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# THE VARIABILITIES OF INFLATION AND OUTPUT GROWTH RATES—ARE THEY RELATED?

Erkin I. BAIRAM*

*Abstract.* This paper tests the variability of output growth rate using a simple approach and pooled cross-country data, 1950–85. The estimated equations reported show that the variability of output growth rate depends upon the variability of inflation rate over time.

## I. INTRODUCTION

Recently, Bairam (1988) tested the variability of inflation using a new approach and pooled cross-country data. The estimated equation reported conclusively shows that the variability of inflation depends upon the variability of money supply over time. Unfortunately, even this strong conclusion is not sufficient to establish Friedman's hypothesis that suggests an increase in the variability of inflation leads to economic instability and inefficiency [see for example, Friedman (1977)]. Here, for the first time, this hypothesis is explicitly tested by estimating the relationship between the variability of inflation and that of output growth rate. If it is established that the variability of the former effects the variability of the latter, it could be argued that economic instability (proxied by the variability of output growth rate) is related to the variability of inflation and, therefore, Freidman's hypothesis is correct.

The outline of the paper is as follows. Section II briefly discusses the model and the data used for estimation purposes. Section III reports the estimated equations and interprets their economic implications. Finally, in Section IV, the main conclusion is summarised.

## II. THE MODEL AND THE DATA

The simple model on which the reported equations are based is of the form:

$$[(V_y^{\lambda}-1)/1]=\pi[(V_p^{\lambda}-1)/1]+e$$

where

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$$V_y=[1/(n-1)]\sum(y_i-y)^2 \quad \text{and} \quad V_p=[1/(n-1)]\sum(p_i-p)^2$$

are the sample variances of the rate of change in real output, $y_i$, and the rate of inflation, $p_i$, respectively, and $e$ is the random disturbance term.

This simple model assumes that the variability of output growth rate (measured by $V_y$) is related to the variability of inflation rate (measured by $V_p$). Since, without *a priori* tests, it is impossible to know the functional form, the equation is specified as a general Box–Cox (1964) model,[1] and is estimated using an appropriate maximum likelihood procedure [see White (1978)].

The annual time-series data used for estimation purposes are from Summers and Heston (1988). They cover the period 1950–85,[2] and are drawn from 115 developed and less developed countries. The rate of change in real output ($y_i$) is measured by the annual percentage change in real GDP and the rate of inflation ($p_i$) by the annual percentage change in GDP deflator. It should be emphasised that these series are not entirely consistent or reliable. Nevertheless, they are undoubtedly the most accurate complete series available. Furthermore, it should also be emphasised that the data used show wide variations across countries, therefore, minor inaccuracies are hopefully of little significance.

## III. THE RESULTS

From the statistical model and the data discussed in the previous section the equations reported in Table 1 are estimated. Since, for estimation purposes pooled **cross-country** data are used, in order to test the sensitivity of the estimated 'overall' relationship (based on the total sample, $n=115$) to sample changes the model is also estimated for six sub-samples based on the geographical locality and the level of economic development.[3] It can be seen from the table however that, although there are minor (but in some cases statistically significant) differences in functional forms estimated,[4] the conclusion to be drawn from each of the sub-sample results is not any different than that implied by the equation based on the total sample. Therefore, the results reported, conclusively suggest that changes in the sample used for estimation purposes would not significantly effect the results obtained.

[1] For example, $\lambda=0$ implies a log-linear model and $\lambda=1$ a linear model.

[2] For some less developed countries the period covered is from the early 1960s to 1985. It is also worthwhile to note that **both** $V_y$ and $V_p$ are computed for the **same** period (i.e. 1950–85).

[3] Initially structural differences within a given group **and** structural changes over time were tested using dummy variables. The test results obtained conclusively showed that it is realistic to assume that countries included in a given sub-sample have similar economic characteristics and have stable economic structures over time.

[4] It is clear from the likelihood ratio test results reported in Table 1 that for European, American and Oceanian countries and, consequently, for developed countries, $\lambda$ is not significantly different from zero, that is to say the log-linear model: $\ln V_y=\pi \ln V_p+e$ is the correct specification, but for African, Asian, and as a result, for all developing countries, and for all countries under consideration, the log-linear model is rejected.

