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RELATIVE PRICES AND INFLATION VARIABILITY

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This study examines the causality and stability of the relationship between variability in inflation and dispersion in relative prices using monthly price data for twenty industrial groups. ARIMA models have been estimated and the adequacy of the filters has been checked with modified Q-statistic before applying the standard causality tests. Also Hannan and Quinn test has been used to identify the lag length. Results indicate a strong but unstable relationship between the two variables. Granger causality is found to be generally bi-directional.

I. Introduction

The neoclassical postulate that 'inflation' depends on changes in money supply, while relative prices are determined by real forces has been put to empirical test. One way to do it is to estimate the relationship between inflation and relative price dispersion. Numerous studies have established a significant relationship between inflation and relative price variability. Many explanations have been put forward. Some of these treat inflation as exogenous, and explain relative price variability in terms of 'menu costs'. Others treat relative price variability as exogenous and explain inflation in terms of asymmetric price responses. Still others take both inflation and relative price variability as exogenous and explain their association in terms of either policy-induced or non-policy induced disturbances which affect both inflation and relative price variability. And finally, the relationship has been explained in terms of anticipated changes in money stock. While theoretical arguments and empirical evidence substantiate a strong relationship between price variability and inflation dispersion, the debate regarding the direction of causation and the stability of the relationship has yet to be resolved. The literature has been reviewed in Fischer (1981), Cuckierman (1983) and Marquez and Vining (1984).

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Ambiguities also remain regarding the channels through which the fiscal and the monetary policies work in Pakistan. Investigation of the direction of causation between inflation dispersion and relative price variability may help in understanding the anatomy of inflation. We do not claim to resolve the issues related with causality and stability in this paper. The purpose of the study is limited to understanding the inflationary process in Pakistan, albeit, through the causality approach.

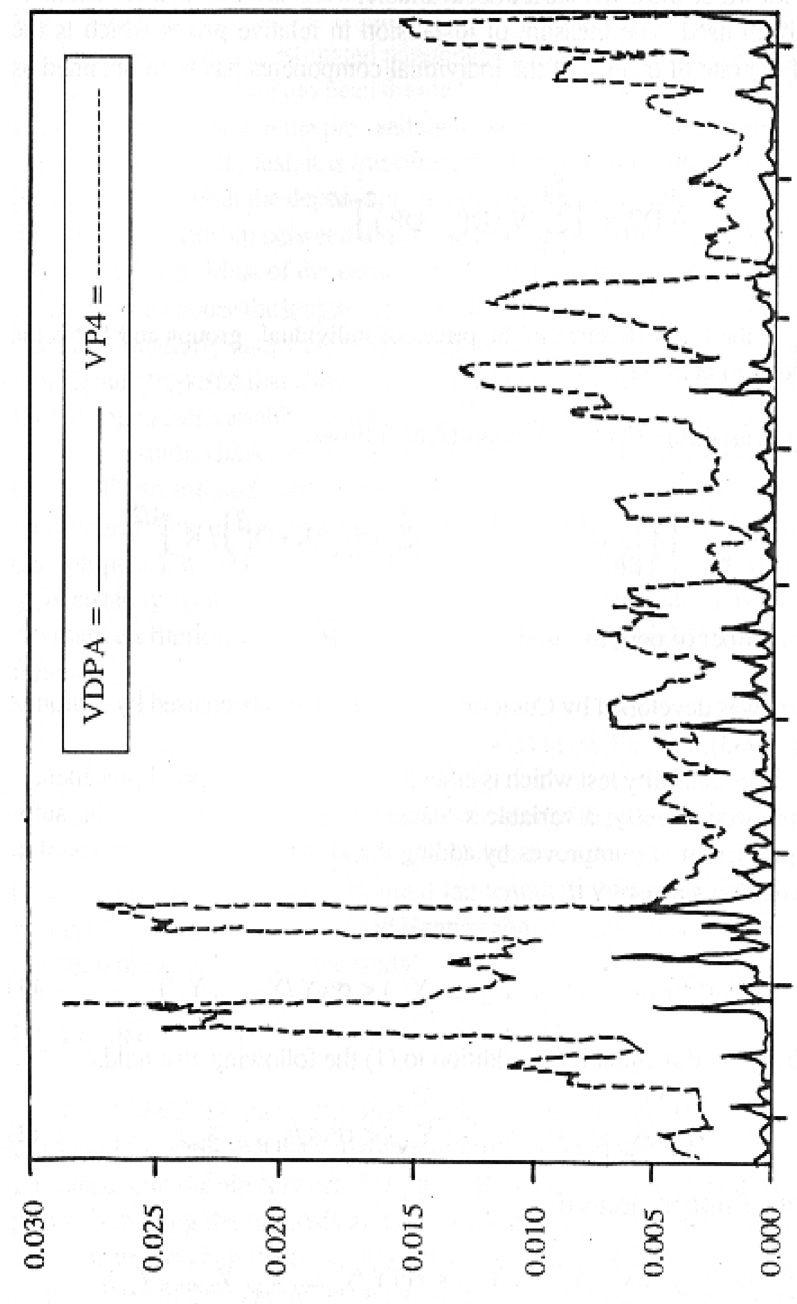
An inspection of time series plots for inflation variability (VDP) and relative price variability (VP) in Pakistan's economy reveals that the peaks and the troughs of these two variables move together,[1] as shown in Figure 1. Although this graphic disposition lends support to the idea that these variables are related to each other, this does not imply causality. Moreover, it also does not say anything about the structural stability of the relationship. Most of the studies in the area relate to the advanced economics, with Mahmood and Butt's (1986) study for Pakistan being the only exception. Using yearly data for food, raw material and manufactured goods with constant 1969-70 weights, the authors found a significant quadratic relationship between inflation and dispersion in relative prices, which is expected when a measure of variance is regressed on a mean. The authors, however, did not address the issue related with the direction of causation between inflation and relative price dispersion. The findings of other studies on the nature and causes of inflation in Pakistan were mixed. For instance, Naqvi (1985) concludes that monetary expansion does not explain inflation. While other studies are at odds with this finding [Chishti, Hasan and Mahmood (forthcoming)].

