Uncertainty of inflation and inflation rate: Does credibility of inflation policy matter

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ABSTRACT

We subject country level data to causality tests within a panel cointegration framework, to examine the relationship between inflation rates and the uncertainty of inflation for a panel of twenty two emerging economies, over the time period 1968 to 2010. Using the GARCH framework, a time series of conditional variances of inflation has been generated to serve as proxies for uncertainty of inflation. This series has been utilised to determine whether and how the relative degrees of central bank independence (CBI) influence the relationship between inflation rates and the uncertainty of inflation across the selected countries. Results of cointegration tests in the total sample confirm a robust long run equilibrium relationship between inflation and the uncertainty of inflation. For causality tests, although the long run outcomes are similar, short run results show some differences along the lines of the degree of CBI. For high CBI countries, the causal link in the short run is unidirectional and supports the Friedman-Ball hypothesis. By contrast, the low CBI countries display bidirectional causal links in the short run and provide support for both the Friedman-Ball and Cukierman-Meltzer hypothesis. In the long run, the entire panel and the two subgroups of countries all provide significant evidence affirming the Friedman-Ball hypothesis. The unambiguous conclusion of the empirical investigation suggests that the Friedman-Ball hypothesis is a long run phenomenon, regardless of differences in degrees of central bank independence.

1. INTRODUCTION

MANY CENTRAL BANKS, in both developed and emerging countries, have taken steps to enhance the levels of independence of their central banks over recent years. The primary motivation for this trend is the widely published empirical evidence linking relatively high levels of the independence of central banks to lower and stable inflation rates (Crowe and

Meade, 2008; Ja'Come and Vazquez, 2008). In this study, we re-examine this widely accepted view for a panel of emerging countries, by focusing on the causal relationship between inflation rates and uncertainty of inflation. As indicated in Keskek and Orhan (2008), the Economics and Finance literature provides ample theoretical and empirical outcomes that suggest a positive relationship between these two variables.

An area of contention of the links between inflation and its uncertainty is the direction of the connection. One side of the debate, generally associated with Friedman (1977) and Ball (1992) (hereafter Friedman and Ball), propose that the link is from inflation to the uncertainty of inflation rates while another group, which notably includes Cukierman and Meltzer (1986), argue that it is uncertainty that induces inflation either to increase or decrease. This takes on considerable importance given the influence of inflation on interest rates, exchange rates and overall health of any country's aggregate economy. Our contribution to this debate is, first, to investigate the existence and nature of the relationship between the two variables in emerging markets. Second, we examine whether there is any impact of the growing adoption and influence of central bank independence measures in these economies on the relationship between inflation rates and the uncertainty of inflation. The surging play-making role of emerging economies in current global financial and economic matters makes this study not only timely but perhaps an imperative one. The study involves 22 countries from different regions of the world.

Theoretical arguments have been presented by Friedman (1977), and Ball (1992) positing that generally high inflation causes inflation uncertainty. The main thrust of their argument centres on uncertainty on the part of agents in an economy trying to gauge the preferences of monetary policymakers toward inflation and the policy responses to rising rates of inflation. The literature provides empirical evidence in support of the endogeneity of the uncertainty of inflation in its relationship with average inflation (Grier and Perry (1998), Perry and Tevfik (2000) among others). Cukierman and Meltzer (1986) on the other hand, present a theoretical proposition that advances an opposite directional relationship between inflation and the uncertainty of inflation. Specifically, they argue that high uncertainty of inflation and the murky economic environment it engenders may provide monetary policymakers the latitude and incentive to surprise unsuspecting agents in an economy with measures that serve to increase inflation rates.[2] Motivation for policymakers to engage in the latter behaviour, are the benefits, among others, of seigniorage which includes the reduction in real value of outstanding government debt. To the extent that policymakers take advantage of the opportunity for monetary innovations, it is conceivable to observe high uncertainty resulting in higher inflation rates.[3] They also posit that the tendency for the latter scenario to occur is likely a function of the credibility of the monetary policymaker.[4]

