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The Relationship between Inflation and Inflation Uncertainty in Emerging Market Economies

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A standard Generalized Autoregressive Conditional Heteroskedastic (q,v) model is employed to construct a measure of monthly inflation uncertainty in 12 emerging market economies, and the relationship between inflation and inflation uncertainty is examined using Granger-causality tests. The results suggest that higher inflation rates increased inflation uncertainty in all the economies, providing strong support for the Friedman hypothesis. The evidence on the effect of inflation uncertainty on average monthly inflation is more mixed, with increased inflation uncertainty leading to lower average inflation in Colombia, Israel, Mexico, and Turkey, consistent with the Holland hypothesis, but to higher average inflation in Hungary, Indonesia, and Korea, consistent with the hypothesis of Cukierman and Meltzer.

JEL Classification: C22, E31

1. Introduction

Friedman (1977) set out an informal two-part argument about the real effects of inflation. In the first part, an increase in inflation may induce an erratic policy response by the monetary authority and, therefore, lead to more uncertainty about the future rate of inflation. In the second part, inflation uncertainty has a negative effect on output. The causal effect of inflation uncertainty on inflation has been analyzed in the theoretical macro literature by Cukierman and Meltzer (1986) and Holland (1995). Cukierman and Meltzer show how, by providing an incentive for the monetary authority to create an inflation surprise in order to stimulate output growth, an increase in uncertainty about money growth and inflation will raise the optimal average inflation rate. Thus, a positive causal effect of inflation uncertainty on inflation is evidence of an 'opportunistic' central bank. In contrast, Holland claims that as inflation uncertainty rises due to increasing inflation, the central bank responds by contracting money supply growth in order to eliminate inflation uncertainty and the associated negative output effects. Thus, a negative causal effect of inflation uncertainty on inflation is evidence of a 'stabilizing' central bank. The different hypotheses on the link between inflation and inflation uncertainty have given rise to a large empirical literature, mainly with respect to the experience of the G7 advanced economies, where average inflation rates typically have been low (with the exception of a brief period in the late 1970s and early 1980s). Davis and Kanago (2000) review

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many of the early studies on the issue, highlighting the mixed results that partly reflect differences in the countries studied, sample periods, frequency of the data sets, and empirical methodologies, including the representation of inflation uncertainty. In the latter regard, recent studies have tended to use the estimated conditional variance from Generalized Autoregressive Conditional Heteroskedastic (GARCH) models to measure inflation uncertainty and generally have been supportive of the Friedman hypothesis.[1] These studies include Grier and Perry (1998) for the G7 countries; Fountas (2001) for the UK inflation experience over a long time span; Fountas, Ioannidis, and Karanasos (2004) for the inflation experience in five out of six European countries; and Conrad and Karanasos (2005) in a study of inflation in the United States, the United Kingdom, and Japan. In this paper, I focus on the inflation-uncertainty issue in emerging market economies. Specifically, I use the estimated conditional variance from a GARCH type model to measure inflation uncertainty and employ Granger methods to test for the direction of causality between inflation and inflation uncertainty in 12 emerging market economies. The results provide strong empirical support for the Friedman hypothesis that higher inflation rates raise inflation uncertainty, but are more mixed regarding the effect of inflation uncertainty on average monthly inflation.

2. The Model, Data, and Results

The GARCH time series studies that examine the link between inflation and inflation uncertainty use a variety of empirical methodologies. Following Fountas (2001), I use a GARCH (q,v) model of inflation extended to allow for the inclusion of the inflation rate as an exogenous regressor in the variance equation in which inflation, y_t, is an AR(p) process with time varying conditional variance:

$$y_t = \phi_0 + \phi_1 y_{t-1} + \dots + \phi_p y_{t-p} + \varepsilon_t;\ E(\varepsilon_t/\theta_{t-1}) = 0;\ Var(\varepsilon_t/\theta_{t-1}) = \sigma_t^2, \qquad (1)$$

$$\sigma_t^2 = \alpha_0 + \alpha_1\varepsilon_{t-1}^2 + \dots \alpha_q\varepsilon_{t-q}^2 + \beta_1\sigma_{t-1}^2 + \dots + \beta_v\sigma_{t-v}^2 + \delta y_t, \qquad (2)$$

where $\alpha > 0$, $\alpha_i \geq 0$, $i = 1,\dots q$, $\beta_j \geq 0, j = 1,\dots, \upsilon$, and θ_t is the information available at time t, and where according to the Friedman hypothesis, $\delta > 0$.

