Estimating a Taylor-type monetary policy reaction function for the case of a small developing economy

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Abstract

This paper estimates a simple, Taylor-type, monetary policy reaction function for the Dominican Republic (DR) during the period 1970-98. The estimated long and short run reactions of DR's monetary authorities can be identified for two distinct time periods. From 1970 to 1984 the authorities did not fully commit themselves to sustain one of their main policy targets, i.e., the official exchange rate. The outcome of such reactions, in part, propitiated the collapse of the exchange rate regime in 1985, and the need to sign a series of stabilisation agreements with the IMF. In contrast, from 1985 to 1998 the authorities' reactions appear to be more 'systematic', which might be attributed to a determination to 'implicitly' follow feedback rules, rather than discretion, in monetary policy making.

Keywords: monetary policy reaction function; Taylor's rule; Dominican Republic.

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1. Introduction

The analyses of the reactions of monetary authorities to economic developments, and of the impact of their actions on the economy, are amongst the key areas of monetary economics. The initial surge of interest in the latter aspect was motivated by Friedman and Schwartz's (1963) influential work, halting after the development, and centre stage role, of Real Business Cycle (RBC) models, which virtually attribute no importance to monetary policy. The focus on the subject was boosted by the work of Sims (1980) on vector autoregressions (VARs), which is to date the dominant approach in the assessment of the effects of the actions of monetary authorities.

The analysis of the monetary authorities' reactions, although a sensibly researched topic (Khoury,1990), has been put aside, probably as a result of the popularity of the VAR methodology[1]. However, a recent interest in monetary policy reaction functions has been (mainly) motivated by the work of John Taylor (1993). Judd and Rudebusch (1998) analyse US reaction functions based on the Taylor rule. Using quarterly data, the authors find that Taylor-rule type reaction functions fit the US monetary policy experience reasonably well during the 1970-1997 period. Nevertheless,

[1] See Rudebusch (1998) for a critique of the secondary role given to the monetary authorities' reaction function in the VAR framework.

the estimations account better for the period of Alan Greenspan as Chairman of the USFED, than for the Paul Volcker, or Arthur Burns ones.

Clarida, Galí, and Gertler (1998) have estimated monetary policy reaction functions for France, Germany, Italy, Japan, the UK, and the US. Using a forward looking version of Taylor's reaction function, the authors report the existence of an implicit inflation targeting framework for the cases of Germany, Japan, and the US. They also report a forward looking behaviour in the policy setting of the central banks of those countries, given their reactions to anticipated inflation. For France, Italy, and the UK they find that the Bundesbank's policy rule can help explain the type of behaviour these countries followed prior to the collapse of the EMS. The authors explicitly argue that, in the light of the outcomes of their investigation, a policy of fixing exchange rates is probably inferior to an inflation targeting one.

Although Taylor's is the most popular approach to the empirical analysis of reaction functions, other approaches have been implemented as well[2]. For example, McCallum and Nelson (1999) show results from the implementation of nominal income targeting as a monetary policy rule. The authors compare the results of Clarida, Galí, and Gertler's (2000) findings for the US based on Taylor's rule to one based on nominal income targets. Specifically, McCallum and Nelson consider responses of the policy instrument (the federal funds rate) to expected nominal income growth, rather than to

[2] McCallum (1999) provides a review of some of the recent development in the empirical analysis of monetary policy rules, giving particular attention to the case of Japan. Taylor (1999) presents a collection of articles which, applying diverse econometric frameworks, quantitatively investigate the robustness of alternative monetary policy rules.

expected inflation. The results they obtain are quite interesting: it seems that US monetary policy since 1979 can be reasonably explained by a policy rule that depends on expected nominal income growth. The authors argue that US monetary policy can be interpreted as if it was designed to stabilise nominal income growth.

Additionally, Mehra (1999) estimates a forward looking monetary policy reaction function for the US economy. Mehra's function is capable of predicting the behaviour of the federal funds rate since 1979 (Volcker-Greenspan periods), and demonstrates that such a rate has responded to long-run inflationary expectations derived from the bond rate, a variable not included in previous US reaction function estimates. The author attributes the success of US monetary policy in achieving macroeconomic stability during this period to forward looking behaviour on the part of the monetary authorities.

