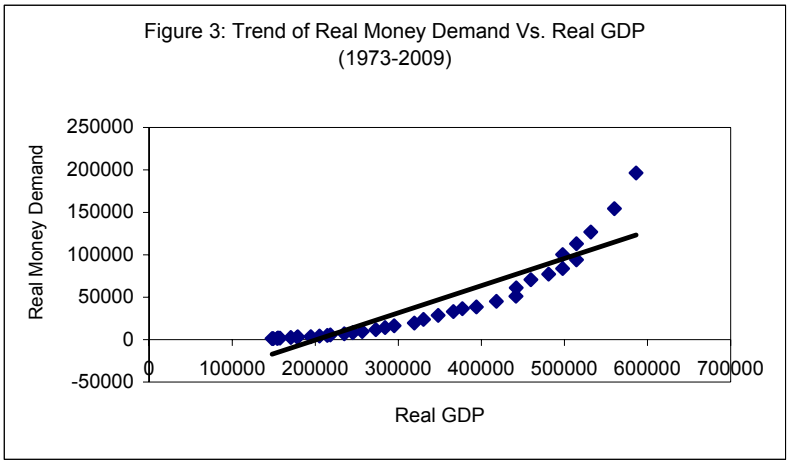



Figure 2: Linear Trend of Inflation
(1973-2009)






Sources: Nepal Rastra Bank

The fluctuation of inflation cycle leads to the determination of the shape of other macroeconomic variables such as real demand for money, real income, etc. and hence motivates policy-makers to choose appropriate counter-cyclical policy measures. In light of these discussions, there is need to examine costs of inflation for academic and policy interest.

The degree of welfare cost of inflation in a macroeconomic perspective is obtained by deducting the loss of real income incurred as a result of rise in inflation from total real income of an economy. However, this loss is proportional to the decrease in holding of real balances due to a specified increase in inflation. The first part of the analysis is to estimate the demand for money function. The latter function is subsequently applied to obtain real balance as a result of rise in inflation from zero and the rate projected for the year 2010. Lastly, welfare loss is worked out utilizing method of definite integrals between the limits of real balances as specified by different rates of inflation.

An econometric exercise is carried out to derive magnitude of welfare loss arising from the currently rising inflation rate in Nepal. For this purpose, use is made up Deaver's (1970) model that assumes that the demand for real balances $(M^d/P)$ depends upon the actual rate of inflation $(\pi)$ and real income $(Y)$. It is given by:

$$(M^d/P) = AY^{\alpha}e^{\beta\pi} \tag{1}$$

where, $\alpha$ is the income elasticity of demand for real balances and $-\beta$ is the elasticity of demand for real balances with regard to inflation. Here $e$ represents the base of all natural logarithms. A slight simplification of the money demand function presented in equation (1) represents the quantity of real balances demanded as a function of the rate of inflation, for a given level of real income as follows:

$$\ln(M^d/P)_t = \delta + \alpha \ln(y)_t - \beta\pi_t + \varepsilon_t \tag{2}$$

Where, $\alpha$ and $\beta$ are coefficients of real income and price elasticities of demand for real money balance and $\delta$ is constant term. Using annual data over the 36 years from 1973 to 2009, I estimated following money demand function, whose theoretical form is suggested by equation (1), for the Nepalese economy:

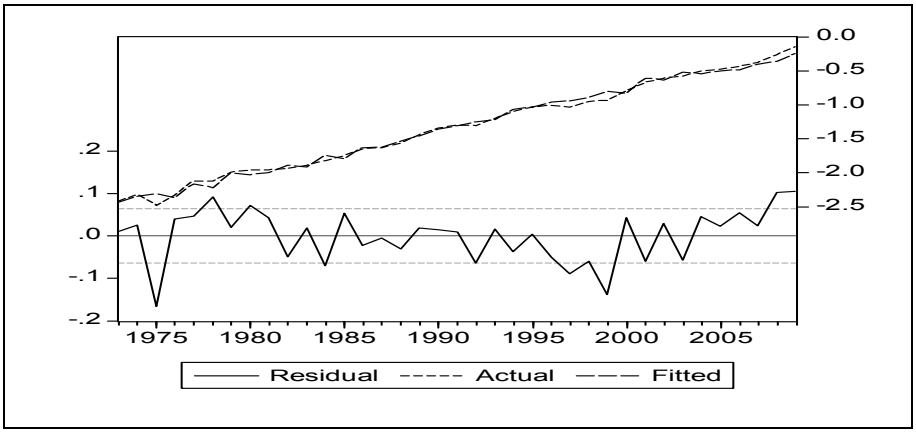
$$\ln(M^d/P)_t = \underset{(-13.93)}{-12.6940} + \underset{(20.23)}{1.4543}\ln(y)_t - \underset{(-1.50)}{0.0029}\pi_t + \underset{(2.72)}{0.5479}AR(1) + \underset{(2.17)}{0.5657}MA(1) \quad (3)$$

$\bar{R}^2 = 0.9917$, $DW = 1.967$, $S.E.\ln(M^d/P)_{y,\pi,ARMA(1,1)} = 0.060$, $S.E.\ln(M^d/P)_t = 0.66$, $F = 1044.683$

The estimated coefficients of demand for real money balance as presented in equation (3) are found to be statistically significant at 5 percent level except coefficient of inflation that is significant at 10 percent level. The signs of the coefficients are in line with theoretical plausibility, that is, demand for real money balance is positively related to real income and negatively to inflation rate. Very high $\bar{R}^2$, acceptable level of $DW$ statistics, $S.E.\ln(M^d/P)_{y,\pi,ARMA(1,1)} < S.E.\ln(M^d/P)_t$ with the incorporation of $ARIMA(1,0,1)$ are the valid statistical criteria for the robustness of the model. The residuals of the model behave almost white noise, as shown in Figure 4, employing predictive capacity of the model.

