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An Exploratory Analysis of Inflation Episodes in Pakistan

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Abstract

This paper explores the past 50 years of data on inflation, growth rates of money and real GDP. It is found that inflation is primarily a monetary phenomena; however, the quantity theory of money does not hold in Pakistan below money supply growth rates of 9 percent. A simple monetary rule is also derived by inspecting the maximum probabilities of keeping inflation low (at most 6 percent); this rule is simply to keep money growth rates below 12 percent. This paper also finds that food inflation too is a monetary phenomena and there is no trade-off between inflation and growth, which are independent in the sense of probability measures. The findings are confirmed by the application of Fisher's Exact Test. The policy implication is that monetary policy should be pursued independently of growth policies of government.

JEL Classification: E41, E52

Keywords: Pakistan, Inflation, Monetary Policy

"Once upon a time, statisticians only explored. Then they learned to confirm exactly-- to confirm a few things exactly, each under very specific circumstances. As they emphasized exact confirmation, their techniques inevitably became less flexible. The connection of the most used techniques with past insights was weakened. Anything to which a confirmatory procedure was not explicitly attached was decried as "mere descriptive statistics", no matter how much we had learned from it."

John W. Tukey (1977)

1. Introduction

Tukey's quotation above sets the direction of this paper. I explore the past 50 years of data on inflation, growth rates of money and real GDP to learn something that, though not necessarily new, is nonetheless important. This study, by calculating the probabilities of observed inflation

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over the past 50 years conditioned on money supply growth, paints a clear picture. I also explore a few questions concerning the relevance of monetary policy in containing food inflation. What I learn is not unexpected, but may surprise the proponents declaring monetary policy as irrelevant for controlling food inflation. The paper also touches on the behavior and relevance of international commodity prices, which also seem to determine the course of overall global and domestic inflation. The paper ends with a discussion of the limitations of the analysis undertaken and its relevance to monetary policy and future research directions.

2. An Exploratory Review of Inflation and Money Growth between FY58 and FY07

I first construct simple stem and leaf displays in the tradition of Tukey (1977), but also add two more columns: of the number of years and fiscal years themselves, for a full reading of inflation and growth rates of broad money supply (M_2). Table-1 describes the inflation data history of the past 50 years, dividing it into two equal parts of 25 years each, indicating that the observed median inflation was 7%. However, at most 5% inflation was observed in 20 out of 50 years, also indicating a considerable possibility for keeping inflation at a low level in Pakistan. We also see two years of deflation (FY59 and FY63) and close to zero inflation (FY63); these seem to be the outliers at the lower end of inflation. Two other outliers, at the higher end are 26% and 30% inflation for the years of FY73 and FY74, related to the oil price shock. Figure-1 presents a graph of inflation, showing a greater visibility of outliers.

Table-1: CPI Inflation History in Stem and Leaf Display (FY58-FY07)

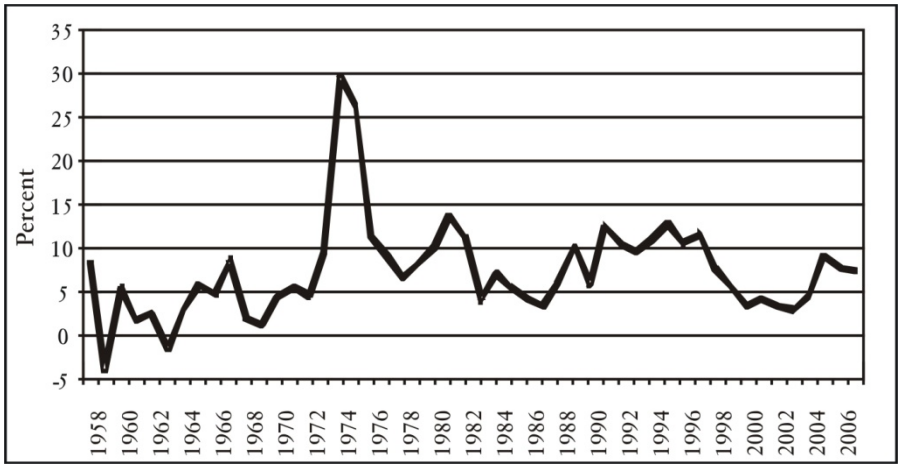
Percent

Main Digit (Stem)	Decimal Digit (Leaf)							No. of Years	Fiscal Year						
-3	2							1	59						
-0	6							1	63						
0	5							1	62						
1	6							1	69						
2	5							1	66						
3	0	1	5	6	6	6		6	61	03	02	68	00	87	
4	1	2	4	4	6	7	7	9	70	64	86	01	04	83	72
	8	9							65	60					
5	7	7	7					3	85	71	99				
6	0	3						2	90	88					
7	1	3	4	8	8	8	9	7	79	84	78	07	98	58	06
8	6							1	67						
9	3	7	8					3	05	73	93				
10	4	6	7	8				4	89	92	80	96			
11	1	3	7	8	8			5	82	94	76	77	97		
12	4	7						2	81	91					
13	0							1	95						
26	7							1	75						
30	0							1	74						

Explanatory Note: The first column indicates the main digit of inflation with the decimal digit in the second column, number of years in the third column and the corresponding fiscal year of occurrence in the last column. An example highlighted is that inflation was 7.8% in FY07

Source: Author's construction based on State Bank of Pakistan (SBP), Handbook of Statistics on Pakistan Economy 2005 and various publications of FBS.

Figure 1: Movement in CPI Inflation



The second stem and leaf display in Table-2 tells the history of broad money growth rates in our economy from FY58 to FY07. Here we see a much larger variation than we saw for inflation in Table-1, indicating that there is, perhaps, a lot more than money growth that explains the inflation phenomena. This point will be explored later in more detail, and before that, some interesting aspects of the monetary history data are discussed here. The first feature is that our economy witnessed a monetary contraction (-0.1%) in FY72, perhaps due to the traumatic nature of that year in Pakistan's history. This is an example of an outlier, which can hardly be ignored. Another feature relates to a historic high level of monetary expansion observed in the recent past: post- 9/11 broad money expansion of 30% in FY04. Other than that, we see from the stem and leaf analysis of money growth that out of 50 years, 25 years have seen a monetary expansion of less than 13.8% (median money growth rate). A much higher (relative to median) monetary expansion of 17% or more was observed for 18 years, whereas a much lower expansion of 7% or less was witnessed in 10 out of 50 years. This is all amply visible in Table-2, and a graph is also presented in Figure-2 of broad money growth rates.

Table-2: M2 Growth History in Stem and Leaf Display (FY58-FY07)

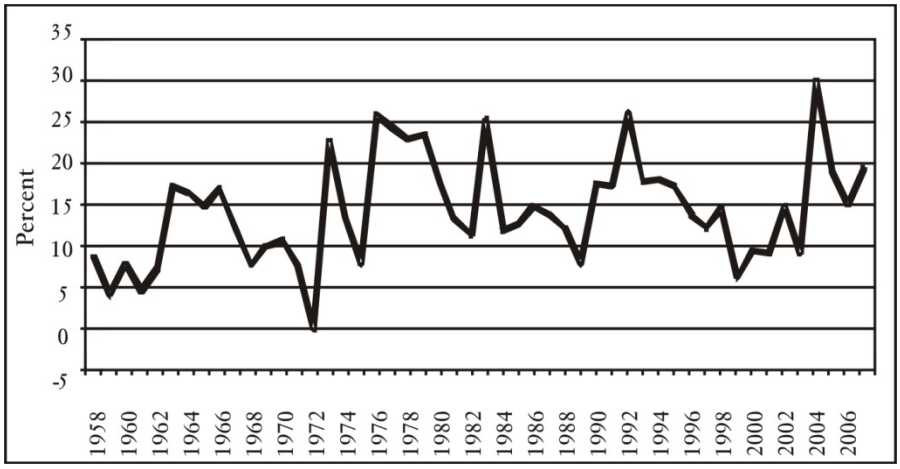
Percent

Main Digit (Stem)	Decimal Digit (Leaf)	No. of Years	Fiscal Year
-0	1	1	72
4	0 5	2	59 61
6	2	1	99
7	2 6 6 8 8 8	6	62 71 68 89 75 60
8	5	1	58
9	0 0 4	3	01 03 00
10	0 7	2	69 70
11	4 8 8	3	82 67 84
12	2 3 6	3	97 88 85
13	2 3 7 8	4	81 74 87 96
14	5 8 8 8	4	98 86 02 65
15	1	1	06
16	5	1	64
17	0 2 4 4 5 6 8	7	66 95 91 63 90 80 93
18	1	1	94
19	1 3	2	05 07
22	7	1	73
23	0 5	2	78 79
24	3	1	77
25	3 9	2	83 76
26	2	1	92
30	1	1	04

Explanatory Note: The first column indicates main digit of M_2 growth with the decimal digit in the second column, number of years in the third column and the corresponding fiscal year of occurrence in the last column. An example highlighted is that M_2 growth was 19.1% in FY07.