Juxtaposing the relationship between inflation rates and uncertainty of inflation on the one hand, with the observed links between degrees of central

bank independence and inflation rate on the other, we investigate the relevance of the results to Friedman-Ball and Cukierman-Meltzer hypotheses in the context of emerging countries. The methodology used for this investigation is a two-step procedure. First we employ a Generalised Autoregressive Conditional Heteroscedasticity (GARCH) framework to obtain proxies for uncertainty of inflation. Second, we subject data on uncertainty and inflation to causality tests within Pedroni's (1999, 2001) panel cointegration framework. Overall we find strong evidence for the Friedman-Ball proposition in the entire panel of countries, and in both the high and low central bank independence (CBI) subgroups. In the short run however, the test results differ between the two subgroups of countries. While the low CBI countries display support for both the Friedman-Ball hypothesis and Cukierman-Meltzer hypothesis, the high CBI countries affirm *only* the Friedman-Ball hypothesis. Based on the overall results, we find evidence in support of the Friedman-Ball hypothesis as a long run phenomenon.

The rest of the paper is organised as follows. An overview of the literature on central bank independence and inflation and the uncertainty of inflation are presented in the section that follows. Data, methodology and empirical results are discussed in section 3. Finally, section 4 discusses the implications and conclusions of the study.

2. Existing views in the literature

2.1 Central Bank Independence

Cukierman (1992) provides CBI indexes based on the legal tenets of the charters of the respective central banks of countries, and another set of indexes based on the turnover rates (TOR) of heads of central banks over periods of ten year blocks. The latter indices are designed to provide a more practical measure of the degree of central banks' independence. He argues, and supports the position empirically, that in most developing countries the legal provisions in the charter of the central bank do not translate to reality on the ground. Empirical results demonstrate that the turnover rates (TOR) provide a more accurate measure of the degree of independence of central banks in these countries. Since all countries in this paper over the period of study are emerging countries, the use of TOR as the measure of central bank independence appears to be more appropriate.

A number of scholars in the CBI literature have offered theoretical expositions and empirical evidence suggesting that countries with high levels of central bank independence tend to exhibit low and stable inflation rates. Prominent among these are Bade and Parkin (1985), Grilli *et al* (1991), Cukierman (1992) Alesina and Summers (1993), Brumm (2000), Dolmas *et al* (2000), Neyapti (2003), Diana and Sidiropoulos (2004), Down (2004) and Siklos (2004). In more recent studies, Crowe and Meade (2008) and Ja'Come and Vazquez (2008) generally confirm the negative relationship between infla-

tion and central bank independence. In the latter study, they find the relationship robust to international crisis, banking crisis and exchange rate regimes.

2.2 Overview of inflation and uncertainty of inflation

Most financial and economic variables are quoted in nominal terms, therefore the behaviour of inflation is fundamentally relevant to the anticipated path of these variables. As indicated by Ireland (1996), Mishkin (1990a, 1990b) and Frenkel and Lown (1994), this renders the unpredictable or uncertain aspect of inflation even more important in the behaviour of nominal data. The path of a crucial variable like market quoted nominal interest rate is important to decision making at all levels. The important role interest rates play in the process of asset valuation serves to underscore the importance of factors that influence its path. Business and individual decisions on investments are largely predicated on the direction of interest rates. Therefore, given that real interest rates hardly change, the uncertainty aspect of inflation rates may tend to define reactions to the expected path of interest rates. So, knowing the direction of the relationship between inflation and its uncertainty, at a minimum, equips investors at all levels with additional information with which to gauge the predictability of rates and make appropriate decisions.

