



Asymmetries in Response to Shocks in Price Setting: Firm-Level Evidence from Survey based Data

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Abstract

The objective of the paper is to estimate the asymmetric response of firms for prices to supply and demand shocks. Firms give an asymmetric response to supply and demand shocks while setting at a price, and the prices are upward flexible and downward rigid to changes in the determinants. Asymmetric response to the cost of raw material is highest. Moreover, the seasonal factors have the lowest degree of asymmetric response. Firms give an asymmetric response to different shocks, with respect to a price increase and decrease, and across variables of demand-side and supply side. The central bank has to focus more on stabilization in response to supply shocks than to demand shocks because supply shocks are found more important than demand shocks to change the prices of firms. Measures should be taken to prevent the possible effects of adverse supply shocks.

Key Words: Supply and Demand Shocks, Asymmetric Response and Price Setting

JEL Classification: E24, E31, E32, E42, E50, E52, E58 and E61

Introduction

According to the previous literature, the price-setting exposes enormous volatility and time is not consistent across firms. Supply of raw materials, firm sector, economies of scale, price contracts (implicit and explicit), lack of coordination between companies, fear that competitors will not do the same, set of information can affect price adjustment, which is also known as pricing triggers. And sticky prices theories are also the most important source of rigidity (Pasten, Schoenle, & Weber, 2020; Vermeulen, Philip, et al. 2007; Blaudow and Burg, 2018; Peneva and Ekaterina, 2009; and Sohail & Fatima, 2018).

It's natural that an economy faces both favorable and adverse supply shocks, and all schools of thought agree that it's the part of every society that the economy will get respond to these shocks both at the individual and aggregate level, but the difference is that, according to the Classical and New-classical, this adjustment process will be quick, while Keynesian and New-Keynesian think that the adjustment process of the firm will be slow. The idea of nominal rigidities and flexibility is not new, and this concept started from the classical school of thought. According to the prices and wages are flexible, and all individuals have perfect information. It means that market forces are strong enough

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to bring the market to equilibrium, until the impact of external force becomes zero, in other words, because of flexibility and perfect information, the adjustment process is very quick due to which markets come to equilibrium ([Gorodnichenko et al., 2018a](#); [L'Huillier, 2020](#); [Nakamura & Steinsson, 2008](#); and [Malik et al., 2008](#)).

On the other hand, the Keynesian school of thought does not agree with the idea of the classical school of thought that prices and wages are flexible. According to Keynesians, prices and wages are rigid, and individuals have imperfect information, so the market forces are weak to bring the economy into equilibrium. It means the adjustment process is slow, because of which the economy will always be in the short run adjustment. According to Keynesians, various factors are responsible for nominal rigidities, e.g., because of market imperfection (i.e., monopolistic competition, monopoly and oligopoly), the producers have the market power to control prices. Now if the demand for the product decreases, which will lead to decrease in the price of the product, then to control the price at a given level, the producer controls the supply of the product, which leads to price rigidity because of this imperfect market ([Iqbal & Amin, 2019](#); Cavallo, 2017; [Nakamura and Steinsson, 2008](#); and [Wang & Werning, 2020](#)).

The 1950s is a golden time in the era of macroeconomics, because of the development of different theories related to saving, investment, consumption, money demand, unemployment and growth etc. but in 1960's a strong controversy began between Monetarists and Keynesians on the issues of policy effectiveness, price and wage rigidity, discretion vs rules, and policies coordination. Keynesian economics saw criticism in the early 1960s because of different empirical and theoretical reasons. The keynesian macroeconomic model was without micro foundation, e.g., micro foundation of prices and wages rigidity was missing. These reasons lead to inconsistency between the theories and empirical evidence, e.g., Philips curve and stagflation ([Calvo, 1983](#); [Taylor, 1980](#); and [Dhyne et al., 2009](#)). The era of new classical begins after the stagflation phenomenon and criticism of Milton Friedman on the role of money in the Keynesian model. New-classical economists incorporated rational expectations and micro-foundation with the assumption that prices and wages are not rigid ([Singh & Ru, 2019](#); and [Mavroedis et al. 2014](#)).