Source: Author's construction based on State Bank of Pakistan (SBP), Handbook of Statistics on Pakistan Economy 2005 and Annual Reports of subsequent years.

Figure 2: Movement in M2 Growth



3. Interactions between Inflation and Money

Let us now explore how money growth has interacted with inflation. At this stage, we do not make any assumptions about which variable is endogenous or exogenous, but are interested in the joint association, if any, between them. At the outset, I report that the most common measure of association, i.e., correlation between inflation and M_2 growth is extremely low at 0.16. Since it is generally accepted that money growth may take time to develop inflationary pressures, we also look at the simple correlation between money growth and inflation in the following year. This comes out to be relatively higher, but still low at 0.4. Does this mean that there is no association between money supply and inflation? We need more exploration to answer even this simple question, not to speak of the more difficult question of a causal relationship.

The simple description provided in the previous section gives us a clue about partitioning our data set by labeling some rates of inflation as high and low, and doing the same for money growth rates. Since this labeling is going to be arbitrary, we do not necessarily have to agree on definitions of low and high inflation or money growth rates. We simply explore with alternative 2x2 partitioning of 50-year inflation and M_2 growth data with reference to some values for inflation and money growth. The simplest 2x2 partition, suggested by (close to) median values of inflation and money growth leads to the following contingency table:

Broad Money Growth	Inflation Next Year			
	2X2 Table	**High (> 7%)**	**Low (Ĝ 7%)**	**No. of Years**
	High (> 14%)	18	6	24
	Low (Ĝ 14%)	7	19	26
	No. of Years	25	25	50

All other possible 2x2 interactions between money growth and inflation lead to following general form of table:

Broad money growth	Inflation Next Year			
	2X2 Table	**High (> F*)**	**Low (Ĝ F*)**	**No. of Years**
	High (> M*)	N_{HH}	N_{HL}	$N_{H.}$
	Low (Ĝ M*)	N_{LH}	N_{LL}	$N_{L.}$
	No. of Years	$N_{.H}$	$N_{.L}$	N

Where
N = total number of years
$N_{H.} = N_{HH} + N_{HL}$
$N_{L.} = N_{LH} + N_{LL}$
$N_{.H} = N_{HH} + N_{LH}$
$N_{.L} = N_{HL} + N_{LL}$
$N_{.H} + N_{.L} = N = N_{H.} + N_{L.}$

We want to explore the behavior of probabilities of occurrence of low or high inflation (as labeled by arbitrary F*), conditioned on values of growth rates of money supply (as labeled by M*). These conditional probabilities are obtained as follows:

$$P[\text{High Inflation} \mid \text{High } M_2 \text{ growth}]$$

$$P[\text{High Inflation and High } M_2 \text{ Growth}] = \frac{N_{HH}}{N} = \frac{N_{HH}}{N_{H.}}$$

$$P[\text{High } M_2 \text{ growth}] = \frac{N_{H.}}{N}$$

These can be obtained, more simply, by taking the number of years in the relevant cell and dividing it by relevant column total.

For our simplest, median-driven 2x2 partition example, these conditional probabilities are as follows:

$$P_{HH} = [\text{High (>7\%) Inflation} \mid \text{High (>14\%) } M_2 \text{ Growth}] = \frac{18}{24} = 0.750$$

$$P_{HL} = [\text{High (>7\%) Inflation} \mid \text{Low } (\hat{G}14\%) \text{ } M_2 \text{ Growth}] = \frac{7}{26} = 0.269$$

$$P_{LH} = [\text{Low } (\hat{G}7\%) \text{ Inflation} \mid \text{High (>14\%) } M_2 \text{ Growth}] = \frac{6}{24} = 0.250$$

$$P_{LL} = [\text{Low } (\hat{G}7\%) \text{ Inflation} \mid \text{Low } (\hat{G}14\%) \text{ } M_2 \text{ Growth}] = \frac{19}{26} = 0.731$$

These probabilities are quite revealing and seem to provide a strong indication of an association between money growth and inflation compared to the weak association revealed earlier by low correlation. The probability of occurrence of high inflation given the occurrence of high M_2 growth is 0.75. Also, the probability of achieving low inflation when M_2 growth is low is 0.73, highlighting the importance of monetary prudence. At the same time, other probabilities indicate the uncertainty of this association in a meaningful way. There is acceptance of the fact that high inflation may still occur despite keeping low money growth (probability 0.27) and low inflation may still be realizable with high money growth. These can be termed as Type I and Type II errors of monetary targeting.

Continuing with this exploration of probabilities of high and low inflation conditional on high or low money growth, for different levels of highs and lows (F* and M*), one hundred and five 2 x 2 contingency tables were constructed for seven high-low cut-off levels of inflation at 4% to 10% at discrete intervals of one percentage point each. Similarly, fifteen cut-off points were taken for high-low levels for M_2 growth ranging from 4% to 18%. All 105 contingency tables are shown in one compact Table-3. Corresponding probabilities, of high/low inflation given high/low M_2 growth, are calculated by dividing cell frequencies in each row with corresponding row totals. Please note that these are not the probabilities of individual cells, which are the joint probabilities of occurrence of high/low inflation with high/low M_2 growth. Of interest to us are the conditional probabilities. Also, my purpose here is not to apply any statistical tests of significance, although these can be applied to show that inflation is ***not*** independent of money supply growth in the usual mathematical probabilistic sense.

Table-3: Interaction between M2 growth and Inflation during FY58-07 in terms of 105 2X2 contingency tables