Various studies, including Ball *et al* (1990), Evans (1991, 1993), Evans and Wachtel (1993), Holland (1993, 1995) and Golob (1994) have attempted to establish the relationship between inflation and its uncertainty. In an earlier study of 17 OECD countries from 1951 to 1968, using standard deviation as a gauge for inflation variability, Okun (1971) reported that countries with average high inflation tend to display higher variability in inflation. In a related study Logue and Willett (1976), using data for 41 industrialised and developing countries, found a positive relationship between inflation and its variability for the period 1950-1970. However, upon disaggregating the sample into industrialised and developing countries in a regression model, the authors reported that some industrialised economies displayed a negative relationship between the referred variables. The authors reasoned that the results may reflect more effective monetary policy measures in periods of increasing uncertainty in the industrialised as against developing economies. Like Okun they used the standard deviation of inflation as proxy for variability and uncertainty of inflation. The use of standard deviation as proxy for inflation uncertainty does not always fully capture actual uncertainty, since in certain cases variability is predictable (Grier and Perry, 1998). Subsequent efforts to capture true inflation surprise and uncertainty have entailed the use of variations of ARCH/GARCH models to extract and generate conditional variances of the error term of autoregressive models of inflation rates. These efforts include Engle (1983); Bollerslev (1986), Grier and Perry (1998), Nas and Perry (2000), Fountas *et al* (2003) and Bhar and Hamori (2004)). Evans (1991, p. 174) shows that the changing behaviour of agents and policymakers toward

inflation can precipitate 'both ARCH effects and time variation in the structure of inflation'.

In large part, tests establish a positive relationship between inflation and its uncertainty; however the direction of the relationship is a matter of considerable debate. Bhar and Hamori (2004) examine the inflation and uncertainty relationship using a Markov switching model on G7 countries, and report that the relationship depends on whether the shock is transitory and differs by country.

Using a GARCH model to derive inflation uncertainty for G7 countries, Grier and Perry (1998) and Ball (1992) employ Granger Causality procedure to test the direction of causality between inflation and its uncertainty. Results indicate that inflation rates raises inflation uncertainty in significant fashion. Evidence establishing the link from inflation uncertainty to inflation connection is frail and inconclusive in this study.

In the same paper Grier and Perry find that for the US, UK and Germany a rise in inflation uncertainty results in lower inflation rates. Results are opposite for France and Japan. These results seem to be in line with each countries measure of credibility of monetary policymaker's commitment to inflation control, as presented by Cukierman's (1992) central bank independence indexes. The U.S. and Germany have higher measures of central bank independence as compared to that of France and Japan. Evidence presented by Fountas et al (2003) appear to confirm Grier and Perry's findings. They report a negative relationship between increased inflation uncertainty and average inflation for Germany and Netherlands, and opposite results for Spain, Italy and France.[5] The latter group of countries has, according to Cukierman's 1992 study, lower central bank independence measures than the former pair. These results perhaps underscores Kydland and Prescott's (1977) proposition of the adoption of 'rules' to enhance monetary policy consistency, a notion presented by Cukierman and Meltzer (1986) as credibility of policymakers. Increased monetary policy consistency reduces ambiguity of commitment of policymakers to inflation control and reduces uncertainty of future inflation expectations by agents following stabilisation actions by policymakers.

Given the influence of CBI on inflation rates, increased efforts of countries to enhance the levels of CBI, and the growing importance of emerging countries in the global economy, it seems imperative that we examine the connection between inflation and uncertainty of inflation, and its implications, for this latter group of countries.

3. Empirical approach

3.1 Data

The data set for our analysis consists of annual inflation rates and uncertainty of inflation for 22 emerging countries. The time period for the data set spans from 1968 through 2010. The time series data set on inflation rates was

obtained from the 2011 World Bank Development Indicators CD-ROM. The data set for uncertainty of inflation represents the time series on conditional variances of inflation constructed using the GARCH model. Also, we use central bank heads' turnover rates data provided in Cukierman (1992), for subdividing the panel into high and low CBI groups. The countries that are above the median turnover rate (of 0.22) have been included in the 'low CBI' group and the rest have been included in the 'high CBI' group. These sub-groups are listed in table 1. Turnover rates for Jordan, Sri Lanka and Jamaica are unavailable and therefore these three countries have been excluded from the list.