The aim of this paper is to empirically estimate a Taylor-type monetary policy reaction function to the case of a small developing economy, namely the Dominican Republic (DR). Although this type of framework has been implemented in the analysis of advanced economies, little work has been done for less developed countries. Despite the fact that the explicit guidelines that central banks in such economies consider when taking their policy decisions are difficult to determine, for obvious institutional reasons[3], empirical evidence could help to determine the fashion in which they 'implicitly' reacted to economic developments. Given the importance of the monetary authorities' reaction functions in, for example, macro modelling, research in the topic should be a useful one.

[3] I.e., non-independence of the central bank from the government, lack of credibility.

2. A reaction function for the DR

2.1. Specification

Taylor's rule advocates that the setting of the US federal funds rate (i) should be determined by the rate of inflation (π), an equilibrium real funds rate (r^*), plus an evenly weighted average of two gaps: the four-quarter moving average of the actual inflation rate given by the GDP deflator less a target rate (π^*), and the percent deviation of real GDP from an estimate of its potential level (y_t). Therefore, Taylor's rule encompasses two key targets of monetary policy: a low and stable inflation rate, and a sustainable growth of output. In equation form, Taylor's rule is given by

$$i_t = \pi_t + r^* + 0.5(\pi_t - \pi^*) + 0.5(y_t) \quad . \qquad (1)$$

The weights given in (1) to deviations of inflation and output (0.5) were assumed, rather than econometrically tested[4]. However, Judd and Rudebusch (1998) analyse the US Federal Reserve's reaction function based on the Taylor rule, giving particular attention to the specification of dynamics, the equilibrium real rate included, the inflation target, and the output gap.

Following Judd and Rudebusch, the present paper estimates a Taylor-type monetary policy reaction function for the case of the DR by paying particular attention

[4] For the US economy, Kozicki (1999) explores the empirical implications of different empirical specifications of Taylor's rule.

to the specification, stability, and dynamics of such a relation. The modified version of Taylor's rule to be estimated can be written as

$$h_t = \beta_0 + \beta_1 Erdiff_t + \beta_2 ygap_t + \varepsilon_t \quad , \qquad (2)$$

where *h* is the monetary base, *Erdiff* is the difference between the black market exchange rate and the official exchange rate, *ygap* is the output gap, and ε is a well-behaved disturbance term. β_0, β_1, β_2 are a constant term and coefficients to be estimated empirically, respectively. Equation (2) can be seen as a 'feedback' rule in which the monetary base reacts to *Erdiff*, *ygap*, or both.

Let us explain the modifications made to equation (1). First and foremost, the most likely demand management instrument to be used by monetary authorities in developing countries is the monetary base[5]. Instruments frequently used in advanced economies, such as an interest rate, are less likely to be implemented, given the different transmission mechanism of monetary policy in such economies (Montiel, 1991). For example, in the case being analysed, i.e., the DR, ceilings were imposed on market interest rates until the beginning of the 1990's[6].

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[5] Amongst the 42 US monetary policy reaction function studies surveyed by Khoury (1990), there are six which employ some measure of the monetary base as the dependent variable.

[6] Young et al (1999) provide a concise description of financial repression in the DR, which was considerable until the wide-ranging economic reforms undertaken in the beginning of the 1990s.

Additionally, given the fact that the DR has historically had a multiple exchange rate regime[7], some sort of exchange rate indicator would be a good candidate to be one of the (implicit) targets of the authorities. These arguments rationalise the inclusion of *Erdiff* in equation (2), a differential that the authorities should be willing to try to keep as small as possible, and as for long as they can, mainly by intervention in the exchange rate market[8]. So $\beta_1<0$ would be achieved if the authorities are in the disposition to defend the official rate. Such an outcome could be generated mainly by depletion of foreign reserves, but could also be paired with a reduction in domestic credit, in order to attempt to reduce liquidity: less RD$ in the streets means less demand for US$. The higher *Erdiff* the higher is the probability that the official exchange rate regime would

[7] The system is composed of the official; banking system (the Monetary Committee of the CBDR officially incorporated commercial banks to the exchange rate market in August of 1982); and extra-banking system (parallel-black) exchange rate markets. The (legal) existence of the last one was acknowledged by the CBDR in 1967, given that, at the time, it could no longer provide 'all' the foreign currency demanded by the system. Notice that the paper does not explicitly incorporates the banking system rate. The main reason for this decision is that such a sector was 'repressed' until the beginning of the 1990s.

