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Price and Wage Rigidity in Nepal

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ABSTRACT

This paper estimates price and wage rigidity by using 5.5 million micro datasets compiled by Nepal Rastra Bank for producing Consumer Price Index, Wholesale Price Index and Salary and Wage Rate Index. The study is first of its kind in Nepal. This paper uses un-weighted arithmetic mean for estimation of aggregates at elementary level and weighted arithmetic mean for aggregates at subgroup, overall and analytical group level. Average duration of price spell, average duration of increasing price spell, average duration of decreasing price spell, share of direction of price spell and size of price adjustment in increasing and decreasing direction are estimated for analyzing the price and wage rigidity in Nepal. The study estimates degree of price rigidity as 68.73% for overall retail prices and degree of wage rigidity as 79.82% for overall salary and wage rates. High degree of heterogeneity in period of price and wage adjustment is observed among sub-group of retail prices and salary and wage rates. The study also finds that prices and wages are downward rigid. The estimated rigidities can be used as an unbiased benchmark for price and wage rigidity in DSGE model with time path of price following Calvo staggered price model.

JEL Classification: E31, E52, E58

Key Words: Price rigidity, wage rigidity, consumer price rigidity, wholesale price rigidity, salary and wage rigidity, average duration of price spell, direction of price change, size of price change

I.   BACKGROUND

 In this paper, I investigate the pattern of price and wage adjustment in Nepal by using micro datasets compiled by Nepal Rastra Bank (NRB) for producing Consumer Price Index (CPI), Wholesale Price Index (WPI) and Salary and Wage Rate Index (SWRI). The sample is quite extensive. Analysis of retail price is based on 496 varieties of goods and services collected from retail outlets across 60 different market places for 5 year period. Wholesale price analysis is based on 262 goods prices collected from major markets and producers for 2 years. Salary and wage rate analysis is based on 170 different types of jobs and profession from different industry for 15 years.

A large number of theoretical models along with empirical evidence in macroeconomics supporting monetary non-neutrality are based on the assumptions that prices and wages adjust sluggishly to changes in aggregate conditions. When prices are very flexible, demand as well as supply shock translates to change in prices immediately and proportionately without altering real quantities. Thus as found in classical economic models, real interest rates and real output are completely divorced from movements in the money supply and nominal interest rates. However, if price adjustment is sluggish, reductions of nominal interest rates by the central bank translates into a reduction in real interest rates. As a result, negative output gap closes to zero and growth in output is realized. Degrees of price and wage rigidity are considered as two important parameter of the economy that influence the length of time required for output gap to close. This study attempts to measure the degree of price and wage rigidity in Nepal.

I have organized this paper in six sections. Section 1 presents background for measuring price rigidity. Section 2 reviews the theories supporting price rigidity along with empirical findings in different countries and region. Section 3 presents the data and methodology used in this paper. Section 4 presents results of analysis. Section 5 presents the implication for monetary policy and section 6 concludes.

II.   LITERATURE REVIEW

Large numbers of literatures have proposed various reasons for price rigidity. Some studies are based on fact that the price does not change frequently for the reason that costs of price adjustment are large while other studies are based on the fact that price does not change for the reason that that economic environment is stable and hence no need for change is felt. Literatures supporting rigidities in price are discussed in this section.

Blinder (1991) used interview questionnaires survey to study the relevance of 12 theories explaining price rigidities in real world. Blinder, from the survey results estimates mean score for each theory and rank 12 theories in descending order of mean score. The order for 12 theories are delivery lags/services, coordination failure, cost based pricing, implicit contracts, explicit nominal contracts, cost of price adjustment, pro cyclical behaviour of elasticity, pricing points, inventories, constant marginal cost, hierarchies and judging quality by price.

The next paragraph briefly explains theories that Blinder have surveyed for relevance in real world.

Deliveries lags/services explain that price do not change for the reason that price is only one element among large varieties of features that matters to customer. Firms might like to raise or lower price but hesitate to do so unless and until other firms moves first, hence making price change more rigid due c*oordination failure*. *The cost based pricing* states that the firms do not change price until the cost of labour, energy and raw materials do not change. Firms have *implicit understanding* with customers that firms charge a fair price and prescribe price changes only when markets are tight to avoid anger by consumers. The written *explicit price contracts* may disable firms to change price until the expiry of contract period. *Cost of price adjustment*, also known as menu cost, explains that firms do not change price for the reason that cost associated with price changes are higher compared to not changing price. *Pro cyclical behaviour of elasticity* explains that when demand curve shift inward; price becomes less elastic and do not change. A *pricing point* also known as *attractive prices* explanation of nominal rigidities is based on the observation that firms prefer to charge prices ending in a nine or round prices. For this reason firms wait for conditions sufficient to set next attractive prices. *Inventories* are building up when demand decreases and inventories are depleted when demand increase instead of price being changed. *Constant marginal* cost argues that cost of production does not change significantly with business cycles and hence price stays constant. When pricing decisions have to flow through long chain of *hierarchies*, price usually does not change. Such behaviour can be seen in regime with price regulation, where changes of price have to be sanctioned by relevant authorities and hence leading to less frequent and larger price changes. *Judging quality by price* explains that most of customer interpret price cut as reduction of quality and hence firm are reluctant to reduce price.

Álvarez et al (2008) uses micro data from Spain to explain the *seasonal behaviour of price changes* that can be attributed to exogenous, calendar related causes. The example of such behaviour can be seen in price of clothes changing at the beginning of the festival, summer or winter seasons, price of various commodities changing at beginning of fiscal year after budget, school and college's admission and fees changing at the beginning of session etc. This is evidenced by the observed unconditional hazard functions that are, in general, decreasing but show large peaks at 12, 24 and 36 months.

Apart from theoretical explanations, mathematical models that are used in micro founded Dynamic Stochastic General Equilibrium (DSGE) model are grouped into two broader categories of time dependent and state dependent model. In time dependent models, timing of price changes by an individual firm is exogenous. In a Time dependent set up, a firm can adjust price at a fixed interval of time (Taylor, 1980) or randomly (Calvo, 1983). In both cases, it is assumed that the fraction of firms adjusting their prices each period is constant. Most of the empirical analysis of price behaviour suggests Calvo price model as more descriptive of real economy. In Calvo staggered price model, natural index of price stickiness is measured by using formula, $\theta = 1 - \frac{1}{AD}$ where θ the natural index of price stickiness and

AD is average duration of price spell i.e. period for which firms do not change price.