According to the real business cycle theories only supply shocks are responsible for business cycle fluctuations, and the demand shocks have no effects on business behaviour. Furthermore, according to the business cycle theories, the market operation is based on the market-clearing assumption, i.e., prices and wages, are flexible. However, on the other side, Keynesian economist thinks that demand shocks have a significant role in the business fluctuation, because of price and wage rigidity.

After the criticism of New-classical economists, in 1980s Keynesian economists include the rational expectation and micro foundation in their model with nominal rigidities and market imperfections (i.e., New-Keynesian models). They further explain that imperfections at the micro-level lead to the price and wage sickness because the monopoly power of price-setting behaviour leads to rigidities ([Borraz, Licandro, & Sola, 2020](#)).

The introduction of the macroeconomic model with rational expectation and micro foundation in 1972 changed the direction of the researchers that is they are now more focused to analyze the micro-foundation of macroeconomic theories. The new-Keynesian economists start working on the optimal behaviour of the individual firm by incorporating the assumption of price and wage rigidity in the macroeconomics models

with rational expectation and micro-foundation ([Barro, 1972](#); [Taylor, 1980](#); and [McCallum and Nelson, 1999](#)). In the past three decades, these Keynesian models of price stickiness gain popularity because of the analysis of price and wage-setting behaviour of firms, institutions and other organization at the micro-level ([Blinder, 1991](#)). These studies various elaborate reasons of price and wage stickiness, i.e. menu cost, implicit and explicit contracts, customer relations, and the real effect of monetary policy (Irregui et al. 2011 and [Da Silva Correa, Petrassi, & Santos, 2016](#)).

The objective of the study is to examine the asymmetric response of price to supply and demand shocks. The asymmetric response of price to shocks has a very important implication for monetary policy. Supply shocks are labour cost, the financial cost (e.g., interest rate), cost of raw materials, energy cost (e.g., oil and electricity), and change in the exchange rate; these factors lead to cost-push inflation. For example, in the case of high expected inflation, the labour demand for high wages, which increase the labour cost; as a result, the price of the product increases. Similarly, when the interest rate increases, the cost of borrowing increases, which lead to a rise in the price of the product. Price of raw materials, petrol and electricity, are important determinants of the product price from the supply side. Demand shocks include inflation, competition, and demand of products, government intervention, change in the price of competitors, seasonal factors and change in the tax rate. These factors lead the demand-pull inflation and play a significant role in the price-setting behaviour. For example, an increase in the tax rate, change in the demand for the product and season may increase the price. So, it is important to explore the difference in response of prices to demand and supply shock.

Section 2 discussed the questionnaire design; section 3 is about population and sampling plan; section 4 discusses results and section 5 include a conclusion.

Questionnaire Design

Before analysis, it is better to explain the design of the questionnaire ([Blinder et al. 1998](#)). Section "A" of the questionnaire consists of general information about firms. It consists of the information regarding the firm's main product, market structure, i.e., a number of competitors, and the market share of the product.

Section "B" of the questionnaire is about price-setting behaviour. It gives information about market power, i.e. how the firm sets the price of its main product, price discrimination and degree of price discrimination, price information, i.e. backwards-looking or forward-looking, time or state-dependent pricing policy, number of times the price is evaluated, frequency of price change, price elasticity of demand, price contracts, price adjustment process, the response of firms when they cannot change price, lagged effect of change in price and contract of input purchases.

Section "C" of the questionnaire is about the determinants of price change. This section gives information about the impact of demand variables and cost variables on a price increase and decrease. The demand factors are competition, inflation, tax rate, the demand for the main product and exchange rate. The supply-side factors are labour cost, cost of raw materials and energy, inflation, financial cost and exchange rate. Further, this section contains information about different factors leading to not change prices during a certain period (e.g., fixed-term contracts, physical cost or menu cost, costly information, risk-averse behaviour, customer relationship, stable price and change in quality). It also deals with how the firm computes the optimal price, i.e., by formula or makes a guess.