I use monthly data on the consumer price index (CPI) obtained from the International Monetary Fund's International Financial Statistics database for 12 emerging market economies with varying sample periods: Colombia, India, Malaysia, Mexico, South Africa (all 1957:1 to 2005:12), Thailand (1965:1 to 2005:12), Turkey (1970:1 to 2005:12), Indonesia (1968:1 to 2005:12), Korea (1970:1 to 2005:12), Israel (1975:1 to 2005:12), and Hungary and Jordan (both 1976:1 to 2005:12). The rate of inflation is measured as the monthly change in the log of the CPI and the number of observations (allowing for differencing) ranges between 359 and 587. The monthly inflation rates of the countries are plotted in Figure 1, from which it is clear that

[1] Although use of the estimated conditional variance from GARCH models to measure inflation uncertainty is more common in the recent literature than the use of survey-based estimates, the results need to be treated with caution. For example, Batchelor and Dua (1993) show that there is no correlation between ARCH and survey-based uncertainty measures, and that ARCH-based measures can give a misleading account of the causes of the changes in uncertainty and the effects on macro variables.

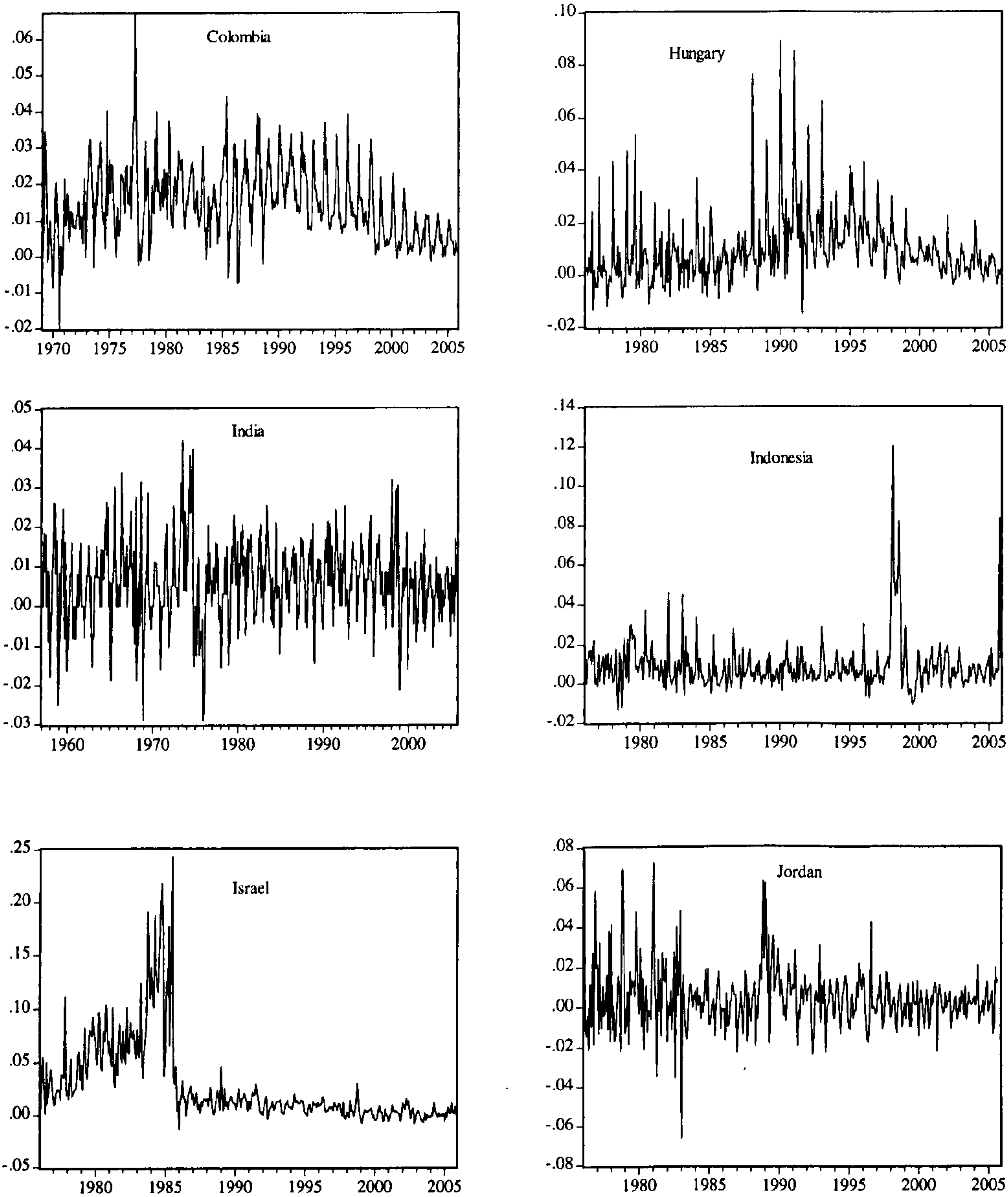

Figure 1. Monthly inflation in selected emerging market economies. Monthly inflation is defined as the change in the log of the consumer price index.

the series are very volatile. Summary statistics for the monthly inflation rates are presented in Table 1. The kurtosis and skewness statistics indicate that the distributions generally are nonnormal, being skewed to the right. The deviation from normality is confirmed by the large values of the Jarque-Bera statistics, and ARCH effects are indicated by the significant Q-statistics of the squared deviations of the monthly inflation rate from the sample means and the LM(12) statistics. The exceptions to these cases are India, where the distribution appears nonnormal, but also is wide and flat, and Mexico and Turkey, where there is no indication of ARCH effects in monthly inflation.