Blanchard, Gali (2007) by extending the baseline new Keynesian model to allow for real wage rigidities, explains that the divine coincidence (no trade-off between stabilizing output gap and stabilizing inflation) disappears, and central banks indeed face a trade-off between stabilizing inflation and stabilizing the welfare-relevant output gap. Gali (2008) in his book develops a DSGE model for closed economy with sticky wages and prices using Calvo model of price and wage adjustment that is is log linearized around the steady state. The model explains the price inflation as function of optimal price setting decisions made by firms resetting their price in current period. The optimal price setting by profit optimizing firms is expressed as function of current price mark-up and present value of desired future price mark-up weighted by price rigidity index and consumer preference parameter. Price mark-up for firm is expressed as excess of price over marginal cost for firms resetting price in a given period. Inflation and optimal price set by firms resetting price is expressed in equation as

$$\pi_t^p = (1 - \theta_p)(p_t^* - p_{t-1})$$

$$p_t^* = \mu^p + (1 - \beta\theta_p)\sum_{k=0}^{\infty}(\beta\theta_p)^k E_t\{mc_{t+k|t} + p_{t+k|t}\}$$

where π_t^p stands for price inflation, θ_p stands for degree of price rigidity, p_{t-1} stands for log of previous price level, p_t^* stands for newly reset price, μ^p stands for current price mark-up, β stands for consumer preference parameter, k stands for time period, $mc_{t+k|t}$ stands for expected marginal cost at period t+k for firms resetting price at period t, and $p_{t+k|t}$ stands for price at period t+k for firms resetting price at period t.

The model also explains the wage inflation as function of optimal wage setting decisions made by group of households resetting their wages in current period. The optimal wage setting by utility optimizing households is expressed as function current wage mark-up and present value of desired future wage mark-up weighted by wage rigidity index and consumer preference parameter. Wage mark-up for household is expressed as sum of marginal rate of substitution of labour for consumption and price level during given period. Wage inflation and optimal price set by firms resetting price is expressed in equation as

$$\pi_t^w = (1 - \theta_w)(w_t^* - w_{t-1})$$

$$w_t^* = \mu^w + (1 - \beta\theta_w)\sum_{k=0}^{\infty}(\beta\theta_w)^k E_t\{mrs_{t+k|t} + p_{t+k|t}\}$$

where π_t^w stands for wage inflation, θ_w stands for degree of wage rigidity, w_{t-1} stands for log of previous wage level, w_t^* stands for newly reset wage, μ^w stands for current wage mark-up, β stands for consumer preference parameter, k stands for time period, $mrs_{t+k|t}$ stands for

marginal rate of substitution of labour for consumption at period t+k for households resetting wage at period t, and price, $p_{t+k|t}$ stands for price at period t+k.

In other type of state-dependent price adjustment model, a small deviation from the optimal price is found to be less costly than the cost of not changing price, and hence price change occurs only at a point when the cost of not changing the price is higher. Fixed menu costs (Mankiw, 1985), Stochastic Menu cost (Dotsey, King, and Wolman, 1999), Generalized (S, s) model (Caballero and Engel 1999), Information processing (Woodford 2008) and Quadratic adjustment costs (Rotemberg 1982) are mostly used state contingent models in DSGE framework. State-dependent price adjustment models are more realistic for economy, but with increasing heterogeneity in price adjustment among various commodities in real world, exact mathematical formulation become challenging. For this reason, time dependent price adjustment model are mostly advised as approximation of state-dependent model comprising heterogeneous set of price adjustment for different commodities within nation.

Empirical studies for price rigidities are found for various countries and regions. In south Asia, such study is found for India alone. The study will add Nepal in the directory of countries doing such kind of studies. Banerjee, and Bhattacharya (2017), estimates price spells for India across the industries is 5.4 months which can be expressed other way as 18.3 % (1/5.4x100) of prices change every month. If quarter is taken as period the degree of price rigidity in India is 45.1 %. Dhyne, Konieczny, Rumler and Sevestre (2009) estimates the average frequency of price change for all goods in Euro Area varies between 15% per month in Italy to 25% in France. Solange Gouvea, (2007) estimates for Brazil is around 26.3% of price changes every month.

III.   DATA AND METHODOLOGY

The price rigidity in Nepal is estimated by using 5.4 million high frequency micro data sets collected during the 5 year period starting from July, 2014 to July 2019 by Price Division, NRB for producing CPI. However, due to inclusion of abnormal period, when Nepal was hit by earthquake and faced long lasting obstruction in Terai, aggregates are calculated on truncated data constituting 3 years starting from 2016 July to 2019 July. The data covers prices for 496 varieties of goods and services from 60 different market places. Three outlets are assigned to each market. Data are collected on weekly, monthly and quarterly frequency. Prices for all commodities from each market and each outlet are arranged in ascending order of date of price collection to form a time series with interval of related frequency.

Since the aim of study is to estimate the duration for price adjustment, all collected prices along price time series for which price in immediate previous collection is same are deleted. Therefore the final price time series will consist of price and date of price collection starting from first collection and sets of prices that are different from remaining immediate previous collection. The notations used in study are described as,

i = commodity, i=1,2....496,

w_i*=weight of the i*$_{th}$ *commodity*

j = market centre, j=1,2 ... 60

k = outlet, k=1,2,3

t =order rank of price in price time series which take the value as s= starting collection i.e (t=0), 1= price observation with different price from that of starting collection, t= price observation such that price observation is different from that of price of t-1 period, and T=period from which price observation are not different till the period being analyzed and e=last collected price in study period.

$P_{ijk,t}$ *= Price of the i*$_{th}$ *commodity collected from j*$_{th}$ *market and from k*$_{th}$ *outlet of th oder,*

$cd(P_{ijk,t}$ *)=calendar date of price observed.*

The set of price along with calendar date of price observation in price time series starting from first prices that is different from starting collection and all other prices such that $P_{ijk,t=t} \neq P_{ijk,t=t-1}$ is defined as *price trajectory*. The duration of price adjustment, *called as duration of price spell,* along price trajectory is calculated as difference of calendar date between two different prices along the price trajectory, which is expressed as,

$$D_{ijk,t,t-1} = cd(P_{ijk,t=t}) - cd(P_{ijk,t=t-1}).$$

Price trajectory will consist T-1 number observation for durations of price adjustment. There should be at least three different prices for each combination of commodity, market and outlet to form a price trajectory. Price time series without three different price observations are not usable to estimate duration of price adjustment and hence omitted in this study. Due to such omission the total weight in the analysis for overall commodities may not total to 100.00. In addition, such omission will exclude the commodity with larger duration for price adjustment and hence likely to underestimate average duration of price adjustment. However, price of commodity such as vegetable and fruits are recorded only once in a week despite chances of price change before week, is likely to overestimate average duration of price adjustment. I assume underestimations caused by the missing commodities are compensated with overestimation of average duration of vegetable and fruit prices and hence producing unbiased estimate of duration of price adjustment. Graphical representation of above mentioned process is shown in Figure 1.
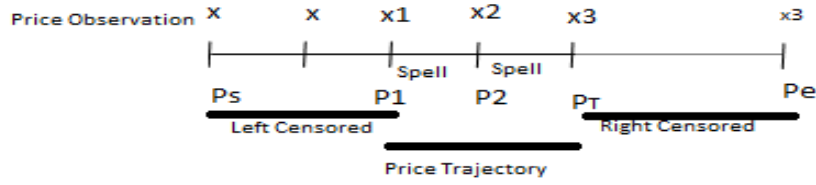
Figure 1

The data points from starting price collection date to next price change ($P_{ijk,t=s}$ to $P_{ijk,t=1}$) are *left censored* and the price from which date no changes in price are observed till last observation *($P_{ijk,t=T}$ to $P_{ijk,t=e}$)* are *right censored.* The analysis is based on data censored on both sides.