Section “E” is about awareness of Central bank working. In this section, firms were asked different questions about awareness, i.e., information about current economic conditions and policies, functions of State Bank of Pakistan (SBP), the target of the central bank (i.e., unemployment and inflation), used of SBP forecasts by firms in decision making, the success of SBP to control inflation, information about SBP policies and SBP report in Urdu.

Data Collection

In Khyber Pakhtunkhwa, there are 14 main industrial estates, of which six are major industrial estates, i.e., Hayatabad, Nowshera, Exporting Processing Zone Risalpur, Hattar, Gadoon Amazi and Dera-Ismail Khan while remaining eight are small industrial estates, i.e., Mardan. Peshawar, Charsadda, Bannu, Kohat, Abbottabad, Kalabat-Haripur and Mansehra.

Hayatabad industrial estate, Nowshera industrial estate, Hattar industrial estate and Gadoon Amazi industrial estate are selected for the data collected through a questionnaire. The summary of total area, total industrial units, operational units, and closed units, units under construction, allotted plots, available plots and number of male and female workers are given in table 1. According to table 1, total industrial units are 1444 in the six major industrial estates, in which 892 units are operational, 301 units are closed, and remaining are under construction or not allotted. Exporting Processing Zone Risalpur and Dera-Ismail Khan industrial estate is also a major industrial estate, but they are not selected in the initial population, because it is still under the developmental stage and a number of operating units is less, i.e., six units and one unit as shown in table 1.

The questionnaire could also be sent and received back through emails or by post, but the response rate was expected to be low in cases of email and post. The data is collected from the manager of the firms of the industrial estates of Khyber Pakhtunkhwa through the interview method. Sample 342 is selected through stratified random sampling technique from the list of registered firms with Sarhad Chamber of Commerce for the four-major industrial estate of Khyber Pakhtunkhwa, as shown in table 2.

Table 1. Summary of the Major Industrial Estates of Khyber Pakhtunkhwa

Industrial Estates	Total area acres	Total Industrial Units	Operational Units	Closed Units	Under Construction	Allotted Plots	Available Plots/Land	Female Workers	Male Workers	Total Workers
Peshawar	868	498	423	67	8	498	0	19384	2178	21562
Hattar	1443	387	282	104	1	387	0	17020	1399	18419
Gadoon	1116	299	123	116	40	299	20 acres	24146	228	24374
Nowshera	108	73	57	7	9	73	5 Kanal	1980	144	2124
Risalpur	92	27	6	7	14	27	37acres	1481	0	1481
DI Khan	189	160	1	0	0	82	77	82	0	82
Total	3816	1444	892	301	72	1366		64093	3949	68042

Table 2. Division of Firms According to the Number of Workers of the Major Industrial Estates of Khyber Pakhtunkhwa

Industrial Estates	Operational Units	Ignored firm (workers <10)	(a) Small Firms (workers >9)	(b) Medium Firms (workers >49)	(c) Larger Firms (workers >200)	Total (a+b+c)	Sample within each Estate
Peshawar	423	2	305	109	7	421	186
Hattar	282	6	168	93	15	276	94
Gadoon	123	5	44	63	11	118	44
Nowshera	57	12	38	4	3	45	18
Total	885	25	555	269	36	860	342

Results

The price-setting behaviour is proxy through the significance of supply and demand shocks in price adjustment for a firm. It only shows the weightage of this variable which might lead to change in the price, i.e., increase and decrease of firm product or the importance of these shocks, while calculating the new price, when required.

Exchange rate, seasonal factors, level of competition, price of the competitive firms, tax rate, inflation rate and demand of your product are the variables which represent demands shocks, while the change in the seasonal factor, change in financial cost, inflation rate, exchange rate, government regulations, cost of energy and raw materials and change in labour cost are used to measure cost shocks.