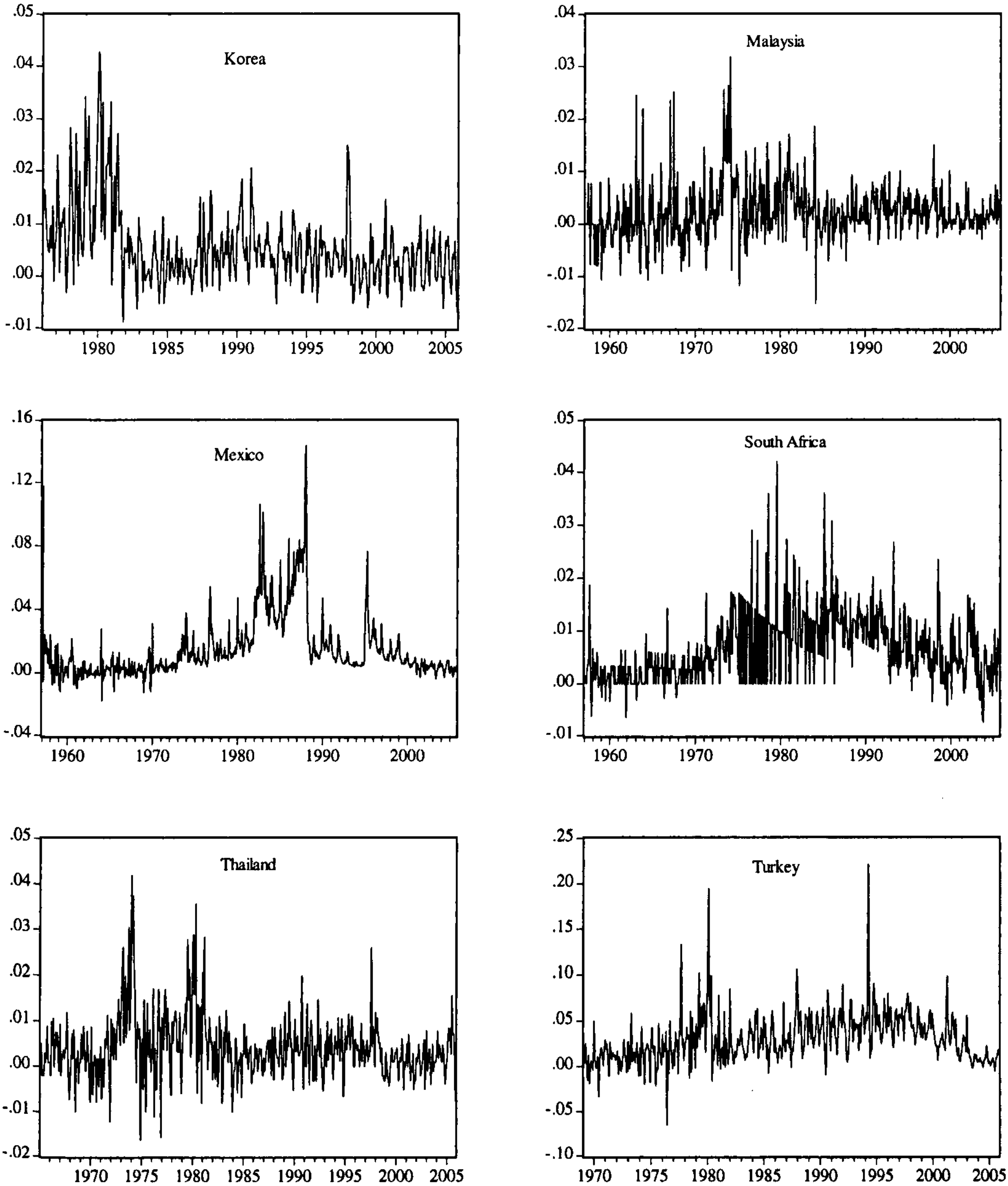

Figure 1. Continued

The next step is to consider the time series properties of inflation in each country. The authors of the studies cited above have tended to proceed as if inflation was a stationary series, though the empirical evidence on the issue is mixed with a substantial literature supporting nonstationarity.[2] A particular problem in the emerging market economies included in this study is the impact on the inflation series of the varying degrees of financial crisis and liberalization measures (including of administered prices) that each experienced during the sample periods

[2] Arize, Malindretos, and Nam (2005) survey recent studies on this issue and provide evidence in support on nonstationarity for a large number of developing economies.

Table 1. Summary Statistics for Monthly Inflation

	Period	μ	σ	K	S	J–B	Q^2_{12}	LM(12)
Colombia	1957:1–2005:12	0.015	0.010	4.143	0.704	49.09 (0.000)	35.88 (0.000)	27.85 (0.006)
Hungary	1976:1–2005:12	0.010	0.014	11.343	2.271	1346.01 (0.000)	168.79 (0.000)	154.11 (0.000)
India	1957:1–2005:12	0.006	0.010	3.938	−0.070	21.88 (0.000)	120.26 (0.000)	61.48 (0.000)
Indonesia	1968:1–2005:12	0.009	0.013	24.280	3.677	7561.26 (0.000)	40.23 (0.000)	50.77 (0.000)
Israel	1975:1–2005:12	0.027	0.040	9.447	2.372	955.67 (0.000)	208.37 (0.000)	107.42 (0.000)
Jordan	1976:1–2005:12	0.005	0.016	7.729	1.057	398.20 (0.000)	45.15 (0.000)	33.49 (0.000)
Korea	1970:1–2005:12	0.006	0.008	7.038	1.674	410.43 (0.000)	221.96 (0.000)	89.61 (0.000)