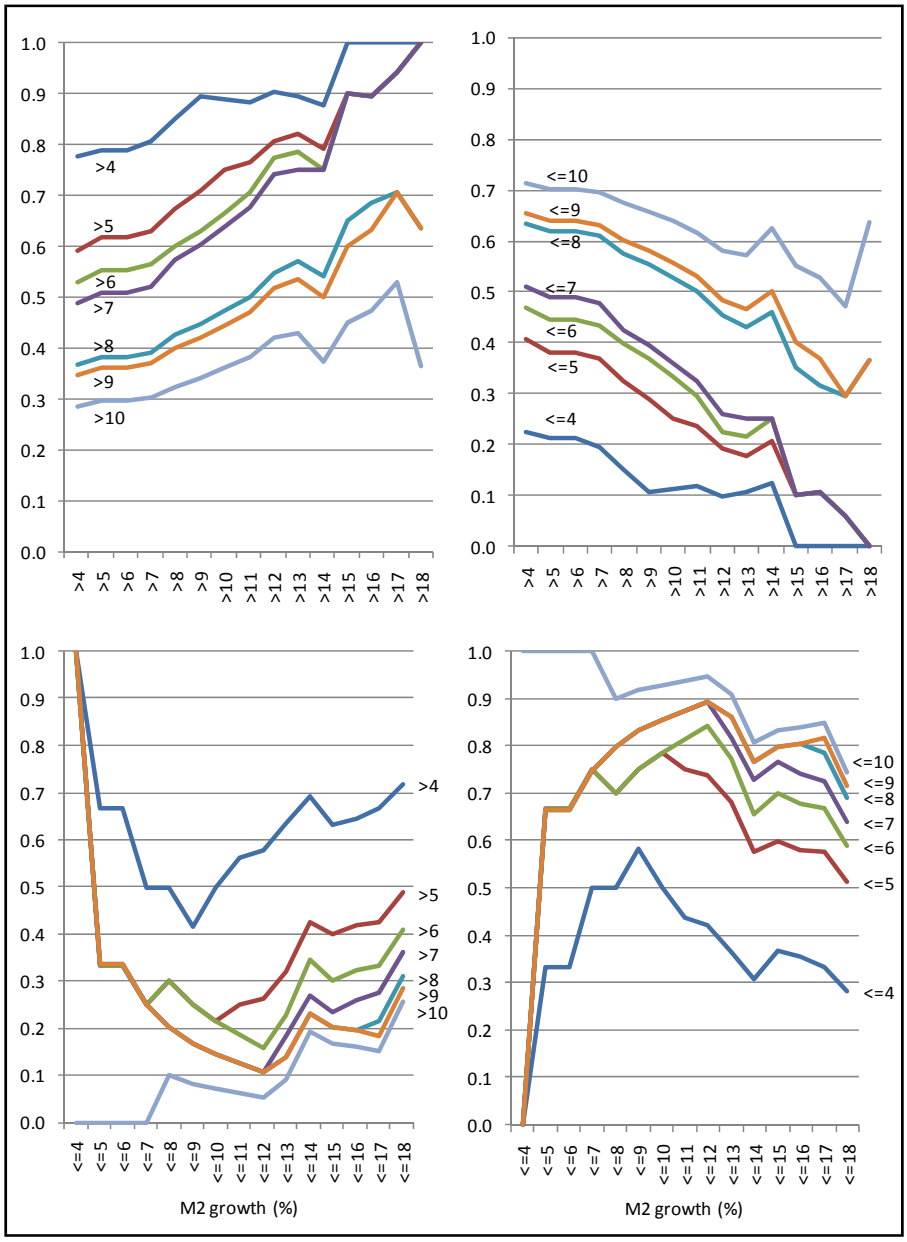
		CPI Inflation in % (next year)														
		>4	<=4	>5	<=5	>6	<=6	>7	<=7	>8	<=8	>9	<=9	>10	<=10	
M2 Growth (%)	>4	38	11	29	20	26	23	24	25	18	31	17	32	14	35	**49**
	<=4	1	0	1	0	1	0	1	0	1	0	1	0	0	1	**1**
	>5	37	10	29	18	26	21	24	23	18	29	17	30	14	33	**47**
	<=5	2	1	1	2	1	2	1	2	1	2	1	2	0	3	**3**
	>6	37	10	29	18	26	21	24	23	18	29	17	30	14	33	**47**
	<=6	2	1	1	2	1	2	1	2	1	2	1	2	0	3	**3**
	>7	37	9	29	17	26	20	24	22	18	28	17	29	14	32	**46**
	<=7	2	2	1	3	1	3	1	3	1	3	1	3	0	4	**4**
	>8	34	6	27	13	24	16	23	17	17	23	16	24	13	27	**40**
	<=8	5	5	3	7	3	7	2	8	2	8	2	8	1	9	**10**
	>9	34	4	27	11	24	14	23	15	17	21	16	22	13	25	**38**
	<=9	5	7	3	9	3	9	2	10	2	10	2	10	1	11	**12**
	>10	32	4	27	9	24	12	23	13	17	19	16	20	13	23	**36**
	<=10	7	7	3	11	3	11	2	12	2	12	2	12	1	13	**14**
	>11	30	4	26	8	24	10	23	11	17	17	16	18	13	21	**34**
	<=11	9	7	4	12	3	13	2	14	2	14	2	14	1	15	**16**
	>12	28	3	25	6	24	7	23	8	17	14	16	15	13	18	**31**
	<=12	11	8	5	14	3	16	2	17	2	17	2	17	1	18	**19**
	>13	25	3	23	5	22	6	21	7	16	12	15	13	12	16	**28**
	<=13	14	8	7	15	5	17	4	18	3	19	3	19	2	20	**22**
	>14	21	3	19	5	18	6	18	6	13	11	12	12	9	15	**24**
	<=14	18	8	11	15	9	17	7	19	6	20	6	20	5	21	**26**
	>15	20	0	18	2	18	2	18	2	13	7	12	8	9	11	**20**
	<=15	19	11	12	18	9	21	7	23	6	24	6	24	5	25	**30**
	>16	19	0	17	2	17	2	17	2	13	6	12	7	9	10	**19**
	<=16	20	11	13	18	10	21	8	23	6	25	6	25	5	26	**31**
	>17	17	0	16	1	16	1	16	1	12	5	12	5	9	8	**17**
	<=17	22	11	14	19	11	22	9	24	7	26	6	27	5	28	**33**
	>18	11	0	11	0	11	0	11	0	7	4	7	4	4	7	**11**
	<=18	28	11	19	20	16	23	14	25	12	27	11	28	10	29	**39**
	Total	**39**	**11**	**30**	**20**	**27**	**23**	**25**	**25**	**19**	**31**	**18**	**32**	**14**	**36**	**50**

Explanatory Note: The first contingency table on top left shows that for 38 years, inflation (next year) was higher than 4% as well as M2 growth; for only 1 year, inflation was higher than 4% when M2 growth was less than 4%; for 11 years, inflation was less than 4 percent when M2 growth was higher than 4 percent; for none of the years, inflation was less than 4 percent when M2 growth was less than 4 percent.

Source: Calculated by using SPSS from joint series of M2 growth rates and inflation rates of the next year reported in Table 1 and 2. For M2 growth rate of FY07, inflation rate of July-March FY08 (period average) is taken as proxy for full year FY08 inflation.

Conditional probabilities are easily derived from Table-3 and shown in a better formatted Table-4, with four distinct panels of high-high, high-low, low-high and low-low inflation/M_2 growth. Conditional probabilities in these four panels are shown in four separate graphs, all shown in a combined Figure-3.

Figure 3: Conditional Probabilities of Inflation in four Panels of the Table-4



The most striking phenomena captured by these conditional probabilities can be seen in the fourth panel of Figure-3. This shows that if at most 4% inflation ($\hat{G}$ 4%) is taken as low inflation, then the probability of observing this low inflation increases with successive increases in low-high cut-off for M_2 growth. But this probability is at a maximum (0.583) at M_2 growth rate low-high cut-off of 9%. Reducing M_2 growth further leads to a reduction in the probability of observing low inflation (of at most 4%). Many other important associations can also be learned from this graph. Increasing the tolerance of accepting higher inflation results in an increase in probability (0.786) of observing low inflation (at most 5%) at M_2 growth of 10%. This maximum probability further increases for inflation tolerance of 6% to 0.842 for M_2 growth cut-off of 12%. What is more striking is that at the same cut-off M_2 growth of 12%, the maximum probability of observing high inflation is 0.895 for inflation tolerances of 7%, 8% or 9%. This indicates that it would be wise to keep M_2 growth at or below 12%, if the objective of low inflation ($\hat{G}$ 6%) is to be taken seriously.

This exploration not only results in our understanding of inflation primarily as a monetary phenomena in a probabilistic sense but also yields a 'monetary rule' that keeping M_2 growth at less than 12% is associated with the greatest chances for keeping inflation below 6%. This is exactly the rule of thumb indicated by the Quantity Theory of Money, which relates growth rate of money to the sum of the growth rate of real GDP and the rate of inflation when the velocity of money is assumed to be constant. Since we have derived our rule by exploring data of interactions of M_2 growth with inflation only, with the interaction of real GDP with inflation already imbedded in historic data, we can ascribe the difference to the implicitly imbedded growth rate of 6% of GDP. However, our rule also suggests not to reduce M_2 growth rate below 9% if inflation is to be kept at most 4%. Reducing money growth further will reduce the probability of keeping inflation below 4%. The rule observed here is not linear and implies the difficulties (embedded in past 50 year history) of keeping inflation below 4%, consistent with a GDP growth of 5%. This can also be taken as an indication that the quantity theory of money does not hold in Pakistan below M_2 growth levels of 9%.