Of late it has been argued that while the earlier studies analyzed the relationship between inflation and dispersion in relative prices, they ought to have focused on the relationship between dispersion in inflation and dispersion in relative prices [Marquez and Vining (1983)]. The issues related to the direction of causality and the stability of the relationship have been re-examined with inflation variability rather than the inflation rate. This sutdy examines the issues of causality and stability of the relationship between variability in inflation and dispersion in relative prices. It is for 20 industrial groups using monthly price data for eighteen years. The level of disaggregation provides a better measure of relative price dispersion based on market-specific price differences [Gerhaeusser (1988)].

II. Methodology and Data

Monthly sectoral data on whole sale price indices for 20 manufacturing groups for eighteen years have been taken from the Statistical Bulletin, having been converted to 1959-60 as the base. The measure of inflation (DP_t) which has been used here is computed as the weighted average of the difference in logs of monthly prices

[1]The variables VDP and VP are more precisely defined in the next section.



VDPA =
VP4 =
0.030
0.025
0.020
0.015
0.010
0.005
0.000
72
74
76
78
80
82
84
86
88

Figure 1

for each of the 20 industrial groups. Value-added in the corresponding sectoral groups obtained from the CMI data for several years have been used as weights. For some years for which the CMI data are not available, weights for the nearest available year have been used. The measure of dispersion in relative prices which is the variance of the rate of change of the individual components has been obtained as follows:

$$VDP_t = \left[\sum_{i=1}^{20} W_i (DP_{it} - DP_t)^2\right]^{1/2}$$

where DP_{it} is the log difference in the prices of individual groups and DP_t is the inflation index in period t.

Inflation variability has been computed as follows:

$$VP_{t,n} = \left[\left\{\sum_{j=0}^{k} D^2P_{t-j} - (K+1)\ \left[\sum_{j=0}^{k} DP_{t-j}/(K+1)\right]^2\right\}/K\right]^{1/2}$$

Where K = number of periods used in computing $VP_{t,n}$.

This measure was developed by Cukierman (1982) and has been used by Marquez and Vining (1983).

Granger-Sims causality test which is essentially based on 'temporal precedence' has been followed. Briefly, a variable x 'causes' y in Granger sense if the auto-regressive prediction of y improves by adding the knowledge of past values of x. More specifically, x causes y if:

$$\sigma^2(Y_t/x_{t-1},\ldots, x_{t-n}, Y_{t-1},\ldots, Y_{t-n}) < \sigma^2(Y_t/Y_{t-1},\ldots, Y_{t-n}) \qquad (1)$$

The causality is bi-directional if in addition to (1) the following also holds:

$$\sigma^2(x_t/x_{t-1},\ldots, x_{t-n}, Y_{t-1},\ldots, Y_{t-n}) < \sigma^2(x_t/x_{t-1},\ldots, x_{t-n}) \qquad (2)$$

The causality is instantaneous if

$$\sigma^2(Y_t/x_t, x_{t-1},\ldots, x_{t-n}, Y_{t-1},\ldots, Y_{t-n}) < \sigma^2(Y_t/x_{t-1},\ldots, x_{t-n}, Y_{t-1},\ldots, Y_{t-n}).$$

Before applying the above tests it is essential to make sure that the series of x_t, and

Y_t are white-noise. Instead of using 'standard' filters [Sims (1972)], we have identified and estimated ARIMA models, thus checking the adequacy of the filters with the modified Q-statistic [Ljung and Box (1976); Feige and Pearce (1979)].

