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A small macroeconomic model of the Cyprus economy

Louis Christofides **Andros Kourtellos**
Department of Economics & Economics Research Centre
University of Cyprus

Ioanna Stylianou
Economics Research Centre
University of Cyprus

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Abstract

Recently, the need for macroeconomic forecasting has increased and questions about the relationship between money variables and output, and their impact on growth, are systematically considered. The right designation and implementation of the monetary policy is based on forecasting, and thus, forecasting has a significant role for the future of the economy. The main aim of this study is to estimate a Vector Autoregressive Model (VAR) for the economy of Cyprus using quarterly data over the period 1981:4-2004:4 for Gross Domestic Product (GDP), Money Liquidity (M2), Average Deposit Rate(ADR) and Consumer Price Index(CPI). The results obtained from the VAR analysis are in line with the related theory. In addition, we examine the dynamic interrelationships among those variables by testing for the existance of cointegration and estimating a Vector Error Correction Model (VECM), where again, the results are consistent with the theory. Finally, following the "two-step approach", we assess the forecasting power of the estimated VECM by performing dynamic forecasts within and out of sample.

ΠΕΡΙΛΗΨΗ

Η ανάλυση τόσο της μακροχρόνιας όσο και της βραχυχρόνιας σχέσης μακροοικονομικών χρονοσειρών έχει ιδιαίτερη σημασία, καθώς μπορεί να δώσει απαντήσεις σε καίρια ερωτήματα που ανέκαθεν απασχολούσαν τις Νομισματικές Αρχές, και συνεπώς συμβάλλει στη σωστή πρόβλεψη και κατ' επέκταση στη χάραξη κατάλληλης οικονομικής πολιτικής. Μέσα στα πλαίσια αυτά, με την εκτίμηση οικονομετρικών μοντέλων και συγκεκριμένα μοντέλων που στηρίζονται στη Διανυσματική Αυτοπαλινδρόμηση, μπορούμε να μελετήσουμε αναλυτικά αυτές τις σχέσεις και συνεπώς να απαντήσουμε στα ερωτήματα αυτά.

Τα μοντέλα Διανυσματικής Αυτοπαλινδρόμησης αποτελούν ένα από τα πιο σημαντικά εργαλεία μακροοικονομικής και νομισματικής πολιτικής, τα οποία παρουσιάζουν τη διαχρονική δυναμική σχέση μεταξύ των διαφόρων μεταβλητών. Για την εκτίμηση της Διανυσματικής Αυτοπαλινδρόμησης χρησιμοποιούμε στοιχεία που καλύπτουν την περίοδο από την τέταρτη τριμηνία του 1981 μέχρι την τέταρτη τριμηνία του 2004, για τέσσερις μακροοικονομικές μεταβλητές: Ονομαστικό ΑΕΠ, Προσφορά Χρήματος Μ2, Μέσο Επιτόκιο Κατάθεσης των Εμπορικών Τραπεζών (ΜΕΚ), και Δείκτης Τιμών Καταναλωτή. Για το σωστό προσδιορισμό του μοντέλου βασιζόμαστε στην έννοια της στατιστικής επάρκειας, σύμφωνα με την οποία τα στατιστικά στοιχεία υποστηρίζουν τις υποθέσεις του προϋποτεθειμένου μοντέλου Διανυσματικής Αυτοπαλινδρόμησης. Η στατιστική επάρκεια ενός μοντέλου είναι ζωτικής σημασίας για την εγκυρότητα των αποτελεσμάτων γιατί, αν τα στοιχεία που εξετάζουμε δεν υποστηρίζουν τις υποθέσεις του μοντέλου που χρησιμοποιούμε, τότε οποιαδήποτε συμπεράσματα πιθανώς να είναι παραπλανητικά. Ακολουθώντας τη μοντέρνα βιβλιογραφία στην οικονομετρία, χρησιμοποιούμε μια σειρά από ελέγχους στατιστικής επάρκειας για κανονικότητα, γραμμικότητα, ομοσκεδαστικότητα, στασιμότητα και μη γραμμική συσχέτιση. Ως εκ τούτου το μοντέλο μας αποτελείται από τέσσερις υστερήσεις, χρονική τάση, καθώς και από δύο ψευδομεταβλητές που αντιπροσωπεύουν σημαντικές δομικές αλλαγές: Τη φιλελευθεροποίηση των επιτοκίων (2001:1) και την έξοδο της Αγγλικής λίρας από το Μηχανισμό Συναλλαγματικών Ισοτιμιών (1992:3).

Τα αποτελέσματα που προκύπτουν παρουσιάζουν μεγάλο ενδιαφέρον αφού συνάδουν απόλυτα με την οικονομική θεωρία και επεκτείνουν τα συμπεράσματα των Ανδρέου, Σπανού και Συρίχα (1997) αναφορικά με τις βραχυχρόνιες και τις μακροχρόνιες σχέσεις που συνδέουν τις μεταβλητές. Συγκεκριμένα, υπάρχει σημαντική θετική σχέση ανάμεσα στις τιμές των μεταβλητών σήμερα και την αμέσως προηγούμενη περίοδο. Παράλληλα, το Μ2 επιδρά αρνητικά στο ΜΕΚ, το οποίο οφείλεται στο γεγονός ότι μια αύξηση του Μ2 οδηγεί σε μείωση του ΜΕΚ με σκοπό την απορρόφηση της υπερβάλλουσας προσφοράς χρήματος και την αποκατάσταση της αρχικής ισορροπίας. Επίσης, ο Δείκτης Τιμών Καταναλωτή επηρεάζει αρνητικά το ΑΕΠ, αφού μια αύξηση στις τιμές οδηγεί σε μείωση του πραγματικού χρήματος και συνεπώς και σε μείωση του εισοδήματος. Ακόμη, κατά την πρώτη τριμηνία, το Μ2