These factors are ranked from 1 to 4 (i.e., 1-unimportant and 4-very important) by the manager of the firm, which measures the importance of these factors on price change, i.e., price increase and price decrease. The average value of all respondents is calculated and which is from 1 to 4. So, a total of four series was calculated, i.e., weightage of demand-side variables and supply-side variables in price increase and decrease

So, to compare that which shocks are more important for the price change and whether the price responses to these shocks are symmetric or asymmetric. The overall average of response to demand and supply shocks is calculated in the first step, and then the response is calculated concerning response in each variable. After this, the mean values are compared through t-test, chi-square test, and mean differences, as shown below in the tables.

Table 3 and 4 show the overall response of prices to change in demand and supply-side variables. According to the table 3, the average response of firms to change the price because of demand shocks in case of price increase (i.e., 2.6) is higher than in case of price decrease (i.e., 1.7). It means the firms increase the price of the product more than the decrease in case of demand shocks. Moreover, according to the table 3, the average response of firms to adjust the price in response to supply shocks in case of price increase (i.e., 2.8) is more than the response of firms in case of price decrease (i.e., 1.9). It shows

that the firms give an asymmetric response to the demand side and supply-side factors in price increase/decrease. Furthermore, according to table 3, the average value of response of firm to a supply-side variable for the price increase (i.e., 2.8) and price decrease (i.e., 1.9) is greater than the average value of response to demand-side variables for the price increase (i.e., 2.6) and for price decrease (i.e., 1.7) respectively. So, it shows that firms give an asymmetric response to shocks while setting at a price.

Similarly, the probability of t-test and chi-square test for testing that response is the same for the price increase, and price decrease is highly significant of both demand shocks and supply shocks, as shown in table 4. So, the average response of the firm to change in demand (supply) side variables in price increase is not equal to the average response of the firm to change in demand (supply) side variables price decrease.

Table 3. Asymmetries in Response to Shocks in Price Setting

Variables	Increase in Price	Decrease in Price
Importance of Demand shocks	2.6	1.7
Importance of Supply shocks	2.8	1.9

Table 4. Asymmetric Response of Price to Demand Shocks & Supply Shocks

Variables Pairs	Chi-square Test	Mean Difference	T-test
Demand shocks price increase- Demand shocks price decrease	63.1***	.86	21.5***
Supply shocks price increase- Supply shocks price decrease	128.3***	.87	20.7**

*Hypothesis ($\mu_x = \mu_y$). “***” 1% significance level and “**” 5% significance level*

To further analyze the asymmetries in response to shocks as a determinant of price-setting, the average of each variable (i.e., inflation, labor cost, financial cost, energy and raw material cost, price of the competitors, seasonal factor, tax rate, government regulation, competition, demand for product and exchange rate) is calculated separately for the price increase and decrease as shown in table 5 and figure 1. According to table 5, the average response to the factors that might cause the firm to change the price of the product is high for price increase than in for price decrease. It means the firms give more response to shocks which lead to a price increase than to price decrease. For the mean comparison of a price increase and decrease, statistical test is applied as shown in table 5. Table 5 shows that the probability of test is significant at 1% significance level. So, the hypothesis ($H_0: \mu_x = \mu_y$) is rejected, i.e., the mean response of prices to factors (e.g., inflation) in case of price increase is not equal to the mean response of prices to factors in case of a price decrease. So, the firms give an asymmetric response in terms of price change (i.e., increases and decrease) to change in different factors.

Figure 1 shows the magnitude of asymmetries across variables of a price increase/decrease in descending order. It shows the asymmetric response to the cost of raw material is highest than all other determinants of price. Moreover, the seasonal factors have the lowest degree of asymmetric response (i.e., price increase and decrease). Figure 1 and Table 5 also indicate that asymmetries in response to different shocks are more in case of supply-side factors than in case of demand-side factors. So, it shows that firms give an asymmetric response to different shocks, with respect to a price increase and decrease, and across variables of demand-side and supply side.