The other panels of graphs in Figure 3 are self explanatory. Suffice it to say here that the third panel plots the complementary probabilities of the fourth panel and does not give new insights. Conditional probabilities in the second panel are much easier to interpret; the chances of observing low inflation get dimmer with the increases in money supply growth. In fact, it was impossible to observe lower than 6% inflation when M_2 growth was higher than 18%. The probabilities in the first panel are the complementary

probabilities of the second panel. In summary, these conditional probabilities not only provide an intuitive acceptance of inflation as a monetary phenomenon in Pakistan, but also reveal monetary rules in terms of maximizing the conditional probability of low inflation given different tolerance rates of money supply growth.

Although I started by saying that there was no need to apply any test, there is no harm in using well-established tests for assessing the significance between probabilities of different treatments in a contingency table. Keeping a balance between exploratory and confirmatory data analysis may prove to be more prudent. The 'sickness' which we want to cure is high inflation, the treatment is the 'application' of low money growth. This treatment can only be shown to work effectively if the proportion (or probability) of cases of high inflation (given high M_2 growth) is significantly higher than the proportion of cases of high inflation (given low M_2 growth). So our null hypothesis here is $H_O : P_{HH} < P_{HL}$, which should be rejected if our remedy is to work effectively. We should expect this rejection to occur in most of the cases of the 105 contingency tables we prepared. The appropriate statistical test in this case is the Fisher's Exact Test, which is used when 2x2 contingency tables have lower cell frequencies.

Table 4: Conditional Probabilities of High/Low Inflation derived from Table 3

		CPI Inflation in % (next year)													
		>4	>5	>6	>7	>8	>9	>10	<=4	<=5	<=6	<=7	<=8	<=9	<=10
M2 Growth	>4	0.776	0.592	0.531	0.490	0.367	0.347	0.286	0.224	0.408	0.469	0.510	0.633	0.653	0.714
	>5	0.787	0.617	0.553	0.511	0.383	0.362	0.298	0.213	0.383	0.447	0.489	0.617	0.638	0.702
	>6	0.787	0.617	0.553	0.511	0.383	0.362	0.298	0.213	0.383	0.447	0.489	0.617	0.638	0.702
	>7	0.804	0.630	0.565	0.522	0.391	0.370	0.304	0.196	0.370	0.435	0.478	0.609	0.630	0.696
	>8	0.850	0.675	0.600	0.575	0.425	0.400	0.325	0.150	0.325	0.400	0.425	0.575	0.600	0.675
	>9	0.895	0.711	0.632	0.605	0.447	0.421	0.342	0.105	0.289	0.368	0.395	0.553	0.579	0.658
	>10	0.889	0.750	0.667	0.639	0.472	0.444	0.361	0.111	0.250	0.333	0.361	0.528	0.556	0.639
	>11	0.882	0.765	0.706	0.676	0.500	0.471	0.382	0.118	0.235	0.294	0.324	0.500	0.529	0.618
	>12	0.903	0.806	0.774	0.742	0.548	0.516	0.419	0.097	0.194	0.226	0.258	0.452	0.484	0.581
	>13	0.893	0.821	0.786	0.750	0.571	0.536	0.429	0.107	0.179	0.214	0.250	0.429	0.464	0.571
	>14	0.875	0.792	0.750	0.750	0.542	0.500	0.375	0.125	0.208	0.250	0.250	0.458	0.500	0.625
	>15	1.000	0.900	0.900	0.900	0.650	0.600	0.450	0.000	0.100	0.100	0.100	0.350	0.400	0.550
	>16	1.000	0.895	0.895	0.895	0.684	0.632	0.474	0.000	0.105	0.105	0.105	0.316	0.368	0.526
	>17	1.000	0.941	0.941	0.941	0.706	0.706	0.529	0.000	0.059	0.059	0.059	0.294	0.294	0.471
	>18	1.000	1.000	1.000	1.000	0.636	0.636	0.364	0.000	0.000	0.000	0.000	0.364	0.364	0.636
	<=4	1.000	1.000	1.000	1.000	1.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000

<=5	0.667	0.333	0.333	0.333	0.333	0.333	0.000	0.333	0.667	0.667	0.667	0.667	1.000
<=6	0.667	0.333	0.333	0.333	0.333	0.333	0.000	0.333	0.667	0.667	0.667	0.667	1.000
<=7	0.500	0.250	0.250	0.250	0.250	0.250	0.000	0.500	0.750	0.750	0.750	0.750	1.000
<=8	0.500	0.300	0.300	0.200	0.200	0.200	0.100	0.500	0.700	0.700	0.800	0.800	0.900
<=9	0.417	0.250	0.250	0.167	0.167	0.167	0.083	0.583	0.750	0.750	0.833	0.833	0.917
<=10	0.500	0.214	0.214	0.143	0.143	0.143	0.071	0.500	0.786	0.786	0.857	0.857	0.929
<=11	0.563	0.250	0.188	0.125	0.125	0.125	0.063	0.438	0.750	0.813	0.875	0.875	0.938
<=12	0.579	0.263	0.158	0.105	0.105	0.105	0.053	0.421	0.737	0.842	0.895	0.895	0.947
<=13	0.636	0.318	0.227	0.182	0.136	0.136	0.091	0.364	0.682	0.773	0.818	0.864	0.909
<=14	0.692	0.423	0.346	0.269	0.231	0.231	0.192	0.308	0.577	0.654	0.731	0.769	0.808
<=15	0.633	0.400	0.300	0.233	0.200	0.200	0.167	0.367	0.600	0.700	0.767	0.800	0.833
<=16	0.645	0.419	0.323	0.258	0.194	0.194	0.161	0.355	0.581	0.677	0.742	0.806	0.839
<=17	0.667	0.424	0.333	0.273	0.212	0.182	0.152	0.333	0.576	0.667	0.727	0.788	0.818	0.848
<=18	0.718	0.487	0.410	0.359	0.308	0.282	0.256	0.282	0.513	0.590	0.641	0.692	0.718	0.744

Explanatory Note: Highlighted column of probabilities (in 4 th panel) of observing low inflation indicates that probability of low inflation (?6%) was zero given M2 growth rate of less than 4%. Probability of low inflation rises with successive increases of M2 growth cut-offs and attains a maximum of 0.842 for the probability of low inflation (?6%) given M2 growth of ?12%. This probability starts falling thereafter in highlighted column. Simple monetary rule of keeping M2 growth below 12% is derived from this column.

Source: Calculated from Table 3 and re-arranged in 4 panels.

Table-5 presents exact tail probabilities for the one sided Fisher's Exact Test for all 105 contingency tables presented in Table-3. There is a disconcerting number of non-rejection of cases corresponding with money growth up to 8%. However, for money growth higher than 9%, most of the cases confirm rejection of the null hypothesis. Overall, there are 67 rejections at the 5% level of significance, out of 105 total cases. This in itself seems like we have not been successful in confirming our previous conclusions about inflation. This is far from true. We learned by inspection of probabilities in 4 panels of Figure 3, that inflation is a monetary phenomenon at money growth of 9% or higher. This is precisely what is being confirmed by the Fisher's Exact Test. Out of 70 cases of 2x2 tables corresponding with at least 9% M_2 growth, 64 cases are significant. In contrast, for the 35 cases of 2x2 tables corresponding with M_2 growth of up to 8%, only 3 are significant. Hence, we are on a much stronger footing now about our findings after "passing" Fisher's Exact Test!

Next we turn to the question "Is food inflation not a monetary phenomena?"