επιδρά θετικά πάνω στο Δείκτη Τιμών Καταναλωτή, υποδηλώνοντας πως η αύξηση του χρήματος επηρεάζει άμεσα το επίπεδο των τιμών. Παράλληλα, μέσα στα πλαίσια του μοντέλου αυτού διεξάγουμε ανάλυση Granger Causality, η οποία επιβεβαιώνει τη βραχυχρόνια σχέση που συνδέει τις μεταβλητές.

Τα μοντέλα Διανυσματικής Αυτοπαλινδρόμησης μας περιγράφουν μόνο τη βραχυχρόνια σχέση των μεταβλητών. Η μακροχρόνια συμπεριφορά των μεταβλητών δίνεται από τα μοντέλα Vector Error Correction (VEC), τα οποία έχουν ως απαραίτητη προϋπόθεση την ύπαρξη συνολοκλήρωσης. Συνεπώς, ελέγχουμε για την ύπαρξη συνολοκλήρωσης ακολουθώντας τη μεθοδολογία των Johansen και Juselius (1990, 1992), υπολογίζοντας όμως ταυτόχρονα τις πεπερασμένες κριτικές τιμές όπως προτείνουν οι Cheung και Lai (1993). Τα αποτελέσματα δείχνουν ότι στο μοντέλο μας υπάρχει όντως σχέση συνολοκλήρωσης, το οποίο επιτρέπει την εκτίμηση του μοντέλου VEC.

Στην επόμενη φάση της μελέτης εκτιμούμε το VEC μοντέλο, το οποίο μας δίνει πληροφορίες για τη μακροχρόνια συμπεριφορά των μεταβλητών: Το ΜΕΚ συνδέεται θετικά με το ΑΕΠ και το Δείκτη Τιμών Καταναλωτή, ενώ η σχέση του με το Μ2 είναι αρνητική. Επίσης, το Μ2 έχει θετική σχέση με το ΑΕΠ και το Δείκτη Τιμών Καταναλωτή, ενώ το ΑΕΠ επηρεάζεται θετικά από το Μ2 και αρνητικά από το Δείκτη Τιμών Καταναλωτή. Παράλληλα, μέσα στα πλαίσια του VEC διεξάγουμε ανάλυση Impulse Responses, όπου μελετούμε τη μακροχρόνια συμπεριφορά των μεταβλητών από ένα σοκ σε μια από αυτές. Τα αποτελέσματα που προκύπτουν συνάδουν με τη θεωρία: Ένα σοκ στο Μ2 έχει θετικά αποτελέσματα στο ΑΕΠ και τις τιμές.

Το βασικότερο στοιχείο που χαρακτηρίζει ένα VEC μοντέλο είναι η προβλεπτική του ικανότητα, η οποία συνδέεται άμεσα με το σχεδιασμό και την εφαρμογή της κατάλληλης νομισματικής πολιτικής από τις αρχές. Ακολουθώντας τους Anderson et al. (2002), εκτιμούμε το μοντέλο VEC και στη συνέχεια αναλύουμε την προβλεπτική του ικανότητα διεξάγοντας δυναμική πρόβλεψη εντός (1998:4-2004:4) και εκτός (2005:1-2007:4) δείγματος, χρησιμοποιώντας τον αλγόριθμο Gauss-Seidel. Τα αποτελέσματα δείχνουν ότι η προβλεπτική ικανότητα του μοντέλου είναι πολύ καλή, και συνεπώς το μοντέλο αυτό αποτελεί αναμφισβήτητα ένα πολύ χρήσιμο εργαλείο για τις αρμόδιες αρχές. Σημαντικό είναι και το γεγονός ότι το μοντέλο διατηρεί την καλή προβλεπτική του ικανότητα ακόμη και κάτω από συνθήκες μιας απρόσμενης αλλαγής στο Μ2 όπου, σύμφωνα με τα αποτελέσματα, μια αύξηση στο Μ2 οδηγεί σε αύξηση του ΑΕΠ και των τιμών, ενώ η επίδραση στο ΜΕΚ είναι αρνητική.

Εν κατακλείδι, το ΑΕΠ, το Μ2, ο Δείκτης Τιμών Καταναλωτή και το ΜΕΚ συνδέονται τόσο βραχυχρόνια όσο και μακροχρόνια, με το Μ2 να διαδραματίζει αξιόλογο ρόλο. Το γεγονός αυτό έχει ιδιαίτερη σημασία, αφού το Μ2 αποτελεί τον ακρογωνιαίο λίθο για το σχεδιασμό και την εφαρμογή της νομισματικής πολιτικής από τις αρχές και συνεπώς οριοθετεί το μέλλον ολόκληρης της οικονομίας.

CONTENTS

I. INTRODUCTION

Since Sims (1980) seminal paper, Vector Autoregression (VAR) models have been the standard tool in the analysis of macroeconomic fluctuations. The vast monetary policy VAR literature spurred by Sims' paper is surveyed in Leeper, Sims and Zha (1996) and Christiano, Eichenbaum, and Evans (2000).