Malaysia	1957:1–2005:12	0.003	0.004	5.172	0.060	89.06 (0.000)	33.64 (0.001)	33.97 (0.000)
Mexico	1957:1–2005:12	0.051	0.094	3.415	3.415	2.87 (0.238)	5.66 (0.932)	10.16 (0.602)
S. Africa	1957:1–2005:12	0.006	0.006	5.652	1.171	304.67 (0.000)	95.93 (0.000)	69.05 (0.000)
Thailand	1957:1–2005:12	0.004	0.006	6.469	1.062	246.79 (0.000)	150.41 (0.000)	71.55 (0.000)
Turkey	1965:1–2005:12	0.035	0.027	11.690	1.640	1286.92 (0.000)	2.99 (0.996)	2.84 (0.999)

Inflation is calculated as the monthly change in the log of the respective consumer price index. μ is the average monthly inflation rate during the sample period and σ is its standard deviation. K and S are the estimated kurtosis and skewness, respectively. J–B is the Jarque-Bera statistic for normality. Q^2_{12} is the 12th order Ljung-Box test for serial correlation in the squared residuals of the inflation rate from its sample mean. LM(12) is the Chi-square (12) test statistic for ARCH effects. The numbers in parentheses are p values.

Table 2. Unit Root Test Statistics for Monthly Inflation

Panel (a) Unit root tests with no structural breaks

	P-P	ADF	DF-GLS	KPSS
Colombia	−11.78***	−3.18*	1.26	0.60***
Hungary	−14.96***	−1.12	−0.98	−2.49
India	−13.17***	−4.21***	−2.63***	0.12
Indonesia	−20.70***	−9.10***	−3.13***	0.21
Israel	−10.49***	−2.90	−2.15**	0.44
Jordan	−18.57***	−18.56***	−0.12	0.66
Korea	−11.76***	−11.76***	−0.77	0.11
Malaysia	−17.96***	−20.22***	−3.79***	0.36
Mexico	−8.95***	−4.14***	−0.63	0.61**
South Africa	−23.79***	−2.21	1.42	1.14***
Thailand	−17.36***	−8.14***	−1.92*	0.32
Turkey	−14.47***	−2.34	−1.98**	0.88***