[8] Note that although inflation is not explicitly included in (2), it enters through the nominal black market exchange rate. Sánchez-Fung (1999) has shown that the black market exchange rate in the DR is determined efficiently, in the sense that it complies with the 'relative version' of the PPP hypothesis. So the black market rate accounts for developments in both domestic and foreign prices.

collapse. Under adverse circumstances, however, it is impossible to maintain an overvalued currency, given that the amount of foreign reserves is not infinite.

The other variable (target) to be included in (2) is the output gap, as in the original Taylor (1993) model. Such a gap is intended to be a gauge of inflationary pressures: the farthest above potential real GDP is the highest is the probability of an 'overheating' of the system. So $\beta_2<0$, unless the authorities follow a lean with the wind policy.

2.2. Long run analysis

Equation (2) is estimated using annual data for the period 1969-1998[9]. The monetary base (*h*) is given by the sum of the IMF's International Financial Statistics (IMF IFS) lines *31n* and *32*, which comprise the asset side of the central bank's balance sheet. The exchange rate ('sell') data of the official and black market exchange rates used in the calculation of *Erdiff* are obtained from the Central Bank of the Dominican Republic (CBDR). Finally, the output gap (*ygap*) is expressed as the percent deviation of DR's real GDP (IMF IFS line *99b* divided by line *99bip*) from its potential. The latter is

[9] Such a time span is analysed given that the late 1960s onwards can be regarded as modern democratic times in the DR. From 1930 to 1961 a dictatorship prevailed, and from 1961 until 1965 institutional and political instability reigned, ending up in a civil war in April of 1965.

approximated by its linear trend over the sample period 1969-1998, as in Taylor (1993)[10].

The version of (2) to be empirically estimated can be written as

$$h_t = \beta_0 + \beta_1 h_{t-1} + \beta_2 Erdiff_t + \beta_3 Erdiff_{t-1} + \beta_4 ygap_t + \beta_5 ygap_{t-1} + \varepsilon_t \quad . \qquad (3)$$

Equation (3) is an autogressive distributed lag specification of order one [ADL (1,1)]. It is chosen in order to account for the well know problem of preliminary, as well as wrongly measured data. Although we are working with ex-post data, i.e. not with the information the authorities based their original decisions on, in developing countries data mining is a well known reality. Therefore, it seems useful to allow lagged reactions by the monetary authorities in the type of exercise being undertaken, even when working with annual data.

The long-run solutions to various estimates of equation (3) are displayed in Table 1. The first column (equation 4) shows the results of estimating equation (3) for

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[10] Specifically, $ygap = \frac{realGDP - potentialGDP}{potentialGDP} \times 100$. As noted by Judd and Rudebush (1998, page 8), other methods have been employed in the estimation of the output gap. Clarida, Galí, and Gertler (2000), for example, include the unemployment rate as an output gap proxy. However, the measure used by Taylor (1993) seems to be the most suitable for the case of a developing country. Other approximations require more specific series, which might not be readily available for the period under analysis, or have not been systematically collected at all. For the case of the DR this is, unfortunately, the situation.

the full sample period 1970-98. The coefficient of *Erdiff* is significant and shows the expected negative sign. However, the coefficient of the *ygap* variable is not significant. Furthermore, although (4) complies with most of the diagnostic statistics reported in Table 1, it fails the normality test. It could be suspected that the relation been studied is subject to an structural break. Given the variables involved in the analysis, the most likely point of such a break is (January) 1985, when the official RD$/US$ exchange rate was first devaluated. Dividing the sample in two periods, 1970-84 and 1985-98, and applying a Chow test confirms such a change[11].