In this paper we estimate a VAR model for the Cyprus economy using quarterly data from 1981:4 to 2004:4. One goal of this paper is to analyze the dynamic interrelationships between money, income, prices, and interest rates. Specifically, what is the relationship between the money variables and output? Do they cause growth? What is the interrelationship between the interest rate and money? Our results shed light on the impact of money on economic variables and provide useful forecasts.

We estimate a four-variable VAR using: Nominal Gross Domestic Product (GDP), Total Liquidity (M2), the Average Deposit Rate (ADR), and the Consumer Price Index (CPI). The estimation results describe thoroughly the short run relationship among variables and provide information on the dynamic impact of random disturbances on the system. However, for policy purposes, it is important to examine if those variables are linked in the long run. To accomplish this, we estimate a Vector Error Correction Model (VECM) and test for the existence of cointegration, using the methodology proposed by Johansen and Juselius (1990, 1992) and applying the finite sample correction of the asymptotic critical values as Cheung and Lai (1993) suggest. The VECM estimation is extremely significant, since it not only provides useful information on the long run equilibrium relationship of the variables but, in addition, is the basis for forecasting analysis. Specifically, we perform dynamic forecasts within and out of sample, in the context of stochastic simulation analysis.

Unfortunately, very little empirical work has been done so far for Cyprus. The main reason for this is the paucity of data. Specifically, many of the variables were available only on an annual basis, and consequently, the sample size was very small. However, Christofides and Mitsis (2004) have, now, constructed quarterly data for GDP, using representative indices of the main sectors of the economy which are available on a quarterly basis.

The first serious attempt to construct a macroeconomic model of Cyprus was carried out by Spanos, Andreou and Syrihas (1997) who estimated a VAR model based on annual data over the period 1960-1994. Their results show that monetary variables play a major role for the determination of nominal GDP and CPI, whereas M2 affects Real GDP too. A further, more structural, attempt at modeling the economy of Cyprus was carried out by Karamanou, Mitsis and Pasiardes (2003), by estimating a system of 44 equations using quarterly data over the period 1990-2001.

Our study not only examines the relation of the variables in the short run and in the long run, but it also compares our findings with the results of Spanos, Andreou and Syrihas (1997). In particular, our results extend their work, since we use a wider period of quarterly data.

Our main findings suggest that monetary variables affect nominal GDP and the price level, a result which is also present in Spanos, Andreou and Syrihas (1997). In addition, we find that M2 affects ADR. Also, important is the impact of structural breaks in the short-run relationship of the variables which we examine in our estimation.

The rest of this study is organized as follows: In Section two, we present the results of a univariate analysis whereas, in Section three, we review the associated literature along with the related methodology we use. In Section four, we present the results of the VAR analysis and, in Section five, the VECM estimation results. Finally, in Section six, we analyze the conclusions derived from the study, Appendix A provides variable descriptions and sources, Appendix B summarizes the misspecification tests undertaken.

II. THE DATA

In this section, we apply univariate analysis to the four long-term macro series[1] using quarterly data over the period 1981:4 -2004:4. Table 1 presents briefly the descriptive statistics for those variables, while Figure 1 and Figure 2 present the level and the first difference graphs respectively.

Table 1: Descriptive Statistics

Series	Mean	Median	St. Dev.	Minimum	Maximum
GDP (In millions CYP)	896.035	839.531	484.948	221.718	1912.441
M2 (In millions CYP)	3529.630	2741.059	2570.046	633.559	8971.770
ADR (%)	5.641	5.700	0.855	3.330	6.600
CPI (Base year 2000)	79.573	80.050	19.175	49.040	114.300

Figure 1 suggests that most series have a trend, whereas the presence of structural breaks is also obvious. It is crucial to incorporate the structural breaks using dummies in the VAR model, since they affect their short run as well their long-run relationship. At first glance, it seems that ADR has a structural break in 2001. The influence of the structural break is more obvious in Figure 2, where the series are presented in first differences. Clearly, at some points, the value of some of the series is greater or smaller than the upper or the lower bound respectively, which indicates that, these series have been affected by breaks. In particular, GDP and ADR reveal a big structural break in 1992 and 2001 respectively.

[1] All the variables are seasonally adjusted using X12-ARIMA, except from the case of the ADR. In addition, all variables are in natural logarithms.