Un-weighted arithmetic mean is used to derive aggregates at elementary level i.e. commodities level and weighted by its respective commodity weights to derive mean at group, overall and analytical level. The study uses common methodology of aggregation used in all study of this kind.

Average duration of price spell is derived using direct approach i.e. from average of price spell. The indirect approach also known as frequency approach uses harmonic mean of duration to estimate aggregate. Harmonic mean results in underestimation of average duration which is more likely to lower for overall commodity with high degree of heterogeneity. The study is based on direct method for estimation of aggregates. Aggregate statistics estimated in this study includes

i) average duration of price spell along with average duration while increasing and decreasing

ii) share of price adjustment along increasing and decreasing direction

iii) average size of price changes along increasing and decreasing direction

The observations in the price trajectory will consist of set of prices that are either increasing or decreasing from that of previous price observation. The study will use subset of observations in price trajectory for estimation of aggregates in increasing and decreasing direction as described by;

Price spell is increasing if $\dfrac{P_{ijk,t=t}}{P_{ijk,t=t-1}} > 1$,

Price spell is decreasing if $\dfrac{P_{ijk,t=t}}{P_{ijk,t=t-1}} < 1$ and

Size of price change (Price ratio) $= \dfrac{P_{ijk,t=t}}{P_{ijk,t=t-1}}$

All durations calculated as $D_{ijk,t,t-1} = cd(P_{ijk,t=t})$ - cd$(P_{ijk,t=t-1})$ are averaged using arithmetic mean for individual commodity *i* to derive average duration of price adjustment *(average duration of price spell)* for individual commodity *(elementary level)*. Average duration of price spell for individual commodity is weighted by respective weight (derived from Household survey and used in current Consumer Price Index for weighing price index) to derive the overall duration of price spell. In notational form, average duration of price change for individual commodity across whole nation AD_i, average duration for commodity subgroup AD_s and overall commodity AD are calculated as,

$$AD_i = \frac{\sum_{j=1}^{60}\sum_{k=1}^{3}\sum_{1}^{T} D_{ijk,t,t-1}}{\sum_{j=1}^{60}\sum_{k=1}^{3}\sum_{1}^{T} 1}, AD_s = \sum_{i \in s} AD_i x w_i, \; AD = \sum_{i=1}^{496} AD_i x w_i,$$

where, w_i represents the weight of respective individual commodity.

The degree of price rigidity is calculated as defined as $\theta = \frac{1}{1-AD}$, where AD in day is expressed in total days within period. For example, for quarter as period, AD is found by dividing AD in days by 90, for monthly AD in days by 30 and for annual AD in days by 365.

Average duration for increasing price spell is calculated with same formula on subset of data with increasing price spell. Average duration for decreasing price spell is calculated with same formula on subset of data with decreasing price spell. Direction of price change is calculated for increasing spell as well as decreasing as a fraction of total price change for individual commodity, subgroup and overall as,

$$DINC_i = \frac{\sum_{j=1}^{60}\sum_{k=1}^{3}\sum_{1}^{T} N_{ijk,t,t-1}^{+}/N_{ijk,t,t-1}^{c} x100}{\sum_{j=1}^{60}\sum_{k=1}^{3}\sum_{1}^{T} 1}, DINC_s = \sum_{i \in s} DINC_i x \; w_i, \; DINC = \sum_{i=1}^{496} DINC_i x \; w_i, \text{ and}$$

$$DDEC_i = \frac{\sum_{j=1}^{60}\sum_{k=1}^{3}\sum_{1}^{T} N_{ijk,t,t-1}^{-}/N_{ijk,t,t-1}^{c} x100}{\sum_{j=1}^{60}\sum_{k=1}^{3}\sum_{1}^{T} 1}, DDEC_s = \sum_{i \in s} DDEC_i x \; w_i, \; DDEC = \sum_{i=1}^{496} DDEC_i x \; w_i,$$

Where $N_{ijk,t,t-1}^{+}$ represents the number of increasing price spells, $N_{ijk,t,t-1}^{-}$ represent number of decreasing price spells and $N_{ijk,t,t-1}^{c}$ total number of price spells in the trajectory.

Size of price change is calculated as average of price ratio for increasing and decreasing price spells for individual commodity, subgroup and overall as,

$$PINC_i = \frac{\sum_{j=1}^{60}\sum_{k=1}^{3} \frac{P_{ijk,t=t}}{P_{ijk,t=t-1}}}{\sum_{j=1}^{60}\sum_{k=1}^{3}\sum_{1}^{T} 1}, for \; all \; \frac{P_{ijk,t=t}}{P_{ijk,t=t-1}} > 1, \; PINC_s = \sum_{i \in s} PINC_i x w_i, \; PINC = \sum_{i=1}^{496} PINC_i x w_i, \text{ and}$$

$$PDEC_i = \frac{\sum_{j=1}^{60}\sum_{k=1}^{3} \frac{P_{ijk,t=t}}{P_{ijk,t=t-1}}}{\sum_{j=1}^{60}\sum_{k=1}^{3}\sum_{1}^{T} 1}, for \; all \; \frac{P_{ijk,t=t}}{P_{ijk,t=t-1}} < 1, PDEC_s = \sum_{i \in s} PDEC_i x w_i, \; INC = \sum_{i=1}^{496} PDEC_i x w_i,$$

The size of decrease in percent is calculated as 100- Average ratio of price increase*100 and the size of decrease is percentage is calculated as Average ratio of price increase*100 -100.

Wholesale price Index (WPI) are calculated on the basis of data collected by NRB on fortnightly, monthly and quarterly basis from outlets across the nation chosen on the basis of probability proportional to size. Wholesale price rigidity is estimated using 70,000 micro datasets starting from period 2017 August to 2019 September. The same aggregation procedure used for retail price aggregates is applied in the derivation of aggregates for wholesale price.

Salary and Wage Rate Index are calculated on the basis of data collected by NRB on monthly basis from 11 different major markets and different organization for different type of jobs. Salary and wage rates rigidity are calculated by using 30,600 micro data sets starting from 2004 August to 2019 August. Weights are available for 170 different types of jobs from different market place and organization. The 170 groups are defined as similar to product level data as used in retail and wholesale price data. The same aggregation procedure used for retail price and wholesale price aggregates are applied in the derivation of aggregates for salary and wage rates.