Table 5. Asymmetric Response of Prices to Demand and Supply Side Variables

Variable	Price Increase	Price Decrease	Chi Square	Difference of Mean	T-statistics
Cost of raw materials	3.49	2.22	26.8***	1.26	19.3***
Cost of energy	3.13	2.11	71.3***	1.01	15.7***
Demand for your product	2.83	1.86	51.1***	0.97	9.7***
Tax rate	2.81	1.88	95.8***	0.93	15.4***
Government regulation	2.78	1.88	134.4***	0.90	13.2***
Exchange rate of Rs/\$	2.76	1.77	92.3***	0.98	13.4***
Price of the competitors	2.76	2.02	98.6***	0.73	6.0***
Labour cost	2.75	1.83	83.6***	0.91	14.8***
Inflation	2.66	1.74	151.6***	0.92	16.2***
Level of competition	2.58	1.87	81.3***	0.71	13.4***
Change in financial costs	2.42	1.71	103.9***	0.70	11.5***
Seasonal factors	2.08	1.71	117.9***	0.36	15.8***

*Hypothesis ($\mu_x = \mu_y$). *** 1% significance level; ** 5% significance level.*

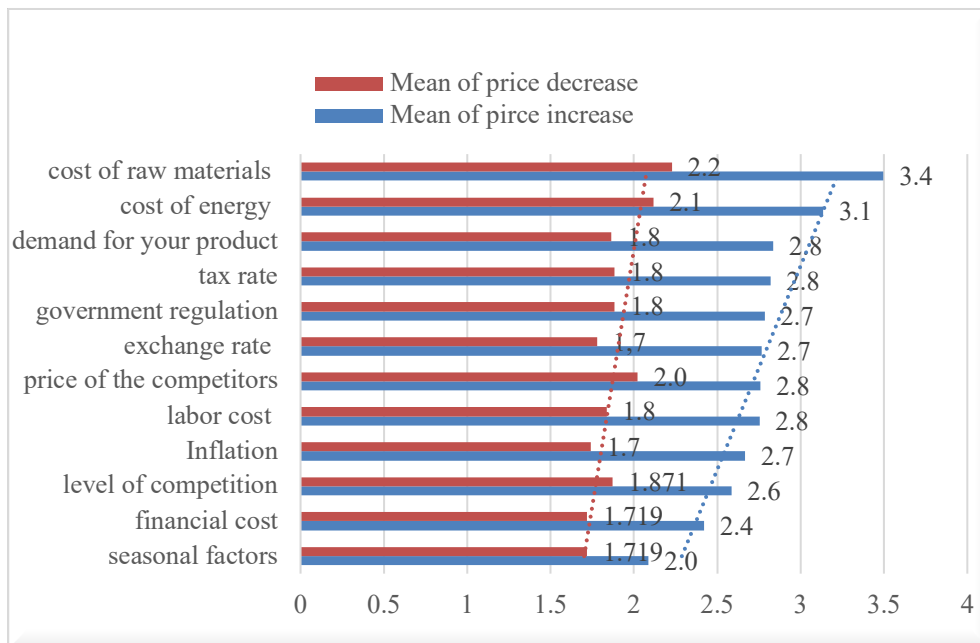


Figure 1: Asymmetric Response of Prices to Shocks

Conclusion

Results show that the firms give an asymmetric response to shocks to change the price. The average value of response to supply shocks is more than the average response to demand shocks in case of price change. The average response to the factors that might cause a change in the price of the firms' product is high in case of price increase than in the case of a price decrease. Asymmetric response to the cost of raw material is highest than all other determinants of price. Moreover, the seasonal factors have the lowest degree of asymmetric response (i.e., price increase and decrease). Results show that asymmetries in response to different shocks are more in case of supply-side factors than in case of demand-side factors. So, it shows that firms give an asymmetric response to different shocks, with respect to a price increase and decrease, and across variables of demand-side and supply side. In this regard, the central bank has to focus more on stabilization in response to supply shocks than to demand shocks. Pre-emptive measures can be taken to prevent the possible effects of adverse supply shocks.

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