Figure 1: Level presentation of the variables

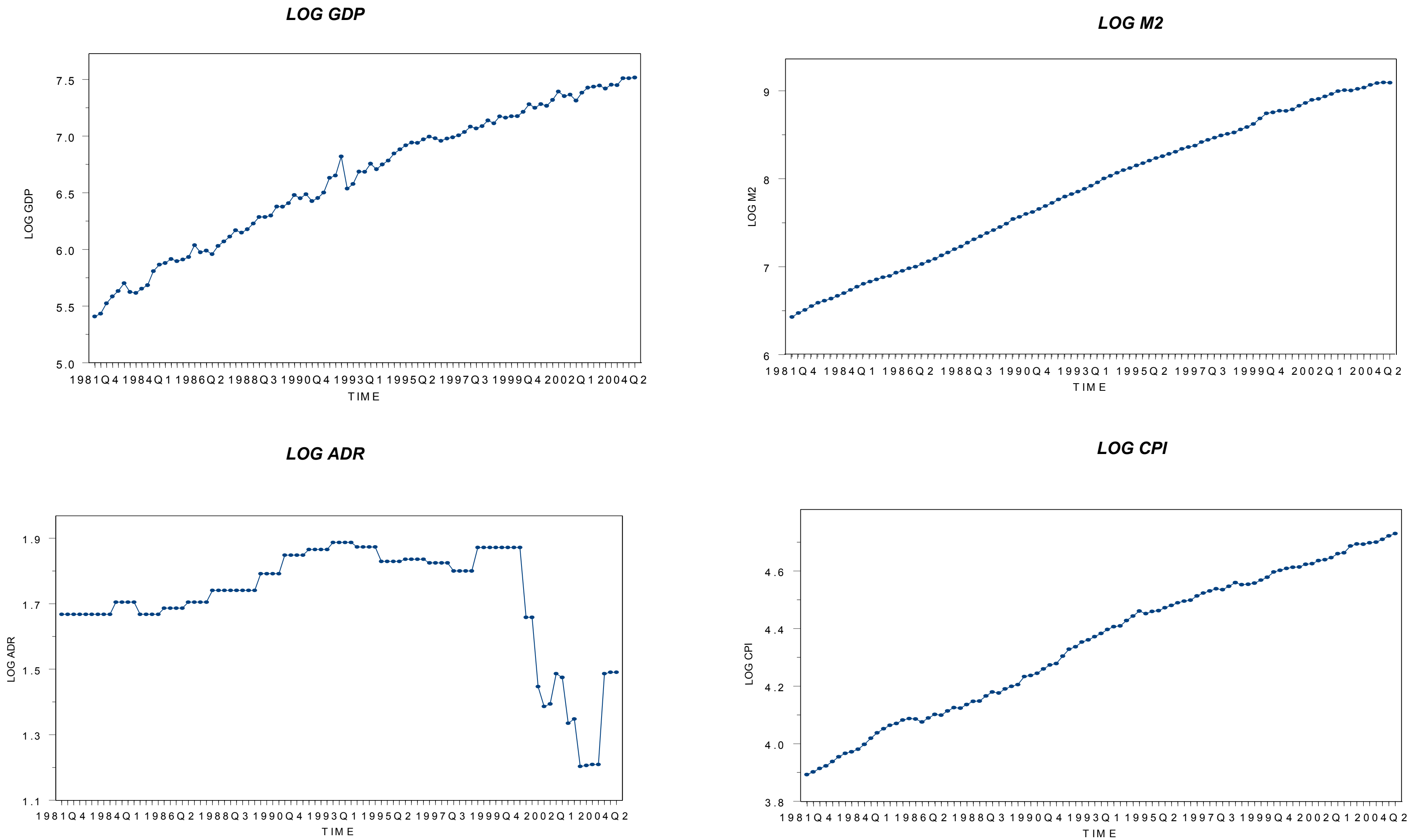
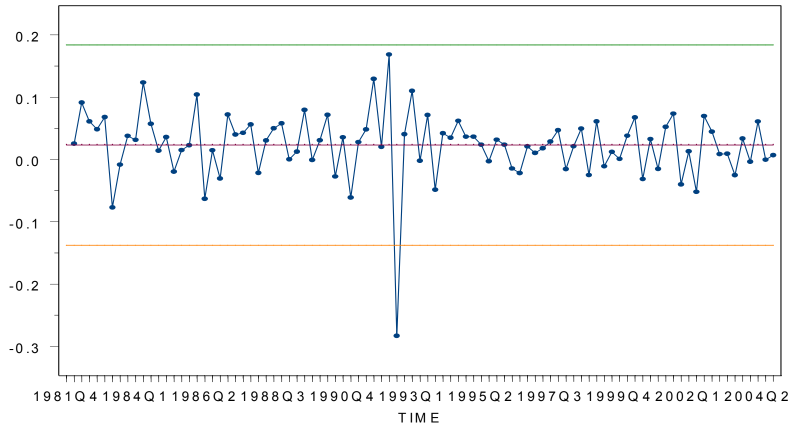
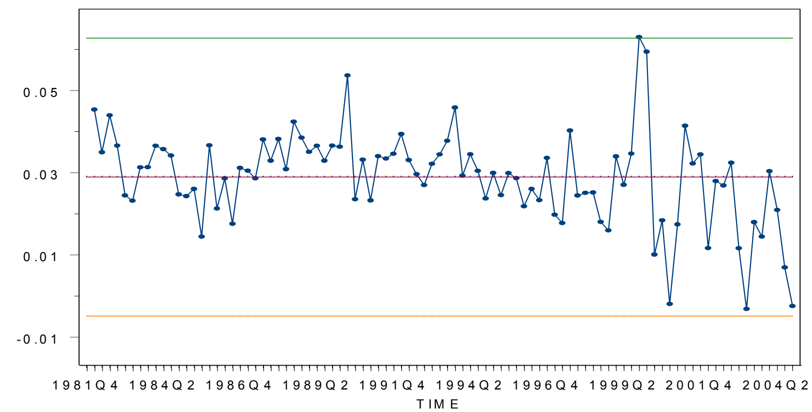