IV. DISCUSSION OF THE RESULTS

Results from CPI Data

The Figure 2 shows that the total number of increases exceeds the total number of decreases for all year and month during the study period. Highest number of price increases is recorded in month of August (Shrawan i.e. the start of fiscal year). The changes can be attributed to revision in tax rates and rise in salary of government officials. Although the numbers of price changes are highest during August, comparatively similar numbers of prices changes are observed during other months. Price changes in Nepal can be considered as randomly distributed over different period.
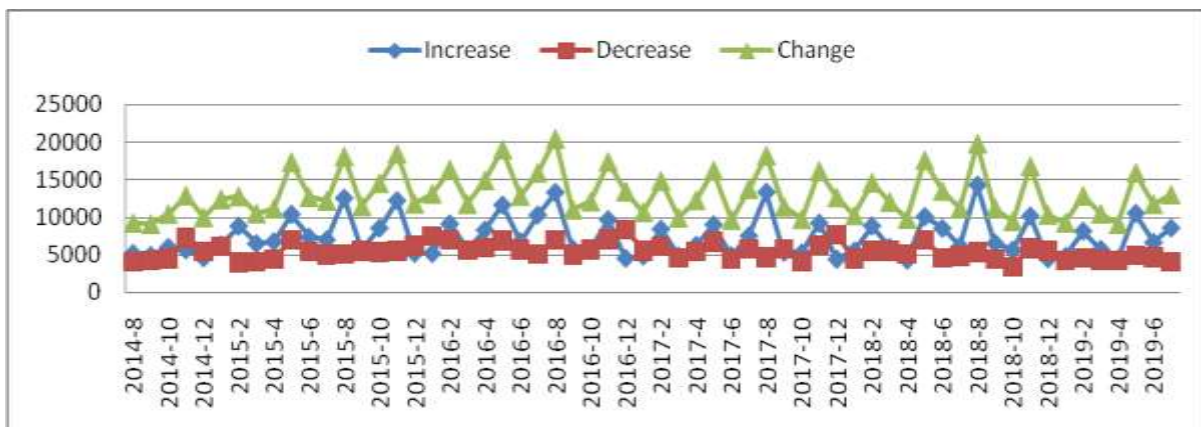

Figure 2

The Figure 2 along the time dimension shows that the highest numbers of price increases were recorded in period starting from November 2015 to August 2016, during the period

when disturbance in Terai led to severe crisis of fuel, leading to higher cost of transportation and shortage of goods. During the period of June 2014, when the high magnitude earthquake strike Nepal, the total numbers of price increases were normal compared to other period of the study period. However, it later increased demand for construction materials and pushed up construction material price for four years. The effect of supply shocks emanating from import disturbances are higher compared to domestic disturbances. The trade openness has increased inflation resistance to internal shocks.

The Figure 3 for vegetable and fruits subgroup, whose price are highly influenced by seasonality, shows that the number of price increases and decreases intersect each other in many periods. This suggests that price in this subgroup are flexible in both direction. The Figure 4 excluding fruits and vegetable subgroup shows that the majority number of price change consists of price increases compared to price decreases, revealing the upward trending and downward rigid price behaviour in Nepal.
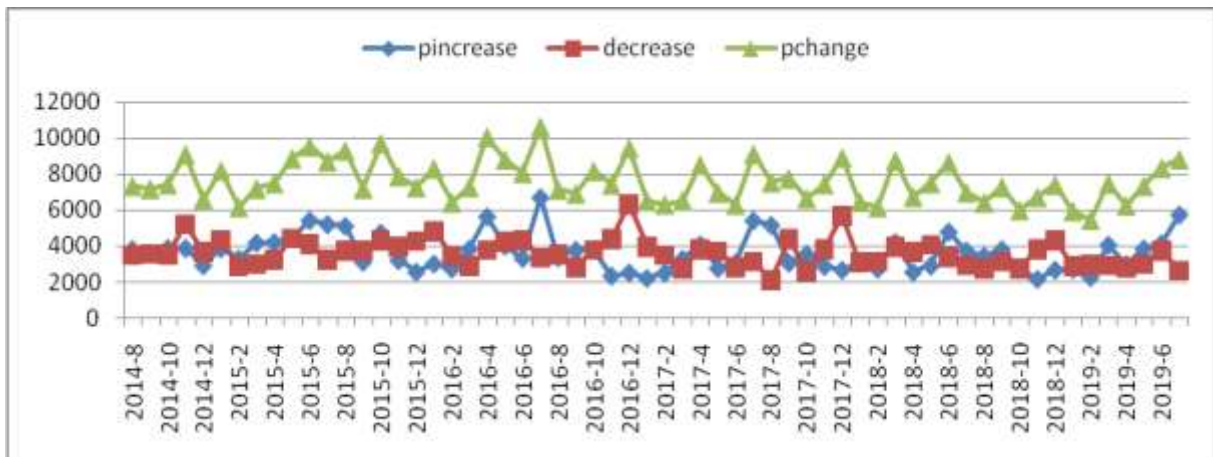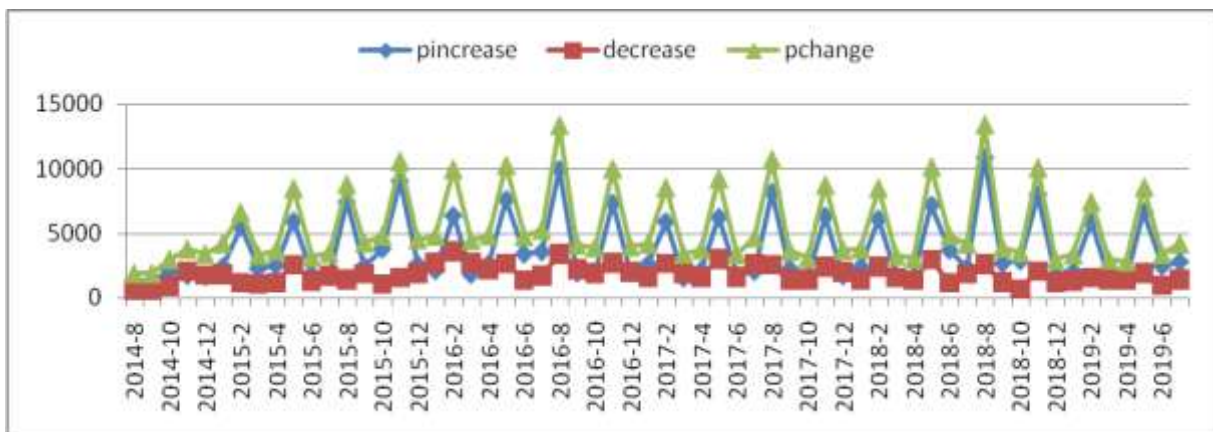