Panel (b) Zivot-Andrews test with one structural break

	Test statistic	Break date
Colombia	−10.328***	1998:05
Hungary	−8.949***	1987:12
India	−11.758***	1999:08
Indonesia	−7.998***	1997:07
Israel	−6.186***	1985:08
Jordan	−12.445***	1988:08
Korea	−8.175***	1981:10
Malaysia	−8.635***	1971:08
Mexico	−6.684***	1988:12
South Africa	−9.004***	1993:05
Thailand	−7.104***	1972:01
Turkey	−7.798***	2000:02

P-P is the Phillips-Perron test, ADF is the Augmented Dickey-Fuller test, DF-GLS is the modified Dickey-Fuller test developed by Elliott, Rothenberg, and Stock (1996); in each case the null hypothesis is of a unit root in the series. KPSS is the Kwiatkowski-Phillips-Schmidt-Shin (1992) test for which the null hypothesis is that the series is stationary. The ZA test considers the null hypothesis of unit root with no break against the alternative of a stationary process with a break. Lag length is chosen on the basis of the Schwartz Bayesian Criterion in the case of the ADF test, the Newey-West criterion in the case of the Phillips-Perron test and KPSS tests, and the t-test in the case of the Zivot-Andrews test.

* $p < 0.1$.

** $p < 0.05$.

*** $p < 0.01$.

under study. In this context, I use five different unit root tests to determine whether the inflation series are stationary. The first four tests are relatively common in the literature but have been criticized because of bias toward nonrejection of the null hypothesis in the presence of structural breaks and their low power for near-integrated processes. These are the Augmented Dickey-Fuller (ADF) test developed by Dickey and Fuller (1979); the DF-GLS test developed by Elliott, Rothenberg, and Stock (1996), which is a modified Dickey-Fuller test that has improved power in small samples; the Kwiatkowski, Phillips, Schmidt, and Shin (1992) (KPSS) test; and the Phillips and Perron (1988) (PP) test. The ADF, DF-GLS, and PP tests are of the null hypothesis of a unit root against the alternative of (trend) stationarity; the KPSS test is based on the null hypothesis of stationarity. The fifth test is that developed by Zivot and Andrews (1992) (ZA), which allows for one structural break in the series. The ZA test considers the null hypothesis of unit root with no break against the alternative of a stationary process

Table 3. GARCH(q,v) Models for Inflation and Inflation Uncertainty

	Colombia	Hungary	India	Indonesia	Israel	Jordan	Korea	Malaysia	Mexico	South Africa	Thailand	Turkey
Inflation equations AR(p)												
Intercept	0.0002	−0.0013**	0.0016*	0.0020	−0.0005	0.0002	0.0005	0.0011**	0.0003	0.0000	0.0008*	−0.0023
	(0.0004)	(0.0004)	(0.0005)	(0.0005)	(0.0005)	(0.0006)	(0.0004)	(0.0002)	(0.0003)	(0.0003)	(0.0003)	(0.0016)
p(−1)	0.4914**	0.2544**	0.3421**	0.2843**	0.4207**		0.3885**	0.1676**	0.6356**	0.1824**	0.2664**	0.2800**
	(0.0305)	(0.0598)	(0.0396)	(0.0582)	(0.0554)		(0.0437)	(0.0434)	(0.0373)	(0.0485)	(0.0507)	(0.0654)
p(−2)										0.0979*		0.1264**
										(0.0462)		(0.0426)
p(−3)		0.1248**	0.1128*	0.1184**	0.1946**					0.1343**	0.1476**	
		(0.0412)	(0.0392)	(0.0363)	(0.0466)					(0.0423)	(0.0447)	
p(−4)									0.1020*			
									(0.0392)			
p(−5)					0.0858**	0.1171*	0.1218*				0.1321*	0.0920*
					(0.0418)	(0.0520)	(0.0429)				(0.0484)	(0.0361)
p(−6)					0.1317**					0.1529**		
					(0.0410)					(0.0316)		
p(−7)	0.0846*								0.0774*			
	(0.0328)								(0.0392)			
p(−8)	−0.0716*	0.0819*	0.0750*									
	(0.0348)	(0.0333)	(0.0346)									
p(−9)										0.1054*		0.0429*
										(0.0385)		(0.0203)
p(−10)	0.1200**		0.1006*									
	(0.0338)		(0.0354)									
p(−11)	0.1050*	0.0481**				0.1413**		0.1241**	0.0996*			0.1040**
	(0.0359)	(0.0154)				(0.0445)		(0.0340)	(0.0340)			(0.0281)
p(−12)	0.2903**	0.4774**	0.1657**	0.2223**	0.2681**	0.2367**	0.2769**	0.2038**	0.1346**	0.1769*	0.2547**	0.3022**
	(0.0309)	(0.0296)	(0.0364)	(0.0263)	(0.0428)	(0.0392)	(0.0337)	(0.0397)	(0.0332)	(0.0307)	(0.0451)	(0.0339)
p(−13)		−0.1569**		−0.2361**	−0.1300*				−0.1339**	−0.0710*		
		(0.0494)		(0.0209)	(0.0529)				(0.0346)	(0.0335)		
p(−14)							−0.1120*			0.1138**	−0.1116**	
							(0.0406)			(0.0368)	(0.0419)	