Figure 2: First difference presentation of the variables

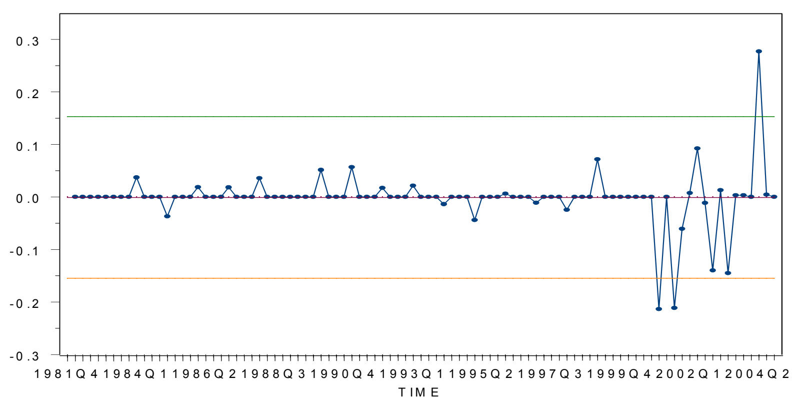
LOG GDP (DGDP)



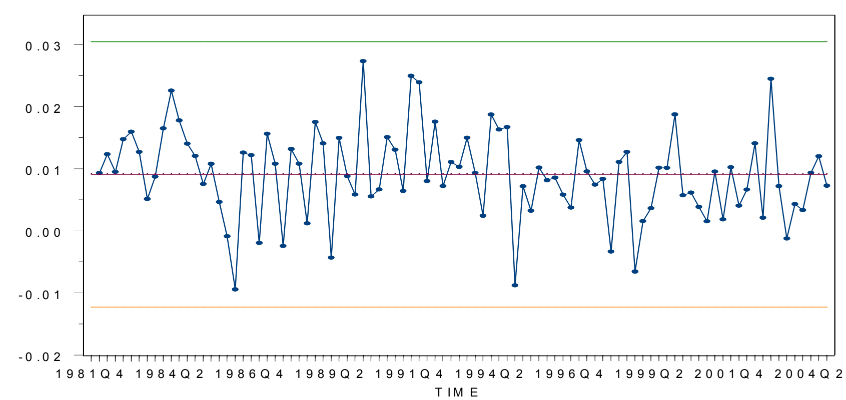
LOG M2 (DM2)



LOG ADR (DADR)



LOG CPI (INFLATION)



III. METHODOLOGY

III.1 Vector Autoregressive Model

Using the four macroeconomic variables, we estimate four-variable and three-variable VAR models. The estimation of a VAR model requires testing the stability of the series, beginning with unit root tests because, when the series under investigation are not stable, then the estimated results are not valid (spurious regression). A recent study by Christofides, Kourtellos, Stylianou and Vrahimis (2005), which tests for the existence of a unit root in the series in the context of exogenous as well as endogenous breaks, finds that all variables have a unit root. We employ the standard VAR model of order p:

$$y_t = \beta_0 + \sum_{i=1}^{p} A_i' y_{t-i} + BX_t + u_t \qquad (1)$$

where $y_t \in R^4$ is the $4x1$ vector of the $I(1)$ endogenous variables, and specifically, Nominal GDP, M2, ADR and CPI. $X_t \in R^3$ is a vector of deterministic variables which might include a trend and dummies which represent two important exogenous breaks (2001:1, 1992:3), $\beta_0 \in R^4$ is a vector of intercepts, A_i is a 4×4 coefficient matrix, B is a 4×3 coefficient matrix, and $u_t \in R^4$ is a vector of innovations.

Because of the usual properties of ADR and following Spanos *et al* (1997), we estimate four-variable and three-variable VAR models. The selection of the final VAR for every combination of variables is based on the criterion of statistical adequacy. A model is said to be statistically adequate if all the underlying assumptions of the model are supported by the data. This is crucial because, if our model is statistically adequate, we are able to support statistically hypothesis testing, forecasting, causality tests, etc. In order to test the statistical adequacy assumption, we employ a series of misspecification tests which can be found analytically in Appendix B. More precisely, we test for Normality, for Static and Dynamic Heteroskedasticity, for Serial Correlation, for non linearity, for omitted variables, as well as stability. In light of the tests undertaken, the VAR model includes four lags, a constant and a trend. An important issue in model specification is also model parameter stability. Often structural breaks characterize macroeconomic variables over a long period of time. This fact is typical of our variables since Cyprus, being a small open economy, is highly influenced not only by internal political and economic changes (eg. the implementation of a new framework for monetary policy in 2001) but also, by external factors, such as wars (Kosovo-1999, Gulf War-1990,1991) and oil shocks (1990, caused by the Gulf War, and 2004, where the oil price increases due to tight sypply margins in the face of increasing demand). Consequently, we include dummies in the VAR specification in order to capture these important events. The structural breaks might cause a temporary effect or a permanent effect on the variable, if the slope of the trend function changes. Thus, the dummy variables have one of the following form:

$$DU_t = \begin{cases} 0 & Otherwise \\ 1 & For \quad t>TB+1 \end{cases} \qquad D(TB)_t = \begin{cases} 0 & Otherwise \\ 1 & For \quad t=TB+1 \end{cases}$$

$$DT^*_t = \begin{cases} 0 & Otherwise \\ t-TB & For \quad t>TB \end{cases} \qquad DT_t = \begin{cases} 0 & Otherwise \\ t & For \quad t>TB \end{cases},$$

where TB is the time of the break. In this context, two important events affect the VAR specification: In 2001:1 we have the liberalization of the interest rates and in 1992:3 there is a considerable decline in tourists arrivals and revenue, because Pound Sterling and Italian Lira forced out of the European Exchange Rate Mechanism. Both events were analysed and, based on our statistical tests, 1992:3 is best modelled with DT^*_t and 2001:1 with DT_t.