Figure 3

Figure 4
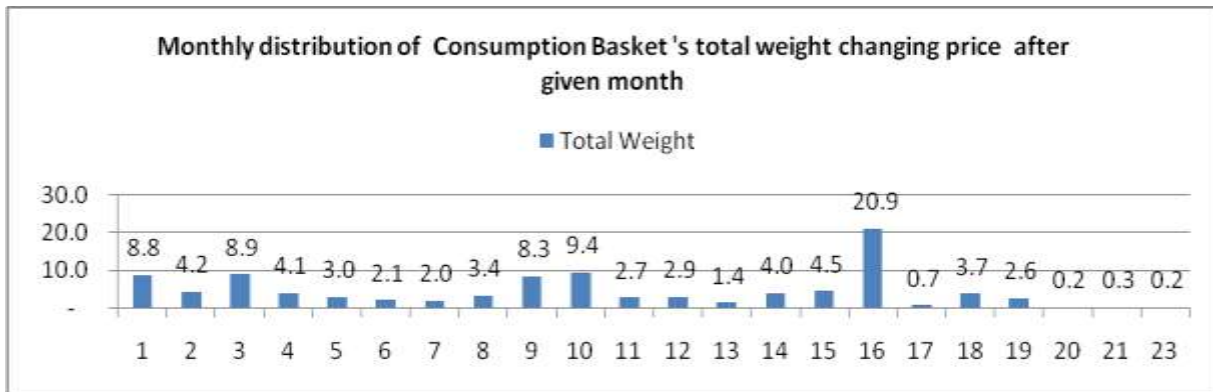
Figure 5

Average duration of price spell for all commodities is grouped by duration (in months) of price adjustment along weights used in CPI. The figure 5 shows varying degree of price rigidity among commodities. Time required for price adjustment ranges from one month to twenty three month. Higher variation in period makes the price adjustment as more random process.

The summary Table 1 presents the average duration of price spell, average duration of price spell in increasing and decreasing direction, distribution of total changes in increasing and decreasing direction, and average size of change per each spell in increasing and decreasing direction.

Table 1

Heading	Weight	Average Duration (Day)	Average Duration		Direction of Change (%)		Size of Change (%)	
			Increase	Decrease	Increase	Decrease	Increase	Decrease
Cereal grains and their products	11.33	141	174	89	61.4	38.6	8.2	6.9
Pulses and Legumes	1.84	60	62	58	45.3	54.7	8.8	8.7
Vegetable	5.52	28	32	24	49.4	50.6	23.9	17.6
Meat and Fish	6.75	164	215	59	67.1	32.9	7.2	5.8
Milk products and Eggs	5.24	455	505	199	83.6	16.4	11.5	9.3
Ghee and Oil	2.95	155	179	116	61.8	38.2	7.1	6.0
Fruit	2.08	32	37	26	53.4	46.6	13.7	11.5
Sugar and Sugar products	1.74	165	186	134	60.0	40.0	8.9	7.0
Spices	1.21	159	188	114	60.7	39.3	15.7	14.3
Non-alcoholic drinks	1.24	343	388	210	74.6	25.4	11.3	9.5
Alcoholic drinks	0.68	302	304	282	90.0	10.0	14.8	14.0
Tobacco products	0.41	355	370	208	90.5	9.5	17.3	23.1
Restaurant and Hotel	2.92	432	460	313	80.8	19.2	17.9	15.6
Clothes and Footwear	7.19	268	275	213	88.1	11.9	9.9	8.7
Housing and Utilities	20.30	413	432	265	88.5	11.5	16.6	8.2
Furnishing and Household equipment	4.30	296	306	244	84.5	15.5	11.3	8.7
Health	3.47	379	395	344	69.0	31.0	23.4	20.9
Transportation	5.34	311	348	202	74.2	25.8	7.7	6.9
Communication	2.66	260	211	351	65.2	34.8	65.7	22.7
Recreation and Culture	2.46	381	407	294	77.0	23.0	16.8	9.1
Education	7.41	523	524	515	91.4	8.6	20.7	13.3
Miscellaneous goods and services	2.81	230	264	132	74.3	25.7	11.3	5.2
Overall	99.84	291	335	159	75.3	24.7	15.0	10.3
Analytical Groups								
Food and Beverage	43.91	191	246	90	64.69	35.3	11.6	9.8
Non-food and Services	55.93	370	388	276	83.63	16.4	17.1	11.2
Non Durable	49.93	185	233	100	64.2	35.8	11.4	9.7
Semi Durable	9.51	272	277	241	85.8	14.2	10.2	8.8
Durable	5.38	237	256	189	71.8	28.2	6.4	5.5
Service	35.02	456	465	389	88.9	11.1	21.1	15.7
Goods	64.82	202	243	115	68.0	32.0	10.7	9.3
Fruit and Vegetable	7.60	29	33	25	50.5	49.5	20.9	16.0
Overall excluding Fruit and Vegetable	92.24	311	349	182	77.4	22.6	14.7	9.3
Food and Beverage excluding fruit and vegeta	36.31	222	276	109	67.7	32.3	10.2	7.8

Average duration of price spell is found to be 291 days. Compared with other economy like India, Brazil and Euro Area price rigidity in Nepal is found to be relatively very high. The degree of price rigidity is calculated as,

i) if duration of time period (t) is quarter, degree of price rigidity equals 68.73%, and

ii) if duration of time period (t) is taken as annual, all price can be considered as flexible.

Prices being fully flexible, fluctuations in real output due to various shocks are less likely to be visible in annual data of Nepal. Without persistent shocks, the effects of shocks are fully translated into price. This fact is also evident from the fact that despite higher rate of monetary growth, real GDP growth has remained low in Nepal.