Table-5: Fisher's Exact Test Probabilities for 105 2X2 Contingency Tables in Table-3

		CPI Inflation in % (next year)													
		>4	<=4	>5	<=5	>6	<=6	>7	<=7	>8	<=8	>9	<=9	>10	<=10	
M2 Growth (%)	>4 <=4	0.780		0.600		0.540		0.500		0.380		0.360		0.720		**49 1**
	>5 <=5	0.534		0.349		0.439		0.500		0.680		0.709		0.364		**47 3**
	>6 <=6	0.534		0.349		0.439		0.500		0.680		0.709		0.364		**47 3**
	>7 <=7	0.206		0.170		0.246		0.305		0.507		0.544		0.256		**46 4**
	>8 <=8	0.030*		0.036*		0.089		0.037*		0.173		0.212		0.153		**40 10**
	>9 <=9	0.002*		0.006*		0.023*		0.009*		0.077		0.102		0.080		**38 12**
	>10 <=10	0.006*		0.001*		0.005*		0.002*		0.030*		0.044*		0.039*		**36 14**
	>11 <=11	0.016*		0.001*		0.001*		0.000*		0.010*		0.017*		0.017*		**34 16**
	>12 <=12	0.010*		0.000*		0.000*		0.000*		0.002*		0.003*		0.004*		**31 19**
	>13 <=13	0.034*		0.000*		0.000*		0.000*		0.002*		0.004*		0.008*		**28 22**
	>14 <=14	0.111		0.008*		0.005*		0.001*		0.024*		0.045*		0.131		**24 26**
	>15 <=15	0.001*		0.000*		0.000*		0.000*		0.002*		0.005*		0.032*		**20 30**
	>16 <=16	0.002*		0.001*		0.000*		0.000*		0.001*		0.002*		0.020*		**19 31**
	>17 <=17	0.005*		0.000*		0.000*		0.000*		0.001*		0.000*		0.007*		**17 33**
	>18 <=18	0.045*		0.001*		0.000*		0.000*		0.053		0.037*		0.364		**11 39**
	Total	**39**	**11**	**30**	**20**	**27**	**23**	**25**	**25**	**19**	**31**	**18**	**32**	**14**	**36**	**50**

* Significant at 0.05 level

* or Significant at 0.10 level

Source: Calculated by using SPSS

4. Interactions between Food Inflation and Money

In this section I first present a data history of food inflation in Pakistan from FY58 to FY08 in a stem and leaf display (Table-6). For reference, we also show the stem and leaf display of non-food inflation history (Table-7). Some interesting facts are that 50-year median food inflation (7.2%) was higher than both CPI inflation (6.7%) and non-food inflation (6.3%). Another surprising historic fact is that food inflation was higher than overall inflation during FY74 and FY75, years synonymous with OPEC embargo driven oil price supply shock. Less well known is the fact that these years also saw an international wheat price shock. Figure 4 presents movements in international oil and wheat inflation during 1958-2007; considerable association between oil and wheat inflation seems to be present, which we do not explore here, but present it as a curious phenomenon of international commodity prices. History seems to be repeating itself nowadays (although not exactly in the same manner), and not necessarily due to the same reasons.

Table-6: CPI Food Inflation History in Stem and Leaf Display (FY58-07)

Percent

Main Digit (Stem)	Decimal Digit	No. of Years	Fiscal Year
-1	3	1	59
-0	5 7	2	69 63
0	8	1	62
2	0 2 5 6 8 8	6	66 00 02 86 83 03
3	4 6	2	72 01
4	0 2 5	3	87 68 90
5	2 9 9	3	64 99 85
6	0 0 1 3 3 9 9	7	71 04 79 61 70 65 06
7	4 7 8 9	4	60 98 78 84
8	0 5	2	88 80
10	1 3 6 6 6 7	6	96 07 67 73 92 58
11	0 1 9 9	4	76 94 97 93
12	1 5 9	3	77 05 91
13	1	1	81
14	2	1	89
16	0 7	2	82 95
27	8	1	75
34	8	1	74

Explanatory Note: The first column indicates the main digit of CPI food inflation with the decimal digit in the second column, number of years in the third column and the corresponding fiscal year of occurrence in the last column. An example highlighted is that CPI food inflation was 10.3% in FY07.

Source: Author's construction based on SBP, Handbook of Statistics on Pakistan Economy 2005 and Annual Reports of subsequent years.

Table-7: CPI Non-Food Inflation History in Stem and Leaf Display (FY58-FY07)

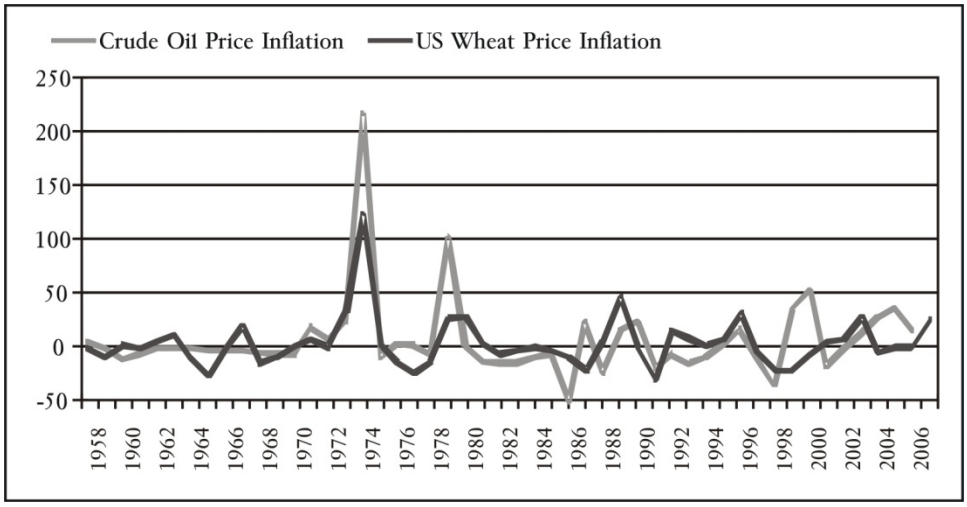
Percent

Main Digit (Stem)	Decimal Digit (Leaf)	No. of Years	Fiscal Year
-4	8 6	2	62 59
-0	5	1	63
1	8	1	60
2	1 5 5 6 8	5	65 70 68 64 69
3	2 3 6 9	4	87 03 04 66
4	2 2 6	3	58 02 88
5	0 3 3 4 4 5 6	7	00 01 61 85 71 67 99
6	0 2 4 6 7 7	6	07 86 82 89 84 83
7	1 1 2 8 8 8 9	7	72 05 79 78 90 73 93
8	0 6	2	98 06
9	4	1	95
10	5	1	92
11	3 4 5 5 7	5	77 94 96 81 97
12	4 4	2	91 76
13	2	1	80
24	1	1	74
26	0	1	75

Explanatory Note: The first column indicates the main digit of CPI non-food inflation with the decimal digit in the second column, number of years in the third column and the corresponding fiscal year of occurrence in the last column. An example highlighted is that CPI non-food inflation was 6.0% in FY07.

Source: Author's construction based on SBP, Handbook of Statistics on Pakistan Economy 2005 and Annual Reports of subsequent years.

Figure 4: Movement in International Prices of Crude Oil and Wheat



Coming back to our exploration on the interaction of money growth with food inflation, I repeat the 2x2 contingency table exercise done in the previous section. All 105 contingency tables are reported in Table-8 and conditional probabilities of observing low food inflation subject to different levels of money growth are shown in Table-9. A four-panel graph corresponding to Table-9 is shown in Figure 5. We find a similar pattern of conditional probabilities of observing food inflation as that of CPI inflation. But important differences are also visible. For example, with low food inflation taken as 4%, the probability of observing low food inflation is lower (than overall inflation) for money growth higher than 10% as shown in the first column of the fourth panel of Table-4. When low food inflation is taken as at most 5%, the probability of observing this level gets maximized (0.667) at M_2 growth of 9% or less (see Table-9), in comparison with the probability of low ($\hat{G}$ 5%) overall inflation that got maximized at M_2 growth of 10% or less (see Table-4). This means that food inflation can also be controlled by monetary tightening, although a slightly higher degree of tightening is needed than for the general inflation level. This exercise again reveals that food inflation is also a monetary phenomenon and can be controlled by monetary policy, but by applying a little more tightening pressure than is required to achieve the CPI inflation target.

Now we turn to the question of the costs of keeping inflation at low levels.