Table 1: Emerging Countries Categorised by degree of CBI based on turnover rates

High CBI		*Low CBI*	
Columbia	Nigeria	Argentina	Indonesia
Israel	Philippines	Brazil	Korea
Kenya	Portugal	Chile	Pakistan
Malaysia	South	Egypt	Peru
Mexico	Africa	Greece	Turkey
	Thailand	India	Venezuela

3.2 Inflation Uncertainty and the GARCH Model

The employment of a GARCH framework for this study is based on the methodology used in Grier and Perry (1998), Nas and Perry (2000), and Fountas *et al* (2003). This methodology captures the extent of inflation uncertainty and is an improvement over the traditional measure of the use of standard deviation of inflation rates. As explained earlier, the latter approach may fail to discount the predictable aspects of the standard deviation of inflation and therefore provide an inaccurate estimate of inflation uncertainty. In a similar vein, efforts to capture the uncertainty of inflation from standard deviations of survey responses to inflation expectations tends to lead to an underestimation of inflation uncertainty. The latter occurs because of the observed tendency of survey respondents to give similar estimates of inflation regardless of their respective actual future expectations of the path of inflation.[6]

The GARCH (1, 1) framework, described by Engle (2001) as 'the simplest and most robust of the family of volatility models' side-steps the short comings of the latter approaches and provides a measure of uncertainty of inflation presented by Ball (1993) and Cukierman and Meltzer (1986). The AR (1) - GARCH (1, 1) model employed in this study is as follows:

$$Inf_t = \delta_0 + \sum_{i=1}^{p} \delta_i \, Inf_{t-i} + \varepsilon_t \tag{1}$$

$$\sigma_{\varepsilon t}^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \alpha_2 \sigma_{\varepsilon t-1}^2 \tag{2}$$

Equations (1) and (2) are the general GARCH (1, 1) framework and assume that residual variance of inflation follows an AR process. Equation (1) is the AR (1) (i.e. autoregressive of order 1) model used to estimate the conditional mean of inflation (Inf_t) with an error term ε_t. Equation (2) is the conditional variance model, where the one period forecast of the variance of the residual $\sigma^2_{\varepsilon t}$ (conditional variance) is a function of the square of the previous error term, ε^2_{t-1} (the ARCH term) and the last residual variance, $\sigma^2_{\varepsilon t-}$ (the GARCH term).

3.3 Empirical results

We begin our empirical investigation into the long run relationship between inflation and uncertainty of inflation by testing for nonstationarity in these two variables. Following the standard technique, we test for the null of non-stationarity against the alternative of stationarity. The results of this test, shown in appendix table A, indicate that inflation and uncertainty of inflation have unit root properties, or are integrated of order one. With confirmation of the integrated order of the two variables, we use Pedroni's (1999, 2001) panel cointegration tests to examine the possibility of a long run relationship between them in the selected panel of countries.

The cointegration relationship we estimate has the general form as shown in equation (3) below. Since inflation uncertainty appears as an independent variable in equation (3), we take it to provide a basis for testing the Cukierman-Meltzer proposal that inflation uncertainty causes inflation. Consistent with the objectives of this study, we also test the alternative form of equation (3), in which uncertainty of inflation appears as the dependent variable. This alternative form, shown in equation (4), provides the opportunity to test the Friedman-Ball Hypothesis that considers uncertainty of inflation as an effect of inflation.

$$Infl_{it} = \alpha_i + \beta_i Uncfl_{it} + e_{it} \tag{3}$$

$$Uncfl_{it} = \alpha_i + \beta_i Infl_{it} + e_{it} \tag{4}$$

where α_i (i =1, 2, 26) refers to country-specific effects, and e_{it} is the estimated residual indicating deviations from the long-run steady state relationship.

With a null of no cointegration, the panel cointegration test is essentially a test of unit roots in the estimated residuals of the panel. If e_{it} in equation (3) and (4) is found to be stationary, or consistent with I(0), one may claim that cointegration exists between inflation rates (infl) and the uncertainty of inflation (uncfl). Pedroni (1999) refers to seven different statistics for testing unit roots in the residuals of the postulated long-run relationship. Of these, the first four are referred to as panel cointegration statistics; the last three are known as group mean panel cointegration statistics. A positive value for the first statistic and large negative values for the remaining six statistics allows rejection of the null of no cointegration. We compute all seven statistics for

both equations (3) and (4), representing Cukierman-Meltzer and Friedman-Ball hypotheses respectively, for the full panel and subgroups. The test results for these two different specifications of the cointegration model are reported in Tables 2 and 3.