In the light of the above results, equation (3) is estimated for two separate periods: 1970-84 (equation 5) and 1985-98 (equation 6). Equation (5) complies with all the diagnostic statistics. Although the coefficient of *Erdiff* is not statistically significant, the one affecting *ygap* is well determined. Contrary to what would be expected, however, the authorities seem to have followed a 'lean with the wind policy', given that β_2 is positive.

Equation (6) shows results that are in sharp contrast to those obtained in (5): the coefficient affecting *Erdiff* is significant and carries the expected negative sign, whereas the *ygap* coefficient is none of the two.

2.3. Dynamic analysis

It is interesting to determine how quick monetary authorities in the DR reacted to deviations from their 'implied rules' estimated above. In order to do so, short run

[11] The Chow test is F(14, 9) = 99.211(0.00), which is significant at the 99% level.

version of (5) and (6) are estimated by using the rates of change of the variables, as well as the lagged saved residuals from such equations, or equilibrium correction mechanisms (ECMs), as explanatory variables. The coefficients of the ECM terms are expected to provide information regarding the speed of adjustment to the equilibrium, or steady state, relation between the variables been modelled.

The short run ECM version of (5) is given by

$$\Delta h_t = 0.038 \Delta Erdiff_t + 0.047 \Delta ygap_t - 0.219 ECM(1)_{t-1}^{**} \quad . \qquad (7)$$

Sample period: 1970-84

$R^2 = 0.92$ RSS = 0.02838 AR-F (1, 11) = 0.692

ARCH-F (1, 10) = 0.052 NORM-$\chi^2(2) = 1.200$

RESET-F(1,11) = 0.632

Equation (7) complies with all the diagnostic statistics reported (described in Table 1). Although the rates of change of the exchange rate differential and the output gap are not significant, the ECM term, which is the key element in (7), is so at the 99% level, denoted by **. According to the coefficient affecting *ECM*(1), roughly over 20% of the deviations from the implied rule (5) would be corrected within one year, on average.

The analogue short run estimations for equation (6) yields

$$\Delta h_t = -5.382\Delta Erdiff_t^{**} - 0.586\Delta ygap_t^{*} - 0.362 ECM(2)_{t-1}^{**} \quad . \qquad (8)$$

Sample period: 1985-98

$R^2 = 0.88$ RSS = 1.40846 AR-F (1, 10) = 1.638

ARCH-F (1, 9) = 0.034 NORM-$\chi^2(2) = 0.994$

RESET-F(1,10) = 1.645

Likewise (7), equation (8) complies with all diagnostic statistics. Additionally, in (8) all the coefficients are statistically significant at the 99% level, with the exception of the output gap one, which is significant at the 95% (indicated by *). Furthermore, all the coefficients carry the expected signs. The coefficient of *ECM*(2) implies that, on average, nearly 40% of the deviations from the estimated monetary policy reaction function (6) is made up in one year. Figures 1 and 2 show the actual and fitted values of (7) and (8), which provide visual support to what could be interpreted as a more 'systematic behaviour' of DR's monetary authorities to economic developments during the period 1985-98.

3. A closer look at DR's key macro-economic developments during 1970-98

3.1. 1970-84

The period 1970-84 was characterised by several phases. From 1970-73 GDP grew at an average annual growth rate of 11.16%, mainly lead by the government's construction of physical infrastructure. During this period the economy was relatively stable, in part thanks to favourable export commodities prices[12]. There was not much pressure on the exchange rate market. In contrast, the second part of the 1970s witnessed world-wide increases in oil prices, and not so favourable exports prices. Additionally, the rate of incoming foreign investment slowed down. From 1974 to 1979 the economy grew an average rate of 4.69% per year.

The healthy rate of growth experienced in the early years could not be sustained in this new environment. The government reacted by increasing public spending, financed by both external and domestic, mostly monetary, sources. This developments rationalise the positive and significant sign of the output gap found for such a period in equation (6), whereas the exchange rate differential does not seems to have played a significant role.