Table-8: Interaction between M2 growth and CPI food Inflation during FY58-07 in terms of 105 2X2 contingency tables

		CPI food Inflation in % (next year)														
		>4	<=4	>5	<=5	>6	<=6	>7	<=7	>8	<=8	>9	<=9	>10	<=10	
M2 Growth (%)	>4	36	13	34	15	30	19	24	25	20	29	18	31	18	31	**49**
	<=4	1	0	1	0	1	0	1	0	1	0	1	0	1	0	**1**
	>5	35	12	33	14	29	18	23	24	20	27	18	29	18	29	**47**
	<=5	2	1	2	1	2	1	2	1	1	2	1	2	1	2	**3**
	>6	35	12	33	14	29	18	23	24	20	27	18	29	18	29	**47**
	<=6	2	1	2	1	2	1	2	1	1	2	1	2	1	2	**3**
	>7	35	11	33	13	29	17	23	23	20	26	18	28	18	28	**46**
	<=7	2	2	2	2	2	2	2	2	1	3	1	3	1	3	**4**
	>8	32	8	31	9	27	13	22	18	19	21	17	23	17	23	**40**
	<=8	5	5	4	6	4	6	3	7	2	8	2	8	2	8	**10**
	>9	32	6	31	7	27	11	22	16	19	19	17	21	17	21	**38**
	<=9	5	7	4	8	4	8	3	9	2	10	2	10	2	10	**12**
	>10	31	5	30	6	26	10	22	14	19	17	17	19	17	19	**36**
	<=10	6	8	5	9	5	9	3	11	2	12	2	12	2	12	**14**
	>11	29	5	28	6	25	9	22	12	19	15	17	17	17	17	**34**
	<=11	8	8	7	9	6	10	3	13	2	14	2	14	2	14	**16**
	>12	27	4	27	4	25	6	22	9	19	12	17	14	17	14	**31**
	<=12	10	9	8	11	6	13	3	16	2	17	2	17	2	17	**19**
	>13	25	3	25	3	23	5	20	8	18	10	16	12	16	12	**28**
	<=13	12	10	10	12	8	14	5	17	3	19	3	19	3	19	**22**
	>14	21	3	21	3	19	5	16	8	14	10	13	11	13	11	**24**
	<=14	16	10	14	12	12	14	9	17	7	19	6	20	6	20	**26**
	>15	20	0	20	0	19	1	16	4	14	6	13	7	13	7	**20**
	<=15	17	13	15	15	12	18	9	21	7	23	6	24	6	24	**30**
	>16	19	0	19	0	18	1	15	4	13	6	12	7	12	7	**19**
	<=16	18	13	16	15	13	18	10	21	8	23	7	24	7	24	**31**
	>17	17	0	17	0	16	1	14	3	12	5	11	6	11	6	**17**
	<=17	20	13	18	15	15	18	11	22	9	24	8	25	8	25	**33**
	>18	11	0	11	0	11	0	9	2	7	4	6	5	6	5	**11**
	<=18	26	13	24	15	20	19	16	23	14	25	13	26	13	26	**39**
	Total	**37**	**13**	**35**	**15**	**31**	**19**	**25**	**25**	**21**	**29**	**19**	**31**	**19**	**31**	**50**

Explanatory Note: Please see explanatory note for table 3.

Source: Calculated using SPSS form joint series of M2 growth rates and CPI food inflation of next year. For M2 growth rate of FY07, CPI food inflation rate of July-March FY08 (period average) is taken as proxy for full year FY08 food inflation.

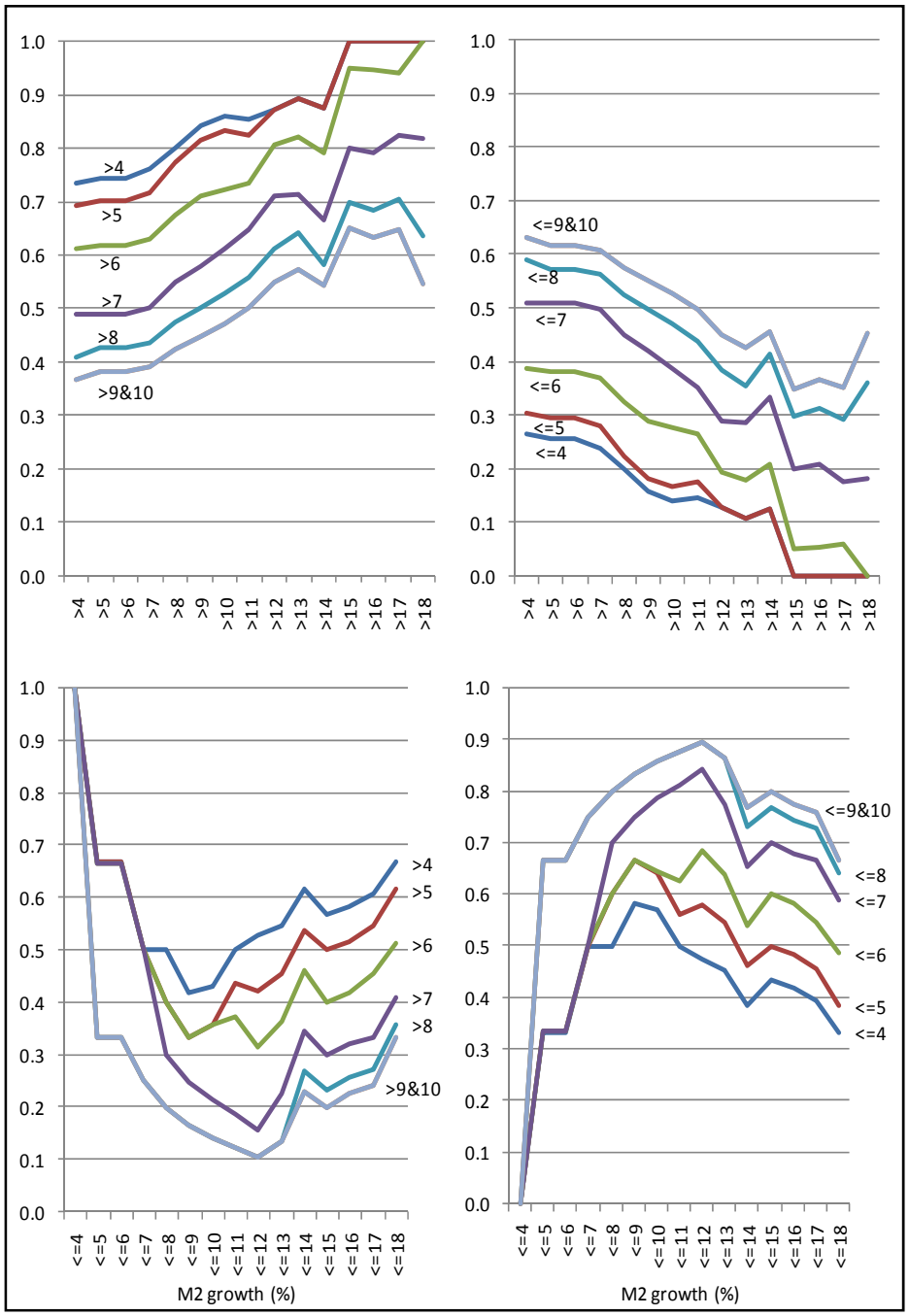
Table-9: Conditional Probabilities of High/Low CPI Food Inflation Derived from Table-8