III.2 Cointegration Analysis and Vector Error Correction Model

Economic theory often suggests that certain groups of economic variables should be linked by a long-run equilibrium relationship. Although the variables may drift away from equilibrium for a while, economic forces may be expected to act so as to restore equilibrium. A crucial assumption in our analysis, based on the study of Christofides, Kourtellos, Stylianou and Vrahimis (2005), is that the all the variables are $I(1)$. Variables which are $I(1)$ tend to diverge as $n \to \infty$ because their unconditional variances are proportional to the sample size. Thus it might seem that such variables could never be expected to obey any sort of long-run equilibrium relationship. But, in fact, it is possible for a group of variables to be $I(1)$ and yet for certain linear combinations of those variables to be $I(0)$. If that is the case, the variables are said to be cointegrated. If a group of variables is cointegrated, they must obey an equilibrium relationship in the long run, although they may diverge substantially from equilibrium in the short run.

The earliest reference about cointegration is probably Granger (1981), but the best–known paper is Engle and Granger (1987).The VAR model in Equation (1) can be rewritten:

$$\Delta y_t = \beta_0 + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-i} + \Pi y_{t-1} + \mathrm{B} X_t + u_t \qquad u_t \sim N(0,\Omega) \tag{2}$$

Recall from Equation (1) that y_t is the vector of GDP, M2, ADR and CPI, with A_i the coefficient matrix to be estimated. Thus, $\Delta y_t \in R^4$ is a $4x1$ vector which includes the first differences of the above variables. $\Pi = \sum_{i=1}^{p} \mathrm{A}_i - I$, $\Gamma_i = -\sum_{J=i+1}^{p} \mathrm{A}_j$, $X_t \in R^3$ is a vector of deterministic variables which includes a trend and dummy variables which represent structural breaks(2001:1, 1992:3), $\beta_o \in R^4$ is a vector of intercepts, B is a 4×3 coefficient matrix and $u_t \in R^4$ is a vector of innovations. Granger's Representation Theorem asserts that if the coefficient matrix Π has reduced rank (r< 4), then there exist $4xr$ matrices a and β, each with rank r, such that $\Pi = a\beta^{'}$ and $\beta^{'} y_t$ is $I(0)$ where r is the number of cointegrating relations (the rank) and each column of β is the cointegrating vector.

We test for cointegration in the context of a system of equations. Johansen and Juselius (1990, 1992) propose a test of this type, which is based on canonical correlations, using a Likelihood Ratio Test. The application of this test requires the inclusion of exogenous variables. According to Figure 1, the macroeconomic variables have a trend and, consequently, we test for cointegration choosing the appropriate deterministic trend assumption. Specifically, we choose the existence of an intercept and trend in the long-run relationship and a linear trend in the short-run relationship. In addition, Johansen, Mosconi and Nielsen (2000) as well as Hungnes (2005) consider the presence of dummies in the cointegration relationship when the variables are affected by a number of breaks. This is important here since, as mentioned before, the economy has been affected by many political and economic events.

Testing for cointegration requires adjusting for the sample size, since the Likelihood Ratio statistics are applicable only asymptotically. Cheung and Lai (1993) suggest the following scaling factor to be applied to the asymptotic critical values:

$$SF = \frac{T}{T - nk} \tag{3}$$

where SF denotes scaling factor, T is the sample size, n is the number of variables, and k is the number of lags.

Finding evidence supporting the existence of a cointegrating relationship among our variables, we estimate a VECM. A VEC Model is a restricted VAR which has cointegration relations built into the specification so that it restricts the long-run behaviour of the endogenous variables to converge to their cointegrating relationships while allowing for short-run adjustment dynamics. The cointegration term is known as the correction term since the deviation from long-run equilibrium is corrected gradually through a series of partial short-run adjustments.

In the spirit of the VECM estimation we perform Pairwise Granger Causality Tests, as well as Impulse Response Function analysis. The Impulse Response Function is the path followed by y_t as it returns to equilibrium when we shock the system by changing one of the innovations (u_t) for one period and then returning it to zero. As Sims suggests (1980), Impulse Response Analysis is important since it can be used for economic policy evaluation.

Another way of characterizing the dynamic behaviour of a VAR system is through Forecast Error Variance Decomposition, which separates the variation in an endogenous variable into the component shocks to the VAR. If, for example, shocks to one variable fail to explain the forecast error variances of another variable (at all horizons), the second variable is said to be exogenous with respect to the first one. The other extreme case is if the shocks to one variable explain all forecast variance of the second variable at all horizons, so that the second variable is entirely endogenous with respect to the first.