Table 2: Cointegration Test: The Full Panel test statistics

Test Statistic	*All Countries*	*Low CBI*	*High CBI*
Panel V-Stat	23.7595	15.7204	8.7254
Panel rho-Stat	-20.6850	-15.8882	-22.2323
Panel PP- Stat	-19.2336	-15.3788	-30.3005
Panel ADF-Stat	-28.2377	-19.2161	-18.6248
Group - Stat	-16.2730	-12.2620	-18.4956
Group pp-Stat	-19.5532	-15.1989	-31.7918
Group ADF-Stat	-29.5208	-20.5742	-19.8506
Hypothesis	Cukierman - Meltzer		
Variables	Inflation Uncertainty (RHS), Inflation Rates (LHS)		

Note: All of the estimates are significant at 1% level.

Table 3: Cointegration Test: The Full Panel Test Statistics

Test Statistic	*All Countries*	*Low CBI*	*High CBI*
Panel V-Stat	21.5342	15.7254	15.3108
Panel rho-Stat	-28.5677	-21.5100	-18.9577
Panel PP- Stat	-32.0223	-24.0233	-20.3406
Panel ADF-Stat	-22.8871	-17.4612	-16.1474
Group - Stat	-22.4264	-16.8490	-15.2621
Group pp-Stat	-34.6411	-24.5080	-20.9893
Group ADF-Stat	-23.6541	-17.9682	-16.7506
Hypothesis	Friedman - Ball Hypothesis		
Variables	Inflation Rates (RHS), Inflation Uncertainty (LHS)		

Note: All of the estimates are significant at 1% level.

As is evident from the table, all of the statistics for all model specifications suggest rejection of the null at the one per cent level. Consequently, we conclude that the two variables of inflation rates and the uncertainty of inflation are cointegrated in the long run. The affirmation of the long run links between the two variables is consistent with both the Cukierman-Meltzer and

Friedman-Ball models, notwithstanding the differences in degrees of central bank independence of countries in the sample. Evidence of these links underscores their relevance in the formulation of policy measures for reducing both inflation and its uncertainty.

With evidence of a cointegrated relationship between the two variables of inflation and uncertainty of inflation, we proceed to test for the direction and the causal links in the long-run and short-run relationships. We follow the procedures for causality tests outlined in Engle and Granger (1987) and Granger *et al* (2000). The causality test itself is a two-stage estimation process. The first step relates to the estimation of the residual from the cointegrated relationship shown in equation (3). Incorporating the residual e_{it} as a right hand side variable, the dynamic error correction model is estimated at the second step for drawing inferences on Granger causality. Following these steps, our dynamic error correction model has the following form:

$$\Delta Infl_{it} = \alpha_{1i} + \eta_{1i} e_{it-1} + \Sigma_k \beta_{1ik} \Delta Infl_{i,t-k} + \Sigma_k \beta_{2k} \Delta Uncfl_{t-k} + u_{1t}$$

$$\Delta Uncfl_{it} = \alpha_{2i} + \eta_{2i} e_{it-1} + \Sigma_k \gamma_{1ik} \Delta Uncfl_{i,t-k} + \Sigma_k \gamma_{2k} \Delta Infl_{t-k} + u_{2t} \quad (5)$$

in which k refers to the optimal lag length for each country in the panel.[7]

The coefficients η_{1i} and η_{2i} represent a long run equilibrium path; the former shows the long run effects of the uncertainty index on logarithmic inflation rate and the latter reflects the long-run effects of logarithmic inflation rate on the uncertainty variable.

The set of β_{2ik} and γ_{2ik} coefficients represents the short run adjustment process along the equilibrium path. A standard F test is used to test the significance of both the long run and short run coefficients. The results of the F-test for the entire panel of emerging countries are reported in Table 4.

Table 4: Causality Test: All Emerging Countries

Hypotheses	*Long-run*	*Short-run*
Ho: Inflation does not cause uncertainty of inflation.	F = 11.79*	F = 6.09*
Ho: Uncertainty of inflation does not cause inflation	F = 0.73	F = 0.98

The reported results indicate that for all emerging countries, causality is unidirectional in both the long and short run, from inflation to the uncertainty of inflation. This confirms the dominance of the Friedman-Ball hypothesis in characterising the relationship between the two variables in the long run.