By the early 1980s the well known worsened world financial conditions for indebted developing countries were already in action. Since the DR's production is highly dependent on imported inputs, the exchange rate system that prevailed at the moment could not survive very long. Inflation soared from 7.4% in the 1970-79 period to 16.29% in 1980-85, more than a twofold increase. This period ended with the country having to sign three agreements with the IMF: an 'extended facility' one in January 1983, a shadow one in September 1984, a 'stand-by' one in January 1985; and with the first devaluation of the official exchange rate in January 1985[13].

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[12] Cocoa, coffee, sugar cane, and tobacco have been traditionally considered as DR's main export commodities, and sources of foreign currency, at least until the late 1970s.

[13] The official exchange rate had been RD$1=US$1 since the foundation of the Central Bank of the Dominican Republic in 1947.

The estimated reaction functions (5) and (7) thus seem to be highly useful and informative. They clearly show that during 1970-84 the authorities followed an accommodative policy, which proved to be time-inconsistent. They paid little attention to what should have been one of their main policy targets: the differential between the official and the black market exchange rate, given their option of having an official exchange rate. The relevance of the rules versus discretion, or time-consistency, literature, originated by Kydland and Prescott (1977), for the case under analysis is straightforward.

3.2. 1985-98

Since that first devaluation an evolving multiple exchange rate market has prevailed in the DR. As mentioned above, the system is composed of the official, banking system, and extra-banking system (parallel-black) exchange rate markets. The official foreign exchange rate has at times been clearly fixed, while at others a managed float has prevailed. The latter is the state in the present. The prevalence of an official exchange rate gives support to estimating the reaction function using the same targets for the period 1970-84 as for 1985-98, which is also useful for comparative reasons.

The economic performance during 1985-98 has been modest, but the country has lived a certain degree of macroeconomic stability. The period, particularly 1985-90, is not, however, free of difficult episodes. The highest inflation rates in the history of the DR were registered in the beginning of the 1990s, and an stand-by agreement with the IMF was approved in August 1991. A major banking sector crisis at the end of the 1980s, the high oil prices of 1990, mainly a result of the Gulf War, and recurrent government deficits are amongst the main causes of such events. After such episodes, i.e. during 1991-98, the country has, nevertheless, been able to maintain a reasonably healthy real GDP growth rate of 5.49% per year, while keeping inflation at a mild level (an average of 7.5% between 1992 and 1998)[14].

An interesting issue and source of concern in the DR continues to be the existence of an official exchange rate. Given the political importance of an official exchange rate in a small developing country, it is no surprise that the authorities have not stopped using it. Although historically the official exchange market has been used for various purposes (e.g., foreign exchange rationing), not only in the DR but in many developing countries as well, in the case at hand the most important ones are (and have been for sometime) the service of the foreign debt and the purchase of oil. An increase in the official rate would therefore generate an increase in both the price of the debt service and all products derived from oil. Changes in such prices have wide ranging effects on the macroeconomy, and significantly undermine the popularity of the party in office[15].

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[14] In a recent IMF report, Young et al (1999, page 8) state that "Since 1992, the Dominican Republic has experienced an extended period of robust economic growth, declining unemployment rates, modest consumer price inflation, and a generally manageable external position".

[15] Notice that the governor of the CBDR is appointed by the President, and can be removed at *any* moment. Other members of the government, such as the Secretary of Finance, and the Secretary of Industry and Commerce, are high ranking members of the Monetary Board. Furthermore, the other members of the Board are appointed by the President as well.

The reaction functions (6) and (8) indicate that in the 1985-98 period the authorities have behaved more systematically than in 1970-84. The estimated functions indicate a ‘lean against the wind’ type reaction to an increase in any of the two gaps included -in contrast to the findings for the period 1970-84. Furthermore, almost 40% of any short run deviations from the above described behaviour is, on average, made up within a year.

Our simple (implied) rules seem to suggest that the monetary authorities learn about how the economy evolves, and about the way in which their actions are transmitted. If they are assumed to behave rationally, it is unlikely that they would be willing to repeat experiences which in the past proved to be costly, both economically and politically. However, granting autonomy to the monetary authorities appears to be less risky and costly than to test the politicians’ capacity of resisting ‘temptations’.