Table 3. Continued

	Colombia	Hungary	India	Indonesia	Israel	Jordan	Korea	Malaysia	Mexico	South Africa	Thailand	Turkey
p(−15)		−0.0794*	−0.1102*	0.0759**	−0.1186*							
		(0.0340)	(0.0383)	(0.0229)	(0.0440)							
p(−16)	−0.0687*			−0.1387**	0.0901*			−0.0671*				
	(0.0255)			(0.0192)	(0.0409)			(0.0334)				
p(−17)					−0.0862*	−0.1284**						
					(0.0384)	(0.0415)						
p(−18)		0.0414*	−0.1473**	0.0786**	0.1370**							
		(0.0173)	(0.0359)	(0.0203)	(0.0336)							
p(−19)		−0.0475*		−0.0570**			0.0593*					
		(0.0202)		(0.0193)			(0.0272)					
p(−20)				−0.0878**								
				(0.0188)								
p(−23)				0.0726*								
				(0.0304)								
p(−24)		0.2307**	0.1786**									
		(0.0290)	(0.0306)									
Variance equations												
Intercept	0.0000	0.0000	0.0000	0.0000	0.0000*	0.0000*	0.0000	0.0000	0.0000**	0.0000**	0.0000	0.0000**
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
ARCH(1)	0.1467**	0.4907**	0.1120**	0.6722**	0.2193**	0.2630**	0.1060*	0.1157**	0.3655**	0.2124**	0.0827**	0.7361**
	(0.0247)	(0.0823)	(0.0308)	(0.1336)	(0.0719)	(0.0630)	(0.0391)	(0.0282)	(0.0843)	(0.0449)	(0.0270)	(0.0999)
GARCH(1)	0.8422**	0.2807**	0.8241**	0.2269*	0.6104**	0.6186**	0.7558**	0.8242**	0.4051**	0.4725**	0.8708**	0.0914*
	(0.0211)	(0.0490)	(0.0438)	(0.0764)	(0.0712)	(0.0852)	(0.0469)	(0.0353)	(0.0634)	(0.0713)	(0.0331)	(0.0419)
P	0.0011**	0.0020**	0.0003*	0.0029**	0.0011**	0.0017**	0.0008**	0.0003**	0.0008**	0.0009**	0.0003**	0.0043**
	(0.0000)	(0.0001)	(0.0001)	(0.0304)	(0.0002)	(0.0004)	(0.0001)	(0.0000)	(0.0000)	(0.0001)	(0.0000)	(0.0003)
Diagnostics												
R^2 adjusted	0.437	0.480	0.112	0.160	0.722	0.048	0.373	0.105	0.765	0.270	0.242	0.225
Standard error	0.009	0.010	0.008	0.012	0.021	0.015	0.007	0.005	0.010	0.006	0.006	0.024
SBC	−6.830	−6.822	−6.819	−6.692	−6.098	−5.860	−7.380	−7.884	−6.986	−7.752	−7.514	−4.875
Q(4)	2.855	2.458	3.720	4.499	2.538	7.236	3.303	1.140	3.943	2.188	2.3663	10.112