Fruit and vegetable prices change at average duration of 26 days. Goods record short price spells compared to service. Service prices changes infrequently compared to nondurable, semi durable and durable goods. Food and beverage records relatively short price spells compared to non food and services group. The average duration of price spells are found to be varying across different sub groups. Hence it can be inferred that price change behaviour of different goods and services are heterogeneous. The Figure 6 shows that the price spells of subgroups from highest average duration of price change to lowest duration. This figure also suggests that the price changes are randomly distributed in different time.
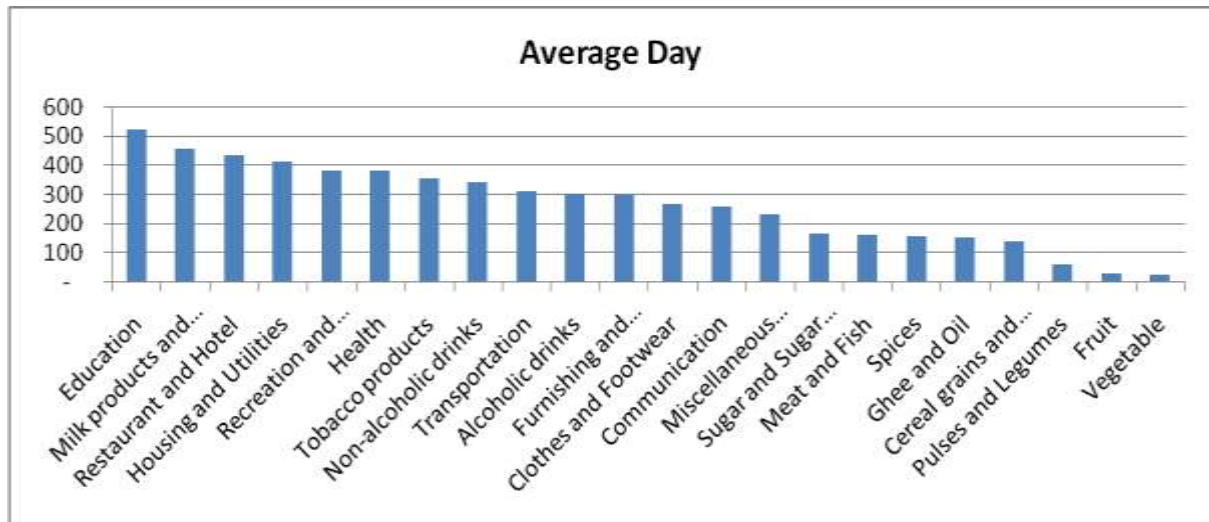

Figure 6

The average duration of price decrease is found to be 159 days and the average duration of price increase in found to be 335 days. The total changes consist of 24.7 percent of price decrease and 75.3 percent of price increases. On an average, size of price decrease is 10.3 percent and the size of price increase is 15.0 percent. The price decreases are quicker but size and frequency of price increase is higher and hence leading to consistent price increase in Nepal.

Percentage of price increases and decreases for fruit and vegetable group are found to be symmetric in both direction but size of increases is higher than decreases. Food and beverage prices are found to be flexible in both direction showing similar size of change but fraction of increases are relatively higher than the fraction of decreases. Service prices are highly skewed towards increases and also higher compared to size of decrease. Hence, it can be concluded that the goods prices are flexible but slowly increasing and services prices are downward rigid and always increasing.

State contingent model are explained as more realistic but heterogeneity observed in price adjustment makes the construction of lower and upper bound as more data intensive and unrealistic. Thus for DSGE modelling, *Calvo Pricing Model with 68.73% as degree of price rigidity* represents the price adjustment pattern in Nepal.

In Calvo model of price adjustment with high degree of price rigidity, few firms will adjust price and hence high level of inertia exists in current price level. However, if firms expect future cost to rise or expect high inflation, the firms resetting price will increase price at higher rate and hence higher will be the inflation in current period. Thus for country with high degree of price rigidity, such as estimated for Nepal, low inflation can be achieved by lowering inflation expectation. Nepal Rastra Bank should stick to low inflation target with strong commitment towards the stated target. Central banks committed towards inflation target have high degree of control in inflation expectations. Nepal Rastra Bank should conduct inflation expectation survey to determine inflation expectation and revise its policy rates accordingly.

In addition to this, there exists high degree of heterogeneity in the average duration for price adjustment among subgroup of commodities. Impacts of shocks are different among various commodity sub-groups. This creates difference in relative prices and hence distorts the quantities of different goods and services being produced and consumed. These types of distortion brought by change in relative price are one of the major sources of welfare loss for economy. Since policies and tools suggested for minimizing this type of distortion are harder and costlier to implement, the wisest solution referred by economist is sticking to low inflation. Nepal Rastra Bank thus should lower inflation target for minimizing welfare loss created from such distortion.

Food and beverage price are found to be stable compared to non-food and service prices. Variations in fruits and vegetable prices are found to be higher but symmetric in increases and decreases. In addition to this, service prices are found to be downward rigid and upward trending. This fact shows that core inflation will include baskets that are increasing, downward rigid and most of which belongs to imported basket. Core inflation will be higher than headline inflation. In addition to this headline inflation are easily understood and acceptable to all stakeholders. Therefore, targeting headline inflation has higher advantage compared to core inflation for Nepal.

Results from WPI Data

The wholesale price index in Nepal covers only good market. The price adjustment pattern in wholesale market can be compared with goods market in retail sector for assessment of degree of pass through. The figure 8 with number of price change during a given year and month shows that the total number of increases exceeds the total number of decreases. The figure 9 for vegetable and fruits subgroup shows that the numbers of price changes are found to be similar in both directions. Intersecting graph with lines above and below shows the symmetric nature of price adjustment in this sub-group. This fact is in line with price behaviour in retail sector for fruits and vegetables sub-group. The figure 10, for commodities except fruit and vegetable, shows that the number of increases is greater than the number of decreases. The number of price changes at quarter ends i.e. (month ending on 2, 5, 8, 11 of English date) are recorded as higher compared to other months. Therefore on each quarter equal proportion of price are likely to change. The fact also supports the assumption of Calvo

model of price rigidity, which requires the same fraction of commodity adjusting price each period, as unbiased benchmark for Nepal.
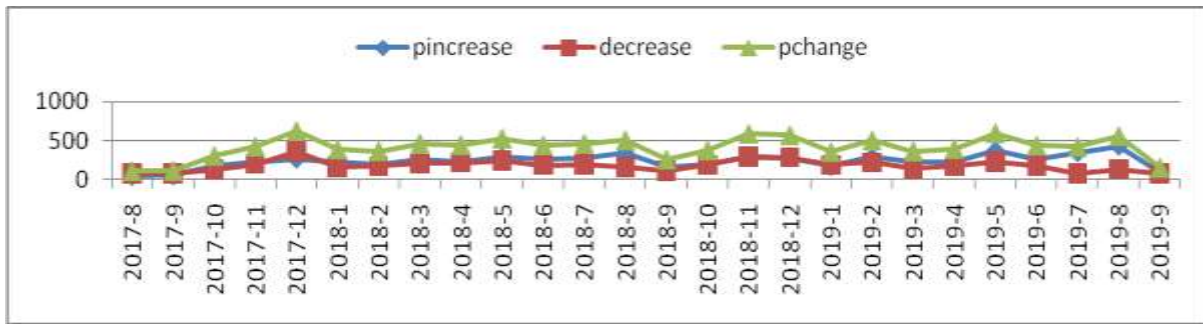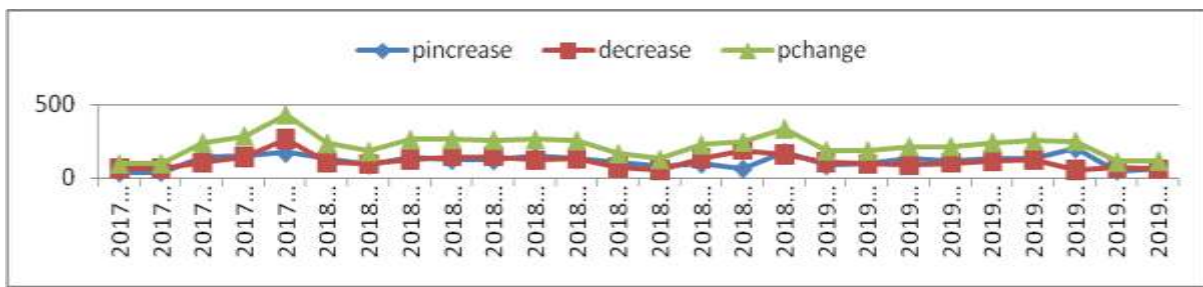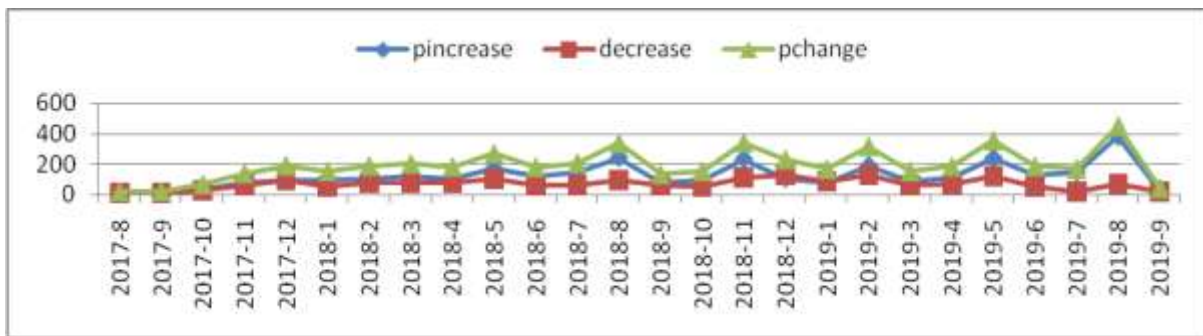