TABLE 1. THE RELATIONSHIP BETWEEN THE VARIABILITY OF INFLATION ($V_P$) AND THE VARIABILITY OF REAL OUTPUT ($V_Y$), 1950–1985.

$$(V_y^{\lambda}-1)/\lambda=\pi[(V_P^{\lambda}-1)/\lambda]+e$$

| Sample ($n$) | $\pi$ | $\lambda$ | $RMR^2$ | $-2\log\theta$ |
|---|---|---|---|---|
| African countries ($n=43$) | 1.27 (28.10) | −0.26 | 0.950 | 11.34 |
| Asian countries ($n=26$) | 1.11 (24.74) | −0.14 | 0.960 | 4.66 |
| European countries ($n=19$) | 1.16 (79.89) | −0.09 | 0.997 | 0.28* |
| American and Oceanian countries ($n=27$) | 0.96 (21.02) | 0.11 | 0.974 | 3.52* |
| Less Developed countries ($n=94$) | 1.14 (62.47) | −0.14 | 0.978 | 24.38 |
| Developed countries ($n=21$) | 1.02 (778.06) | −0.01 | 1.00 | 0.58* |
| All countries ($n=115$) | 1.13 (92.77) | −0.11 | 0.987 | 25.16 |

Data Source: Summers and Heston (1988).

Notes: $RMR^2$ is the row moment $R^2$. The t-statistics are shown in parentheses. $-2\log\theta$ is the appropriate likelihood ratio used to test the hypothesis $H_0:\lambda=0$ (i.e. log-linearity). It is computed as followes: $\theta=[\max L(\lambda=0,\pi,\sigma^2)/\max L(\lambda,\pi,\sigma^2)]$, $-2\log\theta=-2(\log L(\lambda=0,\pi,\sigma^2)-\log L(\lambda,\pi,\sigma^2)]$ is asymptotically distributed as $\chi^2$ with 1 degree of freedom. Therefore, if $\chi^2_{0.05}=3.84>-2\log\theta$, $H_0$ is accepted (* denotes that the estimated $\lambda$ is not significantly different from zero).

Turning to the interpretation of the results obtained, since all $\beta$ and $RMR^2$ are around unity and close to unity, respectively, the equations estimated consistently suggest a near-perfect positive correlation between $V_y$ and $V_p$.[5] This is a very important conclusion for two reasons. Firstly, it confirms Freidman's hypothesis that suggests economic instability and inefficiency rises with an increase in the variability of inflation [see, Friedman (1977), pp. 466–68]. Secondly, since Bairam (1988) has shown that the variability of inflation depends upon the variability of money supply over time, the results obtained also imply that the variability of output growth rate depends upon the variability of money supply. Consequently, the results reported in Bairam (1988) and here have an important policy implication. They imply that a **steady** increase of money supply is the appropriate policy to reduce the variability of inflation and, hence, the volatility of the output growth rate and, thus, to improve economic stability and efficiency.

[5] The results obtained are very similar (with $RMR^2$ close to unity and $\beta$ around unity) when $V_p$ is regressed on $V_y$ (i.e. when $V_y$ is used as the explanatory variable). That is to say the results suggest that there is a correlation between $V_y$ and $V_p$ but the direction of causation is not well defined.

## IV. CONCLUSION

This short paper has tested the relationship between the variability of inflation and that of output growth rate over time using cross-country data and a simple non-linear model. The results obtained conclusively suggest that the two variabilities are very closely related.[6] Therefore, the results reported give support to Freidman's hypothesis that suggests an increase in the variability of inflation causes instability and uncertainty.

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[6] A referee of this journal pointed out that, since Bairam (1988) had shown that there is a relationship between the variability of money supply ($V_m$) and that of income ($V_y$), why not use $V_m$, instead of $V_p$, as the explanatory variable. There are two reasons why $V_p$ was preferred. First is that for most developing countries under consideration money supply data before 1970 are very rare. The second reason is that a correlation between $V_y$ and $V_m$ [Bairam (1988)] and another independent correlation between $V_y$ and $V_p$ (as it is reported here) implies that $V_m$ and $V_p$ are also correlated and this confirms Friedman's other hypothesis that suggests inflation is a monetary phenomenon.