Generally, this result is intuitive since monetary policymakers, for both high and low CBI countries, are expected to target the inflation variable to achieve their objectives. While inflation-averse monetary policymakers (price 'conservative' practitioners) with efforts directed towards reducing and stabilising inflation are more likely in high CBI countries, 'opportunistic' policymakers targeting inflation for the purpose of generating seigniorage are more likely in low CBI countries. In either scenario the inflation variable serves as the 'instigator' and inspires an endogenous response from inflation uncertainty. This view is strongly supported by the non-rejection of the Friedman-Ball hypothesis in both the long and short run.

Expecting that the direction of causality might vary between the high and low CBI countries, we divide the panel into two groups of countries and re-estimate the dynamic models shown in equation (5). The results for the divided panels are shown in Table 5.

Table 5: Causality test for subgroups of countries

Hypotheses	*Low CBI*		*High CBI*	
	Long-run	*Short-run*	*Long-run*	*Short-run*
Ho: Inflation does not cause uncertainty of inflation.	F = 8.69*	F = 8.53*	F = 11.69*	F = 2.51*
Ho: Uncertainty of inflation does not cause inflation.	F = 0.94	F = 1.57***	F = 0.54	F =0.84

Notes: * Significant at 1% level, *** Significant at 10% level

As is evident, the long run results in both high and low CBI economies provide strong support for the Friedman-Ball hypothesis, consistent with the results of the entire panel of emerging economies. However, in the short run, while there is strong evidence affirming only the Friedman-Ball hypothesis for the high CBI countries, the low CBI countries provide evidence in support of both the Friedman-Ball and Cukierman-Meltzer hypotheses. Even though the evidence for Friedman-Ball hypothesis is stronger, the short run bidirectional causality between inflation and uncertainty of inflation for the low CBI countries raises interesting policy issues. A possible explanation for this observation may be the following. In the relatively immediate term, the interaction of the behaviours of value-conscious agents with perceived 'opportunistic' monetary policy makers in low CBI economies may generate uncertainty and actually fuel inflation. These actions may engender an uncertain macroeconomic environment which may, in turn, create an 'ambiguous' relationship between

inflation and the uncertainty of inflation. The latter macroeconomic situation will likely create instability, which is undesirable, and inspire institutional changes to enforce corrective action and enhance credibility of monetary policymakers. As policy measures target and attempt to lower inflation, and to the extent that the policies are perceived to be credible and effective, in the long run these actions may tend to lower both inflation and its uncertainty. In aggregate, the latter actions may result in a less 'ambiguous' macroeconomic environment, resulting in a clearer relationship between inflation and uncertainty of inflation as reflected by the long run unidirectional causal link, supporting the Friedman-Ball hypothesis.

By contrast, in high CBI countries results for both the short and long run offer robust support *only* for the Friedman-Ball hypothesis. This seems consistent with the expected nature of the interaction between agents in an economy characterised by credible inflation-targeting policies and policymakers. More explicitly, in a high CBI country where commitment to inflation reduction and stability is stronger, price targeted innovations, perceived as credible, solicit reactions from agents that ultimately serve to lower the uncertainty of inflation. In such an environment, there exists less ambiguity that the expected 'initiating' variable in the relationship is inflation. In effect it is inflation that induces uncertainty of inflation in this group of countries. Overall, the results for the entire panel as well as the subdivided country groups suggest that the Friedman-Ball hypothesis is unambiguously a long run phenomenon.

4. Conclusion

This paper extends the existing literature on the relationship between inflation and the uncertainty of inflation, by exploring whether and how relative degrees of central bank independence (CBI) in emerging economies may influence the link between the two identified variables. Using conditional variances generated from a GARCH process as proxies for uncertainty of inflation, the paper utilises a panel cointegration framework to assess this influence for a selected group of 22 emerging countries. The annual time series data on the relevant variables for these countries span 1968 to 2010.

Results of cointegration tests in the total sample and in the sub-groups of both high and low CBI countries confirm a robust long run equilibrium relationship between inflation and uncertainty of inflation. This observation holds regardless of the differences between the selected countries in terms of the observed degrees of central bank independence.