Figure 7

Figure 8

Figure 9

The summary table 2 presents the average duration of price spell, average duration of price spell while increasing or decreasing, direction of change as a percentage of total change and average size of change per each spell.

Table 2

Heading	Weight	Average Duration (Day)	Average Duration (Day)		Direction of Change (%)		Size of Change (%)	
			Increase	Decrease	Increase	Decrease	Increase	Decrease
Food	31.18	61	70	46	62.98	37.02	12.6	14.2
Nonfood	2.08	155	150	164	62.67	37.33	11.8	13.1
Fuel and Power	5.66	67	59	102	81.65	18.35	3.8	1.2
Manufacture Of Food, Beverage & Tobacco	14.53	119	132	84	72.06	27.94	5.9	6.9
Manufacture Of Textiles	0.98	189	187	216	93.79	6.21	12.5	9.9
Manufacture Of Leather And Leather Products	0.29	261	280	154	85.45	14.55	4.8	4.8
Manufacture Of Wood And Wood Products	2.07	204	231	148	67.87	32.13	11.3	16.1
Manufacture Of Paper And Paper Products	1.07	235	209	274	60.81	39.19	5.6	16.8
Manufacture Of Chemicals And Chemical Products	6.55	201	211	138	86.04	13.96	10.0	10.5
Manufacture Of Rubber And Plastics Products	1.92	228	228	227	83.07	16.93	6.1	2.3
Manufacture of non-metallic mineral products	3.44	148	162	130	55.17	44.83	10.4	14.0
Manufacture of basic metals	12.07	84	89	69	71.03	28.97	6.0	4.3
Manufacture Of Elctric And Electronic Products	3.10	166	206	151	27.08	72.92	6.2	4.9
Manufacture Of Machinery And Equipment	2.64	222	232	179	82.13	17.87	5.4	4.6
Manufacture Of Transport, Equipments And Parts	3.80	213	219	91	95.74	4.26	5.4	1.8
Other	0.95	324	324		100.00	-	13.0	
Overall	92.33	116	129	87	69.91	30.09	8.7	10.2
Intermediate Goods	50.96	107	113	91	72.35	27.65	7.6	8.7
Consumption Goods	31.63	115	137	67	68.10	31.90	11.5	14.0
Capital Goods	9.73	170	194	129	63.02	36.98	5.6	5.1
Overall except fruit and vegetable	85.19	124	135	97	71.53	28.47	7.1	8.4
Fruits and Vegetable	7.14	24	26	22	50.65	49.35	34.6	22.4

Average duration of price spell in wholesale market is found to be 116 days. The duration is relatively low compared to 202 days in retail market. Also, 7.67 % of commodities price such as electricity do not have at least three price changes to form a price trajectory and hence missing in the estimation. The exclusion of commodity with long price spell is likely to underestimate average duration. Also vegetable price are measured every fortnightly instead of daily, the average duration for vegetable and fruits are overestimated. This error compensates some part of missing commodities with larger price spell but the weight of missing commodity are higher and hence the average duration of price adjustment for wholesale market is more likely to be underestimated.

Compared to retail sector, average duration of price change in wholesale sector is less. Therefore, retail sector can be seen as absorbing pass through from producer to consumer. The absorption of such pass through is one of the sources of welfare loss for the economy. The share of price changes along increasing and decreasing direction is found similar compared to goods price movement in retail sector.

Results from Salary and Wage Rate Data

The figure 11 shows that all changes in salary are increment which occurs mostly in the month of August i.e. month of Shrawan or beginning of fiscal year. The increment can be attributed to salary increment for civil servant in Nepal's Central Budget. The data do not include annual grade in salary which I assume to be associated with increase in productivity due experience earned during the year and hence do not impact real wage. For this reason, the result obtained is considered to be unbiased estimate of salary and wage rigidity. The figure 12 shows that wage rates changes more frequently compared to salaries. In addition to this,