	CPI Food Inflation in % (Next Year)													
	>4	>5	>6	>7	>8	>9	>10	<=4	<=5	<=6	<=7	<=8	<=9	<=10
>4	0.735	0.694	0.612	0.490	0.408	0.367	0.367	0.265	0.306	0.388	0.510	0.592	0.633	0.633
>5	0.745	0.702	0.617	0.489	0.426	0.383	0.383	0.255	0.298	0.383	0.511	0.574	0.617	0.617
>6	0.745	0.702	0.617	0.489	0.426	0.383	0.383	0.255	0.298	0.383	0.511	0.574	0.617	0.617
>7	0.761	0.717	0.630	0.500	0.435	0.391	0.391	0.239	0.283	0.370	0.500	0.565	0.609	0.609
>8	0.800	0.775	0.675	0.550	0.475	0.425	0.425	0.200	0.225	0.325	0.450	0.525	0.575	0.575
>9	0.842	0.816	0.711	0.579	0.500	0.447	0.447	0.158	0.184	0.289	0.421	0.500	0.553	0.553
>10	0.861	0.833	0.722	0.611	0.528	0.472	0.472	0.139	0.167	0.278	0.389	0.472	0.528	0.528
>11	0.853	0.824	0.735	0.647	0.559	0.500	0.500	0.147	0.176	0.265	0.353	0.441	0.500	0.500
>12	0.871	0.871	0.806	0.710	0.613	0.548	0.548	0.129	0.129	0.194	0.290	0.387	0.452	0.452
>13	0.893	0.893	0.821	0.714	0.643	0.571	0.571	0.107	0.107	0.179	0.286	0.357	0.429	0.429
>14	0.875	0.875	0.792	0.667	0.583	0.542	0.542	0.125	0.125	0.208	0.333	0.417	0.458	0.458
>15	1.000	1.000	0.950	0.800	0.700	0.650	0.650	0.000	0.000	0.050	0.200	0.300	0.350	0.350
>16	1.000	1.000	0.947	0.789	0.684	0.632	0.632	0.000	0.000	0.053	0.211	0.316	0.368	0.368
>17	1.000	1.000	0.941	0.824	0.706	0.647	0.647	0.000	0.000	0.059	0.176	0.294	0.353	0.353
>18	1.000	1.000	1.000	0.818	0.636	0.545	0.545	0.000	0.000	0.000	0.182	0.364	0.455	0.455
<=4	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<=5	0.667	0.667	0.667	0.667	0.333	0.333	0.333	0.333	0.333	0.333	0.333	0.667	0.667	0.667
<=6	0.667	0.667	0.667	0.667	0.333	0.333	0.333	0.333	0.333	0.333	0.333	0.667	0.667	0.667
<=7	0.500	0.500	0.500	0.500	0.250	0.250	0.250	0.500	0.500	0.500	0.500	0.750	0.750	0.750
<=8	0.500	0.400	0.400	0.300	0.200	0.200	0.200	0.500	0.600	0.600	0.700	0.800	0.800	0.800
<=9	0.417	0.333	0.333	0.250	0.167	0.167	0.167	0.583	0.667	0.667	0.750	0.833	0.833	0.833
<=10	0.429	0.357	0.357	0.214	0.143	0.143	0.143	0.571	0.643	0.643	0.786	0.857	0.857	0.857
<=11	0.500	0.438	0.375	0.188	0.125	0.125	0.125	0.500	0.563	0.625	0.813	0.875	0.875	0.875
<=12	0.526	0.421	0.316	0.158	0.105	0.105	0.105	0.474	0.579	0.684	0.842	0.895	0.895	0.895
<=13	0.545	0.455	0.364	0.227	0.136	0.136	0.136	0.455	0.545	0.636	0.773	0.864	0.864	0.864
<=14	0.615	0.538	0.462	0.346	0.269	0.231	0.231	0.385	0.462	0.538	0.654	0.731	0.769	0.769
<=15	0.567	0.500	0.400	0.300	0.233	0.200	0.200	0.433	0.500	0.600	0.700	0.767	0.800	0.800
<=16	0.581	0.516	0.419	0.323	0.258	0.226	0.226	0.419	0.484	0.581	0.677	0.742	0.774	0.774
<=17	0.606	0.545	0.455	0.333	0.273	0.242	0.242	0.394	0.455	0.545	0.667	0.727	0.758	0.758
<=18	0.667	0.615	0.513	0.410	0.359	0.333	0.333	0.333	0.385	0.487	0.590	0.641	0.667	0.667

M2 Growth

Explanatory Note: please see explanatory note of Table-4.

Figure 3: Conditional Probabilities of Food Inflation in 4 Panels of the Table 9



5. Interactions between Real GDP Growth and Inflation

Before exploring these interactions, let us look at the 50-year data series of real GDP growth in a stem and leaf display in Table-10. This is indeed a very good growth record. For 24 out of the past 50 years, our economy has witnessed real GDP growth rates of 6% or higher. Before proceeding with our exploratory analysis, I ask a very simple question, "Do we really think that inflation has got something to do with growth?"

Table-10: Real GDP Growth History in Stem and Leaf Display (FY58-FY07)

Percent

Main Digit (Stem)	Decimal Digit (Leaf)	No. of Years	Fiscal Year
0	9	1	60
1	2 7 8	3	71 97 01
2	3 3 5 8	4	72 93 58 77
3	1 1 3 5 9 9	6	67 02 76 98 75 00
4	0 1 2 5 6 8 8 9	8	84 95 99 94 90 89 03 61
5	5 5 6 8	4	59 79 91 87
6	0 4 4 4 4 5 5 6 6 8 8 8	12	62 81 86 88 04 64 69 96 06 68 73 83
7	0 2 3 5 6 6 7 7	8	07 63 80 74 66 82 78 92
8	7	1	85
9	0 4 8	3	05 65 70

Explanatory Note: The first column indicates the main digit of real GDP growth with the decimal digit in the second column, number of years in the third column and the corresponding fiscal year of occurrence in the last column. An example highlighted is that real GDP growth was 7.0% in FY07.

Source: Author's construction based on SBP, Handbook of Statistics on Pakistan Economy 2005 and Annual Reports of subsequent years.

Let us try to find an answer to this question by looking at 63 2x2 contingency tables presented in Table-11. These are constructed simply by successively slicing the real GDP growth rates with tolerance levels of 1% to 9%, with discrete jumps of one percentage point each. Inflation tolerances are taken as in earlier sections. Conditional probabilities of high/low inflation with given high/low growth rates of real GDP are presented in the same format in Table-12. It is much easier to interpret these probabilities meaningfully in this format compared to what we presented earlier. The most striking point to note is that the set of the first two probabilities in each column do not seem to differ much from each other. This means that the probability of observing high inflation does not really differ when real GDP growth is either high or low. This seems to suggest a common sense observation that inflation and growth are independent; inflation is influenced by factors other than growth and growth is influenced by factors other than inflation.

Table-11: Interaction between Real GDP Growth and CPI Inflation during FY58-07 in terms of 63 2X2 Contingency Tables

Real GDP Growth (%)	CPI Inflation														
	>4	<=4	>5	<=5	>6	<=6	>7	<=7	>8	<=8	>9	<=9	>10	<=10	
> 1	38	11	30	19	27	22	25	24	18	31	17	32	14	35	**49**
<= 1	1	0	0	1	0	1	0	1	0	1	0	1	0	1	**1**
> 2	35	11	28	18	26	20	24	22	17	29	16	30	13	33	**46**
<= 2	4	0	2	2	1	3	1	3	1	3	1	3	1	3	**4**
> 3	31	11	25	17	23	19	21	21	15	27	14	28	12	30	**42**
<= 3	8	0	5	3	4	4	4	4	3	5	3	5	2	6	**8**
> 4	26	9	20	15	18	17	16	19	12	23	12	23	10	25	**35**
<= 4	13	2	10	5	9	6	9	6	6	9	5	10	4	11	**15**
> 5	21	7	15	13	14	14	13	15	9	19	9	19	7	21	**28**
<= 5	18	4	15	7	13	9	12	10	9	13	8	14	7	15	**22**
> 6	19	4	13	10	12	11	11	12	8	15	8	15	6	17	**23**
<= 6	20	7	17	10	15	12	14	13	10	17	9	18	8	19	**27**
> 7	9	2	7	4	6	5	6	5	5	6	5	6	4	7	**11**
<= 7	30	9	23	16	21	18	19	20	13	26	12	27	10	29	**39**
> 8	4	0	2	2	1	3	1	3	1	3	1	3	0	4	**4**
<= 8	35	11	28	18	26	20	24	22	17	29	16	30	14	32	**46**
> 9	2	0	0	2	0	2	0	2	0	2	0	2	0	2	**2**
<= 9	37	11	30	18	27	21	25	23	18	30	17	31	14	34	**48**
Total	**39**	**11**	**30**	**20**	**27**	**23**	**25**	**25**	**18**	**32**	**17**	**33**	**14**	**36**	**50**

Explanatory Note: The first contingency table on the top left shows that for 38 (out of 50) years, inflation was greater than 4% when the real GDP growth rate was more than 1%; in 11 years inflation was less than 4% when the real GDP growth was more than 1%; in 1 year inflation was more than 4% when the real GDP growth rate was less than 1 %; in none of the years inflation was less than 4% when real GDP growth was less than 1%.