The stability of the estimated parameters has been examined using Chow test. For this purpose the data has been divided into two sets, namely 1971-75 and 1975-88, which correspond to the pre- and the post-oil crisis periods. Before conducting the Granger causality test, it is important to select the appropriate lag length of the polynomials for both the dependent and the independent variables. This is because the causal relationship between the two variables is sensitive to the selection of the order of the lags. Most of the earlier studies on causality test adopted some ad hoc procedures to choose the length of the lag. For instance 12 lags for monthly data and 4 lags for quarterly data were suggested by Jones (1989). Geweke (1978), on the other hand, proposed that shorter lags for the independent variales and a longer lag for the dependent variable would increase the explanatory power of the test.

Recent studies have, however, used the optimal search methods to specify the lag length. These methods are primarily based on the idea of balancing the bias vs inefficiency. One of the commonly used statistical procedures in this context is the one proposed by Akaike (1969) which though unbiased, involves asymtotic inconsistancy. Hanan and Quinn (1978), on the other hand, have provided an alternative criterion which essentially requires the minimization of the following function:

$$\sigma(l) = ln(\sigma) + (2T\, l\, \hat{\alpha})\, ln(ln\, T); \quad \alpha > 1$$

Where T is the sample size, $\hat{\alpha}$ is the estimator of the variance generated from an autoregression of order l. Hannan and Quinn have analytically proved that this criterion is consistent and the optimal lag length is thus achieved when $\sigma(l)$ is minimized. We have therefore used Hannan and Quinn's consistent criterion for the selection of lag lengths for the study.

III. Results

The ARIMA estimates and modified Q-statistics for all the variables used in the casuality tests show that the variables are white-noise (Table 1). Table 2 presents the estimated relationship between VDP_t and $VP_{t,n}$ for several values of n and for the two periods covering the oil crisis and the post-oil crisis. The results indicate that the relationship between the two variables is significant both during and after the oil crisis. Fischer (1981) found inflation and relative price variabilty to be strongly related during the oil and food price rises of the 1970's, but not during other periods. Following Marquez and Vining (1983) who found the relation between variability in inflation and variability in relative prices to be consistently strong and positive

TABLE 1

Estimates of ARIMA models for VDP_t and $VP_{t,n}$

Variables	VDP_t	$VP_{t,2}$	$VP_{t,3}$	$VP_{t,4}$
Differencing	1	1	1	1
Constant	2.88E-6	3.26E-5	2.93E-5	2.38E-5
	(0.207)	(0.265)	(0.25)	(0.234)
AR1	-0.638	-	-	-
	(-5.57)	-	-	-
AR2	-0.593	-	-	-
	(-5.6)	-	-	-
AR3	-0.491	-0.72	-	-
	(-4.77)	(-10.5)	-	-
AR(4)	-0.405	-	-0.612	-
	(-4.74)	-	(-9.09	-
AR(5)	-0.253	-		-0.547
	(-3.86)	-	-	(-8.49)
AR(6)	-	-0.458	-	-
	-	(-5.61)	-	-
AR(8)	-	-	-0.351	-
	-	-	(-5.07)	-
AR(10)		-	-	-0.307
		-	-	(-4.62)
MA(1)	-0.225	-		-
	(-1.66)	-	-	-
MA(9)	0.386	-0.158	-	-
	(5.15)	(-1.72)	-	-
MA(18)	0.391	0.243	-	0.433
	(5.17)	(3.17)	-	(5.73)
R^2	0.561	0.392	0.315	0.347
F-Statistics	31.180	31.973	30.211	34.530
Durbin-Watson	2.000	2.202	2.182	2.051
Q-Statistic	9.310	12.277	23.617	15.472

Note: The numbers in parentheses are the t-statistics.

TABLE 2

Estimated Relationship between VDP_t and $VP_{t,n}$

Variables	1971.03-1975.06	1971.03-1988.07
Constant	-7.448E-5	-1.382E-6
	(-0.81)	(-0.035)
$VP_{t,2}$	7.757E-2	0.0743
	(3.866)	(5.827)
R^2	0.230	0.141
Durbin-Watson	1.954	1.826
Constant	-5.080E-5	-3.996E-7
	(-0.67)	(-0.01)
$VP_{t,3}$	0.1634	0.1359
	(6.745)	(8.225)
R^2	0.467	0.246
Durbin-Watson	1.402	1.642
Constant	-4.279E-5	1.247E-6
	(-0.51)	(0.03)
$VP_{t,4}$	0.1615	0.1214
	(5.395)	(6.382)
R^2	0.368	0.164
Durbin-Watson	1.726	1.596

Note: The numbers in parentheses are t-statistics.

over the entire post-war period, we experimented with variability in inflation as well. Our findings lend support to Marquez and Vining.