Table 3. Continued

	Colombia	Hungary	India	Indonesia	Israel	Jordan	Korea	Malaysia	Mexico	South Africa	Thailand	Turkey
p value	(0.582)	(0.653)	(0.445)	(0.343)	(0.639)	(0.124)	(0.508)	(0.888)	(0.414)	(0.701)	(0.669)	(0.039)
$Q^2(4)$	6.631	3.818	1.862	1.464	3.348	2.742	3.581	1.472	1.188	2.322	1.267	1.969
p value	(0.157)	(0.431)	(0.761)	(0.833)	(0.501)	(0.602)	(0.466)	(0.832)	(0.880)	(0.677)	(0.867)	(0.741)
Q(12)	22.326	6.458	8.552	15.156	10.152	12.766	10.018	17.355	14.080	8.239	28.959	39.293
p value	(0.034)	(0.892)	(0.741)	(0.233)	(0.603)	(0.386)	(0.614)	(0.137)	(0.296)	(0.766)	(0.004)	(0.000)
$Q^2(12)$	20.219	31.495	7.783	5.643	9.842	5.602	0.515	13.408	13.323	20.387	6.691	10.436
p value	(0.063)	(0.002)	(0.802)	(0.933)	(0.630)	(0.935)	(0.571)	(0.340)	(0.346)	(0.060)	(0.877)	(0.578)
LM4 (chi-square)	0.164	0.431	0.760	0.754	0.517	0.699	0.463	0.825	0.887	0.679	0.867	0.752
LM12 (chi-square)	0.073	0.004	0.798	0.684	0.657	0.959	0.476	0.339	0.488	0.100	0.419	0.564

SBC is the Schwartz Bayesian Criterion; Q(k) and Q2(k) are the Box-Pierce statistic of the levels of the residuals and the squared residuals, respectively; LM4 and LM12 are ARCH LM test statistics of chi-square(4) and chi-square (12), respectively. In the inflation and errors variance equations, figures in parenthesis are standard errors.

* Significant at the 5% level.

** Significant at the 1% level.

with a break. The results from the tests that make no allowance for structural breaks are in Panel (a) of Table 2. The PP test statistics indicate that inflation is a stationary series in all cases. The other test statistics are less clear cut; however, the null hypothesis of a unit root is not rejected for Hungary, Israel, South Africa, and Turkey in the case of the ADF test and for Colombia, Hungary, Jordan, Korea, Mexico, and South Africa in the case of the DF-GLS test; and the null hypothesis of stationarity is rejected in the cases of Colombia, Mexico, South Africa, and Turkey. The results from the ZA test are given in Panel (b) of the table and suggest that the inflation series are stationary when structural breaks are taken into account. In each case, the null hypothesis of a unit root with no break against the alternative of a stationary process with a break is rejected.

The maximum likelihood estimates of the GARCH model are reported in Table 3. In carrying out the estimates, I began with an inflation lag length of 36 months, which was then shortened on the basis of the Schwartz Bayesian Criterion. The results strongly support the existence of a positive relationship between the level and variability of inflation. In all cases the reported parameters in the inflation and covariance equations are highly significant and of the hypothesized signs. The intercept in the conditional variance equation is positive, which is consistent with the nonnegativity of the variance. The sum of the ARCH and GARCH coefficients in the conditional variance equation is less than one, which is consistent with the conditional variance of inflation being stationary. Finally, the parameter δ in the covariance equation is always positive and significant, and indicates that if inflation rises by one unit, its conditional variance goes up by between 0.01–0.008.[3] The Q-statistics for the standardized residuals and squared residuals show no patterns with the exceptions of a significant spike at the 12th lagged residual in the Thailand and Turkey data.[4]

Table 4 reports results from Granger-causality tests of the inflation–inflation uncertainty relation with lags of four, eight, and 12 months. Panel (a) reports results of tests of causality running from inflation to inflation uncertainty and provides evidence strongly favorable to the Friedman hypothesis. The null hypothesis that inflation does not Granger-cause inflation uncertainty is rejected in all cases with the exception of Malaysia, and the Granger-causal effect is positive in all cases. Panel (b) reports results where causality runs from nominal uncertainty to the rate of inflation. The null hypothesis that inflation uncertainty does not Granger-cause inflation is rejected in seven of the 12 cases. The results for Hungary, Indonesia, and Korea suggest a positive causal relation from inflation uncertainty to inflation, supporting the Cukierman and Meltzer (1986) hypothesis of an 'opportunistic' central bank. In the cases of Colombia, Israel, Mexico, and Turkey, the causal relation is negative, supporting the Holland hypothesis of a stabilizing central bank. In their work, Grier and Perry (1998) and Conrad and Karanasos (2005) suggest that whether central banks are 'opportunistic' or 'stabilizing' in response to increased inflation uncertainty might depend on the degree of central bank in-

[3] As the unit of measurement for the inflation series is 0.1 or 10%, the unit of measurement for the conditional variance is 0.01 or 1%.