Source: Calculated using SPSS from joint series of real GDP growth rates and inflation rates of the same years, reported in Table 1 and 10.

Table-12: Conditional Probabilities of High/Low Inflation Derived from Table-11

		CPI Inflation												
		>4	<=4	>5	<=5	>6	<=6	>7	<=7	>8	<=8	>9	<=9	>10	<=10
Real GDP Growth (%)	> 1	0.776	0.224	0.612	0.388	0.551	0.449	0.510	0.490	0.367	0.633	0.347	0.653	0.286	0.714
	<=1	1.000	0.000	0.000	1.000	0.000	1.000	0.000	1.000	0.000	1.000	0.000	1.000	0.000	1.000
	> 2	0.761	0.239	0.609	0.391	0.565	0.435	0.522	0.478	0.370	0.630	0.348	0.652	0.283	0.717
	<=2	1.000	0.000	0.500	0.500	0.250	0.750	0.250	0.750	0.250	0.750	0.250	0.750	0.250	0.750
	> 3	0.738	0.262	0.595	0.405	0.548	0.452	0.500	0.500	0.357	0.643	0.333	0.667	0.286	0.714
	<=3	1.000	0.000	0.625	0.375	0.500	0.500	0.500	0.500	0.375	0.625	0.375	0.625	0.250	0.750
	> 4	0.743	0.257	0.571	0.429	0.514	0.486	0.457	0.543	0.343	0.657	0.343	0.657	0.286	0.714
	<=4	0.867	0.133	0.667	0.333	0.600	0.400	0.600	0.400	0.400	0.600	0.333	0.667	0.267	0.733
	> 5	0.750	0.250	0.536	0.464	0.500	0.500	0.464	0.536	0.321	0.679	0.321	0.679	0.250	0.750
	<=5	0.818	0.182	0.682	0.318	0.591	0.409	0.545	0.455	0.409	0.591	0.364	0.636	0.318	0.682
	> 6	0.826	0.174	0.565	0.435	0.522	0.478	0.478	0.522	0.348	0.652	0.348	0.652	0.261	0.739
	<=6	0.741	0.259	0.630	0.370	0.556	0.444	0.519	0.481	0.370	0.630	0.333	0.667	0.296	0.704
	> 7	0.818	0.182	0.636	0.364	0.545	0.455	0.545	0.455	0.455	0.545	0.455	0.545	0.364	0.636
	<=7	0.769	0.231	0.590	0.410	0.538	0.462	0.487	0.513	0.333	0.667	0.308	0.692	0.256	0.744
	> 8	1.000	0.000	0.500	0.500	0.250	0.750	0.250	0.750	0.250	0.750	0.250	0.750	0.000	1.000
	<=8	0.761	0.239	0.609	0.391	0.565	0.435	0.522	0.478	0.370	0.630	0.348	0.652	0.304	0.696
	> 9	1.000	0.000	0.000	1.000	0.000	1.000	0.000	1.000	0.000	1.000	0.000	1.000	0.000	1.000
	<=9	0.771	0.229	0.625	0.375	0.563	0.438	0.521	0.479	0.375	0.625	0.354	0.646	0.292	0.708

Source: Calculated from Table-11.

Now let us test this simple hypothesis with the Fisher's Exact Test. The result is extremely surprising, although in full conformity with common sense. In none of the 63 contingency tables, the null hypothesis of the equivalence of conditional probabilities is rejected as shown in Table-13. This is equivalent to acceptance of the independence between inflation and growth.

Table-13: Fisher's Exact Test Probabilities for 63 2X2 Contingency Tables in Table-12

Real GDP Growth (%)	CPI Inflation													
	>4	<=4	>5	<=5	>6	<=6	>7	<=7	>8	<=8	>9	<=9	>10	<=10
> 1 <= 1	0.780		0.400		0.460		0.500		0.640		0.660		0.720	
> 2 <= 2	0.357		0.528		0.246		0.305		0.544		0.580		0.690	
> 3 <= 3	0.115		0.599		0.552		0.649		0.609		0.558		0.604	
> 4 <= 4	0.283		0.380		0.404		0.269		0.470		0.608		0.589	
> 5 <= 5	0.411		0.225		0.362		0.388		0.364		0.494		0.413	
> 6 <= 6	0.353		0.431		0.518		0.500		0.552		0.575		0.517	
> 7 <= 7	0.544		0.533		0.620		0.500		0.345		0.287		0.364	
> 8 <= 8	0.357		0.528		0.246		0.305		0.544		0.580		0.256	
> 9 <= 9	0.605		0.155		0.207		0.245		0.405		0.431		0.514	

This is again a very strong result with clear implications for macroeconomic policies. This simply means that monetary policy should be pursued independently of growth policies. There seems to be no trade-off between inflation and growth. If there is any tradeoff, this can be taken care of by not lowering money supply growth below 9%, a rule arrived from earlier analysis. This result also casts doubts on the concept of "threshold" inflation for our country (Hussian 2005;, Mubarik, 2005). Our analysis reveals that it is possible to achieve higher growth rates of real GDP irrespective of the level of inflation. It is possible to achieve high real GDP growth rates with low levels of inflation as long as M_2 growth does not fall below 9%. Also, if it is ensured that M_2 growth rate is kept below 12%, this would exclude the cases of high inflation.

6. Conclusion, Relevance for Monetary Policy, Limitations of Exploration and Future Research Directions

We have learn from our examination of the data that inflation is primarily a monetary phenomenon. However, the quantity theory of money does not seem to hold for expansions in money supply below 9%. A simple monetary rule to maximize the probability of keeping inflation low (at most 6%) is to keep money growth at most 12%. These exploratory findings are strengthened by the results of Fisher's Exact Test. In addition, we learned that food inflation is also a monetary phenomena, and in order to keep food inflation lower, greater tightening is necessary than for the general inflation level. Our study also indicated the absence of a trade-off between inflation and real GDP growth. Therefore, monetary policy should be pursued independently of the growth oriented policies of government.

We need to be cautious here because our exploratory analysis was derived from the use of contingency tables in a way, perhaps, not done before. Nothing is new here, except for the repeated construction of 2x2 contingency tables, exploring the group of probabilities by putting them into new formats, and applying conventional statistical tests of independence or significance on the difference of conditional probabilities. In this way, our approach can be labeled as "2x2 qualitative exploratory analysis of quantitative data". First caution relates to unforeseen methodological problems that may arise due to the repeated partitioning of continuous time series data to make it qualitative. Contingency table analysis is usually applied on qualitative data, a mix of qualitative and quantitative data or also on classified quantitative data. I have not only classified the quantitative data but also done it repeatedly for pairs of time series data. Intuitively, there does not seem to be a problem. But this needs to be checked by other experts also. If it receives academic acceptance, this can lead to its replication on 2x2 interactions of other macroeconomic variables of interest that can potentially be bifurcated into high-low categories. Further applications can be explored in terms of the simultaneous interactions of more than two variables by using higher dimensional contingency tables.

A second cautionary note concerns drawing very strong policy conclusions for the future. This is so because we have only analyzed the past 50 years of data, without recourse to any economic theory. Analysis eschewed the questions of cause and effect, exogeneity and endogeneity etc. The focus of the analysis is exclusively on "interactions", and whether these are independent (in a probability sense) or not. It may be pertinent here to relate a famous saying of Imam Ghazali, who said if you beat a dog with a stick, the dog is going to bite you and not the stick! Hence, the dog knows

that stick has not caused the beating. Similarly, I can say it is excessive money growth which is beating the prices up and not vice versa. Therefore, cause and effect should be better ascribed by taking recourse to knowledge outside our analytical approach. The confusion in establishing cause and effect can be taken as a superiority of human beings who have been abundantly endowed with the seeds of doubt, that have created the bulk of human knowledge, though not necessarily the core knowledge.

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