Since cointegration is present, it is extremely significant to model the short-run adjustement structure, i.e the feedbacks to deviations from the long run relations, because it can reveal information on the underlying economic structure. Modeling the feedback mechanisms in cointegrated VAR models is typically done by testing the significance of the feedback coefficients. These tests are called weak exogeneity tests, because certain sets of zero restrictions imply long run weak exogeneity with respect to the cointegrating parameters. The concept of weak exogeneity was defined by Engle, Hendry and Richard (1983) and is closely related to testing the feedback coefficients. If all but one variable in a system are weakly exogenous, then efficient inference about the cointegration parameters can be conducted in a single equation framework. Choosing valid weak exogeneity restrictions is of major importance, because policy implications are some times based on the short-run adjustement structure. Following Johansen (1995), we test weak exogeneity using a Likelihood Ratio Test:

$$LR = T \sum_{i=1}^{r} \log \left\{ \frac{1 - \hat{\lambda}_i^*}{1 - \hat{\lambda}_i} \right\} \quad (4)$$

where T denotes the sample size, r the number of cointegrating equations, $\hat{\lambda}_i^*$ and $\hat{\lambda}_i$ the eigenvalues from the restricted and the unrestricted model respectively. However, following Sims(1980), we adjust for the sample size using a simple degrees of freedom correction:

$$LR^M = (T - k)LR) / T \rightarrow x^2(df) \quad (5)$$

where k is a correction for the degrees of freedom, and T is the sample size. Choosing k is crucial because it affects the test statistic or the degrees of freedom and hence the test decision. A number of proposals have been made in the literature. Podivinsky (1992) suggested to choose k equal to the total number of parameters in Π and Γ. However, if the number of the endogenous variables and the number of lags becomes large relative to the sample size, we end up with negative degrees of freedom. Therefore, we choose k such that it equals the approximate number of estimated coefficients in one equation in the VAR, as suggested by Lutkepohl (1991). More precisely,

$$k = r + Kr + K(p-1) + 3 \quad (6)$$

where the first right hand side term gives the number of a parameters per equation, the second the number of β parameters, and the last two the number of parameters in Γ and B.

The VECM presents not only the long-run relationship of the variables, but it has an addional significant advantage: foracasting. Following Anderson, Hoffman and Rasche(2002) we perform a "two-stage technique", where we estimate an economic relation using the technique of a VECM and, on a second stage, we assess the quality of forecast outcome. Thus, in the context of stochastic simulation analysis we apply dynamic forecasts (multi-step forecasts) using a large number of iterations within and out of the time bounds of the observations of the sample. After forecasting, we assess how far the estimated model has approximated the real-historical values. The closer the forecasts are to the real values, the better the forecasting power of the VECM considered. The algorithm used for the implementation of iterations is the well known Gauss-Seidel, which works by evaluating each equation in the order that it appears in the model, and uses the new value of the left-hand variable in an equation as the value of that variable when it appears in any later equation.

IV.VECTOR AUTOREGRESSIVE MODEL ESTIMATION

IV.1 Vector Autoregressive Model results

In this section we examine the short-run relationship among the series, through the estimation of alternative VAR model over the period 1981:4-2004:4. Specifically, we estimate VAR models using GDP, M2, CPI and ADR. We have also estimated alternative VAR models using real GDP, real M1 or M2, and the inflation rate. However, the most successful VAR model in terms of theoretical interpretation as well as statistical adequacy was the VAR which includes nominal GDP, M2, ADR, and CPI. We test the statistical adequacy of the model performing various misspecification tests, which can be found in Appendix B.

According to the estimation results, it is obvious that our variables are connected with a short-run relationship: Table 2 suggests that there is strong positive relationship between our variables and their first lagged value. Also, there is a strong impact of M2 on ADR, which becomes very significant through time. This relationship is complex since the sign changes in every quarter; however, we expect finally this relationship to be negative because an increase in M2 should decrease ADR in order to eliminate the excess money supply and restore the initial equilibrium. Note that the sum of coefficients on M2 in the ADR equation is negative. The CPI also seems to influence GDP through time since, despite the fact that in the first and the second quarter there is no impact, in the third and the fourth quarter we observe a negative and a positive effect respectively with the negative effect dominating. Theory suggests that a higher level of CPI reduces real money balances and hence income. We examine again this claim in the long-run analysis. Finally, an increase in M2 increases significantly CPI only in the first quarter, suggesting that the effects of an increase in money impact prices immediately and very directly.

Another important issue in the VAR estimation is the role of the dummy variables which represent important exogenous breaks. First, in 1992:3 there is a substantial decline in tourists arrivals[1] and revenue (tourists arrivals in 1992 and 1993 were 1.991.000 and 1.841.000 respectively), and also, a decrease in exports more generally (in 1992, and 1993 the domestic exports were C£213.409.000 and C£199.851.000 respectively). This fact is closely related with the crash in the European Exchange Rate Mechanism: Pound Sterling and Italian Lira forced out of the European Exchange Rate Mechanism with direct and unpleasant effects for Cyprus, since many citizens from Italy and especially England, which is one of the most important trade partners for our country, prefer Cyprus for their vacations. Also, although the interest rates were controlled by the Central Bank, in 2001:1 the situation changed with interest rate liberalization. This development affects ADR in a negative, signigicant, way.

[1] Statistical Service: Statistical Abstract 2001

In order to examine the robustness of these results we also estimate a three-variable VAR, excluding the ADR, since we want to eliminate the impact of two important facts related to this variable: First, the liberalization of the interest rates in 2001:1 and second, its different construction after 1981. Specifically, over the period 1981-1998 this series is constructed by averaging the deposit rates of all commercial banks; however, during 1999-2004, we average the retail three-month interest rates only for the three biggest commercial banks. Due to the fact that these events had a major impact on ADR, there is a possible influence on the estimation results. The related three-variable VAR, is presented in Table 3.

The results obtained from the estimation are similar to the four-variable VAR. Again, all the variables have a strong relationship with their first lagged value. Also, the CPI and M2 have a similar impact on GDP as in the first model. The same result holds for the impact of M2 on CPI. Furthermore, we derive a new result which involves CPI with M2: CPI influences M2 negatively and positively in the third and fourth quarter respectively. We examine this relationship more carefully in the long-run analysis.