[4] At the suggestion of one of the referees, as a final robustness check, the equations were re-estimated over the lengthiest period of the sample for which no structural break is indicated by the results of the ZA test reported in Table 2 and where sufficient observations were available for GARCH estimation. The equations were re-estimated for Colombia (1957:1–1998:4), Hungary (1988:1–2005:12), India (1957:1–1999:7), Indonesia (1968:1–1997:6), Malaysia (1971:9–2005:12), Mexico (1958:1–1988:11), South Africa (1957:1–1993:4), and Thailand (1972:2–2005:12). The results (available from the author) are in line with those presented in Table 3 for each country; in addition, the Q-statistics for the standardized residuals show no patterns in the case of Thailand.

Table 4. F-test Statistics for Granger-Causality between Inflation and Inflation Uncertainty

	Colombia	Hungary	India	Indonesia	Israel	Jordan	Korea	Malaysia	Mexico	South Africa	Thailand	Turkey
Panel (a) H_0: inflation does not Granger-cause inflation uncertainty												
Four lags	6.7**(+)	29.6**(+)	4.8**(+)	107.7**(+)	6.2**(+)	14.1**(+)	23.2**(+)	ns	102.7**(+)	51.0**(+)	21.0**(+)	47.7**(+)
Eight lags	4.3**(+)	17.8**(+)	4.0**(+)	53.0**(+)	10.5**(+)	9.6**(+)	9.9**(+)	ns	51.2**(+)	25.1**(+)	12.3**(+)	26.6**(+)
Twelve lags	3.2*(−)	13.6**(+)	2.9**(+)	35.9**(+)	10.1**(−)	6.8**(+)	7.9**(+)	ns	35.4**(+)	15.8**(+)	9.4**(+)	18.1**(+)
Panel (b) H_0: inflation uncertainty does not Granger-cause inflation												
Four lags	ns	5.2**(+)	ns	6.8**(+)	6.2**(−)	ns	7.6**(+)	ns	11.6**(−)	ns	ns	6.1**(−)
Eight lags	ns	3.6**(+)	ns	3.2*(+)	13.9**(+)	ns	3.3*(+)	ns	6.3**(−)	ns	ns	3.2**(−)
Twelve lags	3.3*(−)	ns	ns	ns	13.6**(−)	ns	ns	ns	4.6**(−)	ns	ns	3.1**(−)

(+) and (−) indicate that the sum of the coefficients are positive and negative, respectively; ns indicates not statistically significant.
* Significant at the 5% level.
** Significant at the 1% level.

dependence. A commonly used index of central bank independence is provided by Cukierman, Webb, and Neyapti (1992), which was updated recently by Polillo and Guillén (2005). The index, which is constructed on a scale from 0 (least independent) to 1, rates the central banks of all of these countries on the low side of the independence spectrum (though they generally have become more independent over time). However, the central banks exhibiting stabilizing behavior in the sense of the Holland hypothesis are generally ranked somewhat higher than those exhibiting the 'opportunistic' behavior according to the Cukierman and Meltzer hypothesis. Thus, in the former category, Colombia was rated as 0.27 in the 1970s and 1980s (though it improved to 0.44 in the 1990s), Israel was rated as 0.39 (improving to 0.70), Mexico was rated as 0.34 (improving to 0.56), and Turkey was rated as 0.46 (with no later improvement). In the latter category, Hungary was rated as 0.24 (improving to 0.67), Indonesia was rated as 0.28 (improving to 0.80), and Korea was rated as 0.27 (improving to 0.44).

3. Conclusions

In this paper I employed a standard GARCH (q,v) model to construct a measure of monthly inflation uncertainty in 12 emerging market economies over time spans of up to 48 years. I then examined the relationship between inflation and inflation uncertainty in these economies using Granger-causality tests. The results suggest that higher inflation rates raised inflation uncertainty in all the economies, thereby providing strong support for the Friedman hypothesis. The evidence on the effect of inflation uncertainty on average monthly inflation was mixed. Colombia, Israel, Mexico, and Turkey show the relation predicted by Holland where increased inflation uncertainty leads to lower average inflation. In contrast, the results for Hungary, Indonesia, and Korea show the relationship predicted by Cukierman and Meltzer, where increased uncertainty is associated with higher inflation.

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