Table 3 presents the results of the Chow test for various values of n. The test has been performed to examine the stability of the parameters over the period. The reslts clearly indicate a significant structural change during the two periods. The hypothesis of stability of parameters has been consistently rejected for all values of n. This again lends support to Marquez and Vining's findings that the relationship is strong but unstable.

Finally the Granger-Sims causality test results are presented in Table 4. As has been mentioned earlier, the lag lengths for these tests are identified on the basis of Hannan and Quinn criterion. Both unidirectional and instantaneous causality tests have been performed. Relative price variability does not seem to cause inflation during the period 1971-75. During this period the relative price variability was very high (Figure 1). It seems that only part of this high variability could be translated into general price variability. However, for the entire period from 1971 to 1988 the causal relationship appears to hold, with relative price variability causing inflation in Pakistan, where prices are generally inflexible downwards. Whenever exogenous or policy-induced supply shocks or changes in tastes due to the international demonstration effect lead to price increases in some sector without any declines in others, the result would be inflationary. In Solows (1975) words "If prices are inflexible downwards then normal market forces will set up a more or less perpetual tendency for the price level to float upwards."

TABLE 3

Chow Stability Test
between periods 1971.03-1975.06 to 1975.07-1988.07

	Variables		
	$VP_{t,2}$	$VP_{t,3}$	$VP_{t,4}$
F-Value.	50.9613	72.9983	64.9909
Significance Level.	*	*	*
Degrees of Freedom.	250	250	250

Asterisk indicate significance at less than 0.001 level.

TABLE 4

Results of the Causality Test

	$VP_{t,n} \longrightarrow VDP_t$		$VDP_t \longrightarrow VP_{t,n}$	
	71.03-75.06	71.03-88.07	71.03-75.06	71.03-88.07
$VP_{t,2}$		*Unidirectional*		
F-stat	0.9666	4.4665	2.6607	2.2352
S.L.	0.5	*	*	*
DF.	(1019)	(5186)	(1215)	(9178)
$VP_{t,3}$				
F-stat	0.9698	1.7087	2.0128	2.3398
S.L.	0.5	***	***	***
DF	(1019)	(10176)	(1215)	(818)
$VP_{t,4}$				
F-stat	0.7156	1.4135	0.8042	1.5813
S.L.	0.7	0.185	0.38	0.21
DF	(1019)	(9178)	(137)	(1194)
$VP_{t,2}$		*Instantaneous*		
F-stat	1.5379	3.3679	2.6607	3.3252
S.L.	0.22	*	**	*
DF	(1314)	(7182)	(1215)	(9178)
$VP_{t,3}$				
F-stat	0.9698	1.7087	0.1964	2.3398
S.L.	0.5	***	0.66	**
D.F.	(1118)	(10176)	(137)	(8180)
$VP_{t,4}$				
F-stat	1.73	1.216	0.8042	1.3635
S.L.	0.15	0.3	0.38	0.26
DF	(1118)	(5186)	(137)	(2192)

Note: * indicates significance at less than 0.01 level.
** indicates significance at less than 0.05 level.
*** indicates significance at less than 0.10 level.

Our results also indicate a causal relation from inflation dispersion to relative price variability, which appears quite understandable for Pakistan. The data on relative price changes pertains to the large scale manufacturing sector which is characterized by oligopolies [White (1974), Sherwani (1976)]. In such a market environment producers may take the likely response of their competitors into account while adjusting their prices [Glejser, (1965)]. Moreover, some important manufacturing industries are in the public sector. Frequent adjustments of prices of products like petrol, electricity, cement, iron and steel may have political as well as transaction costs, which dictates a gradual price adjustment at an appropriate time [Sheshinski and Weiss, (1977)].

The overall conclusion which emerges from these tests is that causality is bi-directional and the relationship is not stable. This is quite in line with many similar studies [Fischer, (1981), Marquez and Vining (1984)]. But this does not mean that all the variation in inflation is explainable in terms of relative price varability or vice-verca. The large scale manufacturing sector of Pakistan contributes only 17.6 per cent to the GDP. It is therefore quite plausible that forces in other sectors may influence the two variables exogenously.

IV. Conclusions

The purpose of this study is to examine the relationship between relative price variability and inflation variability using industrial data at a fairly disaggregated level. The results indicate a strong but unstable relationship between the two variables. The Granger causality is found to be generally bidirectional. This means that policy-induced and other exogenous price shocks for some individual commodities, in an environment where prices are inflexible downwards, generate pressures for the general price level to rise. At the same time, due to the oligopolistic nature of the market structure in the large scale manufacturing sector with some public sector controls, the transactions costs and other political considerations may inhibit the instantenous relative price adjustments.

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