**Figure 4: Actual, Fitted and Residual Graph of Real Money Demand Function**

(Sample: 1973:2009)




Source: Derived from Equation No (3)

As explained at the beginning paragraph of this section, the next step of analysis is to calculate welfare cost of inflation utilizing estimated demand for real balance given in equation (3). Now assuming that real GDP (at 2000/01 price) grows at a 5 percent rate in

2010, the level of real income is projected at Rs.615.55 billion. Substituting $y = 615.55$ in equation (3) yields:

$$\ln(M^d/P)_t = 3.3538 - 0.0029\pi_t \tag{4}$$

It implies that the calculated welfare loss will be expressed as a fraction of this income level in 2010. Now the value of real money balances at a zero inflation rate $(M^d/P)^0$ is obtained by setting $\pi_t = 0$ in equation (4), this yields:

$$\ln(M^d/P)^0 = 3.3538 \text{ or } (M^d/P)^0 = 28.6113 \tag{5}$$

Let it be assumed that the inflation rate in 2010 would be 7.5 percent based on percentage change of the Urban Consumer Price Index of Nepal (Budget Speech of Fiscal Year 2009-2010). Thus, the level of real money balances $\ln(M^d/P)^1$ with a 7.5 percent inflation rate is obtained by setting $\pi_t = 7.5\%$ in equation (4). This yields:

$$\ln(M^d/P)^1 = 3.3035 \text{ or } (M^d/P)^1 = 27.2076 \tag{6}$$

In order to compute the welfare loss $(L)$ resulting from this fall in real money balances because of inflation, let it be rewritten equation (4) in terms of the inflation rate, i.e.

$$\pi = 1156.4344 - 344.8275\ln(M^d/P)_t \tag{7}$$

and then evaluate its definite integral between the limits defined in equation (5) and (6), i.e. $(M^d/P)^0 = 28.6112$ and $(M^d/P)^1 = 27.2076$:

$$L = \int_{27.2076}^{28.6112}[1156.4344 - 344.8275\ln(M^d/P)\ ]d(M^d/P) \tag{8}$$

The computation yields:

$$L = 1156.4344\int_{27.2076}^{28.6112} d(M^d/P) - 344.8275\int_{27.2076}^{28.6112}\ln(M^d/P)d(M^d/P) \tag{9}$$

$L = 1623.2869 - 1611.2825$, $L = 11.9457$ billion.

Thus the social cost at 7.5 rate of inflation and Rs. 615.55 billion real income projected for the Nepalese economy in 2010 is about Rs.12 billion.. The calculated cost yields to be 1.94 percent of real income, which accounts to be a significant fraction. The welfare losses corresponding to different ranges of inflation are presented in Table 1.

**Table 1: Welfare Loss at Different Rates of Inflation**
(1973-2009)

| Inflation Rate | Antilog $(M^d/P)^0$ | Antilog $(M^d/P)^1$ | Welfare Loss (Rs in billion) | Projected real income for 2010 | Percentage of loss to real income |
|---|---|---|---|---|---|
| 0%-5.0% | 28.6113 | 27.2131 | 11.8038 | 615.55 | 1.92 |
| 0%-7.5% | 28.6113 | 27.2076 | 11.9457 | 615.55 | 1.94 |
| 0%-10% | 28.6113 | 27.2023 | 12.0866 | 615.55 | 1.96 |
| 0%-13% | 28.6113 | 27.1941 | 12.1826 | 615.55 | 1.98 |
| 0%-15% | 28.6113 | 27.1887 | 12.3213 | 615.55 | 2.00 |

Source: Author's Calculation

Though an inverse relationship is found between inflation and real balance and positive relationship between inflation and welfare loss, the increases in welfare loss as a result of different ranges of inflation are less significant. As the result presented in Column 4 of Table 1, the welfare cost increased only from Rs.11.80 billion to Rs. 12.32 billion as a result of a significant rise in inflation from the range 0%-5% to 0%-15%. However, the extent of welfare cost of inflation as depicted in the analysis depends critically on the elasticity of real balance curve and use of newly created money by the government. The welfare cost of inflation is subject to change under the explicitly introduction of the government's fiscal policy shocks and investment decisions of the economic agents into the behavior of money holders.

## VI. CONCLUSION

This paper carries out an econometric exercise to obtain welfare cost of inflation in the context of Nepalese economy utilizing annual time series data ranging from 1973 to 2009. Consumer surplus approach used here for the analysis supports the view that a rise in inflation leads to decrease in real balance and hence increase in welfare loss. A sluggish rate of increase in welfare cost as a result of a significant rise in inflation lead one to conclude that welfare loss is less responsive to anticipated inflation. A significant fraction of real income as welfare cost, as the cost accounts to be Rs. 11.95 billion out of projected real income of Rs. 615.55 billion (i.e., 1.95 percent of real income) in the year 2010, corresponds to other factors affecting real balance rather than anticipated inflation. In view of the calculated welfare cost of inflation utilizing relatively inelastic real balance curve as found in this paper, the aspire of mobilizing the amount of inflation tax revenue received by the government may not be a good policy options provided that such tax is determined by the product of inflation rate and real money base. However, the magnitude of welfare loss examined here depends critically on the degree of welfare loss owing to inflation-induced investment risk and motivation of the government to raise inflation tax revenue by printing new money independent of central bank's policy objectives, which are not dealt in this paper. Thus, the extent of welfare cost of inflation corresponding to an optimal rate of inflation has opened an avenue for the further research in this area.

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