4. Conclusion

The aim of this paper has been to empirically estimate a simple, Taylor-type, monetary authorities’ reaction function for the case of the Dominican Republic. The ‘implicit’ reactions of such authorities suggest that they have been more systematic during the period 1985-98 than during 1970-84. Given the economically and politically costly adjustments that were undertaken in the first years of the 1980s, the findings could be interpreted as a learning in the part of the authorities, which is reflected in an apparent inclination to follow feedback rules rather than extreme discretion.

References

Clarida, Richard, Jordi Galí, and Mark Gertler (1998) Monetary policy rules in practice: some international evidence, *European Economic Review*, **42**, 1033-1067.

Clarida, Richard, Jordi Galí, and Mark Gertler (2000) Monetary policy rules and macroeconomic stability: evidence and some theory, forthcoming, *Quarterly Journal of Economics*.

Friedman, Milton, and Anne J. Schwartz (1963) *A monetary history of the United States, 1867-1960*, Princeton University Press, Princeton, NJ.

Judd, John, and Glenn D. Rudebusch (1998) Taylor's rule and the FED:1970-1997, Federal Reserve Bank of San Francisco *Economic Review*, No. 3, 3-16.

Khoury, Salwa S. (1990) The federal reserve reaction function: a specification search, Chapter 3 in Thomas Mayer (Ed.), *The political economy of American monetary policy*, pages 27-41, Cambridge University Press, UK.

Kydland, Finn E., and Edward C. Prescott (1977) Rules rather than discretion: the inconsistency of optimal plans, *Journal of Political Economy*, **85**, 473-491.

Kozicki, Sharon (1999) How useful are Taylor rules for monetary policy, Federal Reserve Bank of Kansas *Economic Review*, second quarter, 5-33.

McCallum, Bennett T. (1999) Recent developments in the analysis of monetary policy rules, Federal Reserve Bank of St. Louis *Review*, **81**(6), 3-11.

McCallum, Bennett T., and Edward Nelson (1999) Nominal income targeting in an open-economy optimizing model, *Journal of Monetary Economics*, **43**, 553-578.

Mehra, Yash P. (1999) A forward-looking monetary policy reaction function, Federal Reserve Bank of Richmond *Economic Quarterly*, **85**, 33-53.

Montiel, Peter J. (1991) The transmission mechanism for monetary policy in developing countries, *IMF Staff Papers*, **38**, 83-108.

Rudebusch, Glenn D. (1998) Do measures of monetary policy in a VAR make sense? *International Economic Review*, **39**, 907-931.

Sánchez-Fung, José R. (1999) Efficiency of the black market for foreign exchange and PPP: the case of the Dominican Republic, *Applied Economics Letters*, **6**, 173-176.

Sims, Christopher A. (1980) Macroeconomics and reality, *Econometrica*, **48**, 1-49.

Taylor, John (1993) Discretion versus policy rules in practice, *Carnegie-Rochester Conference Series on Public Policy*, **39**, 195-214.

Taylor, John (1999) *Monetary policy rules*, University of Chicago Press, Chicago.

Young, P., D. Dunn, A. Giustiniani, F. Nadal De-Simone, E. Tanner, and J. McHugh (1999) Dominican Republic: selected issues, IMF Staff Report No. 99/117, International Monetary Fund, Washington, D.C., October.

Table 1

Long-run solutions to estimates of equation (3)

Sample (equation number) Coefficient/test	1970-98 (4)	1970-84 (5)	1985-98 (6)
β_0	12.23 (1.526)	7.164 (0.542)	11.97 (1.324)
β_1	-15.95 (5.946)	1.538 (1.646)	-24.94 (14.02)
β_2	-0.114 (0.550)	0.237 (0.075)	-0.29 (0.619)
R^2	0.94	0.99	0.94
RSS	4.4085	0.0283	1.4084
AR-F	0.4117 (2, 21)	0.8476 (2, 7)	2.3245 (2, 6)
ARCH-F	0.0012 (1, 21)	0.0369 (1, 7)	0.0229 (1, 6)
NORM-χ^2	20.317 (2)**	1.2008 (2)	0.9940 (2)
RESET-F	0.1678 (1, 22)	0.0914 (1, 8)	0.1572 (1, 7)