The outcome of long and short runs causality tests show some variation along the lines of the degrees of central bank independence in the sample of emerging countries. The overall sample provides strong and significant support in both the long and short run for the Friedman-Ball hypothesis. This outcome is intuitive since for both high and low CBI economies, monetary policymakers will target inflation to realise a desired outcome. While the objec-

tives of the high CBI countries will be to lower and stabilise inflation, those for the low CBI countries will more likely be to generate revenues. In either scenario, since the inflation variable is targeted, it will serve as the 'inducer' in the inflation and uncertainty of inflation relationship and, hence, provide strong affirmation of the Friedman-Ball hypothesis.

By contrast, along the lines of CBI we find an interesting difference in the outcomes. Similar to the outcome of the entire panel of emerging countries, high CBI countries display robust support for the Friedman-Ball hypothesis, both in the long and short run. On the other hand, the results of the low CBI countries show some difference between the short and long run outcomes. In line with the outcomes of both the entire panel and high CBI countries, test results of low CBI countries confirm support for the Friedman-Ball hypothesis in the long run. However, unlike the high CBI outcome, the short run results of low CBI countries display bidirectional causal links between the two variables of inflation and uncertainty of inflation; both the Freidman-Ball and the Cukierman-Meltzer hypotheses are thus affirmed in the short run. We posit that the reaction of agents to inflation-prone policies of 'opportunistic' central bankers in low CBI countries may tend to elevate the level of uncertainty and induce an inflationary situation in the near term, indicating support for the Cukierman-Meltzer hypothesis. This inflationary situation, however, is not sustainable in the long run. Subsequent credible actions taken to stabilise the situation will lower uncertainty and marginalise 'ambiguity' in the macroeconomic environment, allowing for clearer interaction of the two variables. Since inflation is the target variable, this relatively 'unambiguous' environment will make it more apparent that inflation is the 'inducer'. This may explain the significant long run unidirectional support for the Freidman-Ball hypothesis in the low CBI countries. Taken together, all the short and long run results derived from the full and the subdivided panels of countries provide overwhelming support for the Friedman-Ball hypothesis in the long run. Based on this support, the empirical investigation undertaken in this paper concludes that the Friedman-Ball hypothesis is a long run phenomenon.

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APPENDIX

Table

Unit Root Test for Inflation (Infl) and Uncertainty of Inflation (Uncfl)

Variable	*Levin-Lin rho-stat*	*Levin-Lin t-rho-stat*	*Levin-Lin ADF-stat*	*IPS ADF-stat*
Model 1: Intercept and Heterogeneous Trend with Common Time Effects				
Infl	-6.9049	-6.5350	-6.4115	-6.6275
DInfl	-75.8187	-19.2054	-18.2839	-29.7778
Uncfl	-5.5731	-4.0121	-4.5650	-5.8959
DUncfl	-94.8829	-32.0529	-19.2462	-32.1767
Model 2: Intercept with Common Time Effects				
Infl	-6.1114	-8.9327	-8.7018	-8.7989
DInfl	-63.5330	-23.5460	-22.4547	-29.9058
Unclf	-4.4906	-6.4916	-5.9812	-8.1832
DUncfl	-78.5851	-38.0192	-23.9153	-32.4748
Null:	Nonstationarity			

Figures showing the behaviour of inflation in the countries concerned will be available on the journal's website: www.economicissues.org.uk

ENDNOTES

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2. This behaviour of policymaker is what Cukierman-Meltzer described as the opportunistic central banker.

3. Grier and Perry (1998) find relatively weak empirical support for the uncertainty to inflation argument. Of the G-7 countries included in their study only Japan and France provide support for the uncertainty to inflation relationship.

4. Kontonikas (2004) reports that the adoption of inflation targets in the U.K. reduced long run inflation uncertainty and inflation rates. The announcement of an inflation target may have signalled an enhancement of inflation control credibility of policy-makers.

5. The observations on Spain, Italy, France and Japan may represent some support for Cukierman and Meltzer's idea of an opportunistic policymaker.

6. Zarnowitz and Lambros (1987) provide an in-depth examination on what they describe as 'consensus' forecasts.

7. With no evidence of increased model significance from extended lags, we kept the lag length limited to two periods.

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