wage rate changes are found in all month as opposed to salary changes occurring at some specific month. Of the total employment in Nepal, wage earners comprise relatively large share in total employment and hence changes in wages are dominant factor in determination of overall salary and wage rate adjustments. Hence the salary and wage adjustment can be also generalized as randomly distributed over different period.
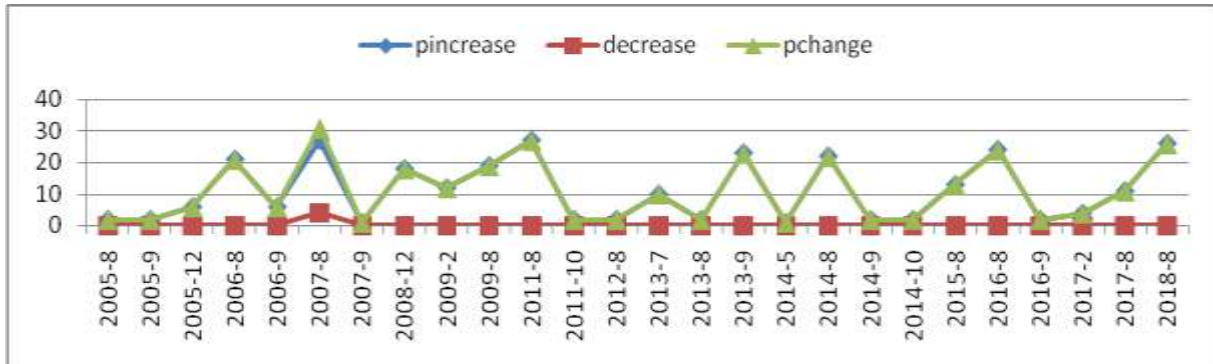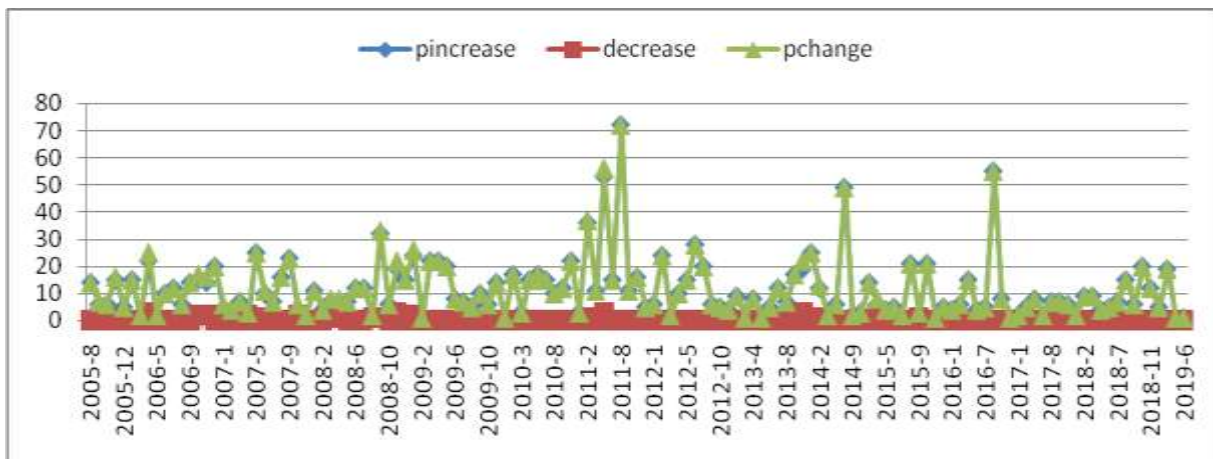

Figure 10

Figure 11

The summary of average duration, direction and magnitude of changes are presented in the table 3. The average duration of overall salary and wage rate are found to be 451 days. Salaries are more rigid compared to wage rates. Average duration among various sub-groups is found to be heterogeneous. The size of increase is found to be 16.3 percent and decreases are rare. The salary and wage rates changes are unidirectional and downward rigid.

Table 3

Payment Type	Profession	Weight	Average Duration(Day)	Size of Change	Direction of Change %	
					Decrease	Increase
Salary	Army & Police Forces	4.02	578	18.7	-	100.0
Salary	Bank & Financial Institutions	0.55	643	28.2	-	100.0
Salary	Civil service	2.82	517	16.8	-	100.0
Salary	Education	10.55	515	16.1	-	100.0
Salary	Public Corporations	1.13	624	18.3	2.4	97.6
Wage	Agricultural Labourer	39.49	391	16.0	4.2	95.8
Wage	Construction Labourer	8.29	458	16.1	4.8	95.2
Wage	Industrial Labourer	25.25	477	16.2	1.0	99.0
	Overall	92.10	451	16.3	2.5	97.5
	Monthly Salary	19.07	539	17.2	0.1	99.9
	Daily Wages	73.03	428	16.1	3.2	96.8

Larger share of wage rates accompanied by heterogeneity within sub-groups makes salary and wage rate adjustment process as more random as opposed to calendar specific changes occurring in salary. Hence, *Calvo model for wage determination with wage rigidity can be used as benchmark for DSGE model in Nepal*.

For Calvo model of wage rigidity,

    i)   degree of wage rigidity for quarter as period (t) is found to be 79.82%,

    ii)   degree of price rigidity for annual period (t) is found to be 19.07%.

Salary and wage rates are highly rigid and hence creating strong inertia for existing salary and wage rates. However, the remaining fraction of unions and workers interest group will revise their salaries and wages in a way that maintain their current and anticipated real wages mark-ups. This revision pushes wage inflation. Expected real wage mark-ups depend upon expected nominal wages and expected price inflation. Therefore when inflation expectations are low, lower will be the wage inflation.

Salary and wage rates are adjusted slowly compared to price. Therefore, positive demand shocks lead to negative real wage gap. Although negative real wage gaps provides incentive to producer, size of salary and wage rate increases are higher compared to size of price change, leading to shorter life of incentives. In addition to this, when negative demand shocks hit economy, positive real wage gap creates disincentive to producer. Negative as well as positive real wage gap are considered as one of the major source of welfare loss for economy. Therefore, sticking to lower price inflation accompanied by lower rate of increase in nominal salary and wages that compensates for constant real wage and increase in productivity will minimize welfare loss.

V. IMPLICATION FOR MONETARY POLICY

- Nepal Rastra Bank should be committed towards achievement of its inflation target to get high degree of control in inflation expectations. Inflation expectations are found to be crucial element in determination of current price and wage inflation.

- Low inflation target will minimize welfare loss related with heterogeneous impact of shocks among various commodity groups and salary and wage rate groups.

- Fluctuation in output due to onetime shocks is less likely to be visible in annual data and hence policy prescription for business cycles due to shocks should be based on quarterly output data.

- Targeting headline inflation has higher advantage to Nepal Rastra Bank compared to core inflation.

- Retail sector reforms can increase price pass through from producer to consumer and hence reduce welfare loss.

VI. CONCLUSION

The study provides the unbiased estimate of degree of price rigidity as 68.73% and degree of wage rigidity as 79.82%. The price and wage rate adjustments are found to be random and time dependent. Thus, Calvo model of price and wage adjustment is found to be best benchamark for price adjustment model in DSGE modelling for Nepal.

There is wider heterogeneity in average duration of price change among subgroup of commodities. Most of the price changes are increase. Size of increases are larger compared to decreases. Retail prices are found to be more rigid compared to wholesale price. Salary and wage rates are to found be downward rigid and less heterogeneous compared to heterogeneity in retail price.

The inflation in Nepal are found to be higher compared to targeted inflation in past periods which have led consumers, firms and wage setters to expect inflation on higher side. The higher inflation expectation have fed on own self leading to higher price and wage inflation in the current period. Strong commitment towards targeted inflation is required for achieving higher control in inflation expectation. Strong commitment are possible only if central bank is committed towards the benefit of low inflation, are politically independent and bad thing happens to chief central bankers when inflation target is not met.

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