Notes: coefficients standard errors are inside parentheses. The diagnostic statistics are described as follows: coefficient of determination (R^2); residuals sum of squares (RSS); residual serial correlation (AR); autoregressive conditional heteroscedasticity (ARCH); normality (NORM); and functional form mis-specification (RESET) test. The null distribution is given by $\chi^2(\cdot)$ or F $(\cdot,\cdot)$, where the degrees of freedom are inside parentheses. For AR and ARCH the first degree of freedom indicates the maximum lag length. * and ** means failure of the test at the 95% and 99% levels, respectively.

Figure 1
Actual and fitted values, equation (7)

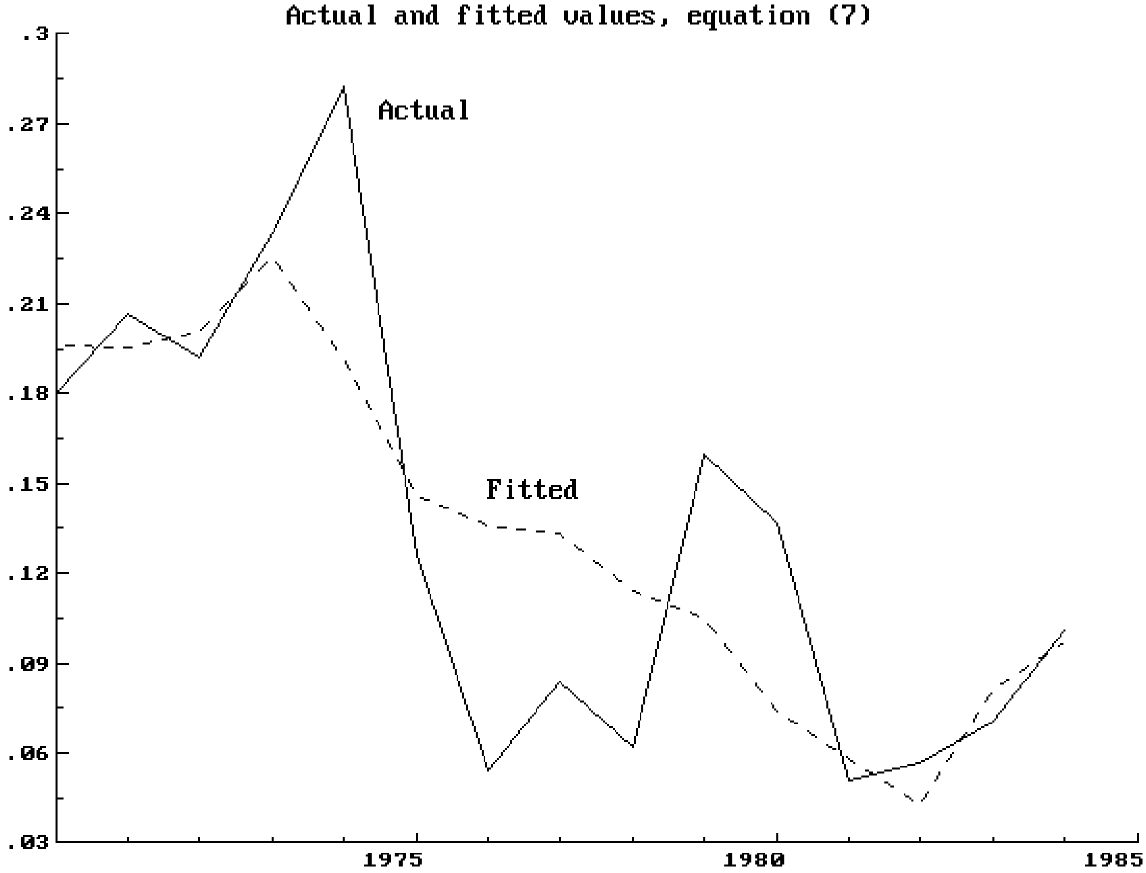

Figure 2
Actual and fitted values, equation (8)