On the whole, our results provide evidence which supports the related theory about the short run relationship of the variables: M2 and ADR, as well as, CPI and GDP are related negatively. In contrast, CPI and M2 have a direct and immediate positive relationship.

Table 2: VAR Model estimation

Series	ADR	M2	GDP	CPI
ADR(-1)	0.749***	-0.008	0.035	0.002
	(0.125)	(0.027)	(0.121)	(0.018)
ADR(-2)	0.095	0.026	-0.108	0.021
	(0.142)	(0.030)	(0.137)	(0.021)
ADR(-3)	-0.252	-0.029	0.179	-0.008
	(0.162)	(0.035)	(0.157)	(0.024)
ADR(-4)	0.010	0.043	-0.116	-0.024
	(0.133)	(0.028)	(0.129)	(0.020)
M2(-1)	1.287**	1.213***	1.314**	0.160**
	(0.545)	(0.117)	(0.527)	(0.081)
M2 (-2)	-1.643*	-0.278	-1.612*	-0.019
	(0.849)	(0.183)	(0.823)	(0.127)
M2 (-3)	2.229***	-0.175	0.329	0.030
	(0.854)	(0.184)	(0.827)	(0.128)
M2 (-4)	-2.028***	0.236*	0.458	-0.020
	(0.602)	(0.130)	(0.584)	(0.090)
GDP (-1)	-0.068	-0.014	0.287**	-0.007
	(0.120)	(0.026)	(0.116)	(0.018)
GDP(-2)	-0.032	-0.025	0.018	-0.028
	(0.121)	(0.026)	(0.117)	(0.018)
GDP (-3)	-0.068	0.010	-0.185	-0.017
	(0.120)	(0.026)	(0.116)	(0.018)
GDP (-4)	0.077	-0.015	-0.145	-0.022
	(0.119)	(0.025)	(0.115)	(0.017)
CPI(-1)	-1.272*	-0.198	-0.049	0.707***
	(0.774)	(0.167)	(0.750)	(0.116)
CPI (-2)	1.478	0.138	0.721	-0.024
	(0.974)	(0.210)	(0.944)	(0.146)
CPI (-3)	-0.406	-0.257	-1.923**	0.310**
	(0.992)	(0.214)	(0.961)	(0.149)
CPI (-4)	0.861	0.181	1.541**	-0.108
	(0.739)	(0.159)	(0.716)	(0.111)
C	-0.513	0.783**	1.391	-0.085
	(1.617)	(0.349)	(1.567)	(0.243)
T	0.003	0.002	0.009	-0.001
	(0.008)	(0.001)	(0.008)	(0.001)
DT01Q1	-0.001***	0.0000	0.000	0.000
	(0.0005)	(0.0001)	(0.0004)	(0.000)
DT*92Q3	-0.003*	-0.0009**	-0.006***	-0.0006**
	(0.001)	(0.0004)	(0.001)	(0.0002)

Table 3: VAR Model estimation

Series	M2	GDP	CPI
M2(-1)	1.244*** (0.111)	1.435*** (0.485)	0.127* (0.077)
M2 (-2)	-0.257 (0.181)	-1.791** (0.787)	-0.021 (0.125)
M2 (-3)	-0.170 (0.184)	0.308 (0.801)	0.049 (0.127)
M2 (-4)	0.261** (0.128)	0.523 (0.559)	-0.052 (0.089)
GDP(-1)	-0.007 (0.026)	0.266** (0.113)	-0.009 (0.018)
GDP (-2)	-0.026 (0.026)	0.030 (0.114)	-0.031* (0.018)
GDP (-3)	0.009 (0.025)	-0.185* (0.112)	-0.021 (0.017)
GDP (-4)	-0.016 (0.025)	-0.161 (0.111)	-0.018 (0.017)
CPI(-1)	-0.275* (0.164)	0.019 (0.713)	0.756*** (0.113)
CPI (-2)	0.178 (0.205)	0.556 (0.894)	-0.017 (0.142)
CPI (-3)	-0.343* (0.206)	-1.598* (0.898)	0.285** (0.142)
CPI (-4)	0.276* (0.155)	1.302* (0.677)	-0.121 (0.107)
C	0.392 (0.297)	1.633 (1.293)	0.174 (0.205)
T	0.0004 (0.001)	0.010 (0.006)	-0.000 (0.001)
DT01Q1	-0.000 (0.000)	0.000 (0.0002)	0.000 (0.000)
DT*92Q3	-0.0008** (0.0004)	-0.007*** (0.001)	-0.0006** (0.0002)

Note: *** denotes significance at 1%, ** at 5%, and * at 10%

IV.2 Granger Causality Analysis

Our estimation results provide evidence which supports the existence of a short run relationship among the variables. In order to verify this correlation we perform Granger Causality Tests, which are presented in Table 4. Particularly, we test the null hypothesis that there is no Granger Causality relationship in the system, for the above (three and four variable) VAR models. According to the table, GDP is influenced by M2, CPI is Granger- Caused by GDP as well as M2, whereas ADR by M2 and CPI (this result holds only in the four-variable VAR). Finally, M2 is Granger-caused by CPI (the result is present in the three- variable VAR), and thus there is a bi-directional relationship between those variables. Consequently, the results obtained from the VAR models, are confirmed as well in the Granger Causality analysis.

Table 4:Pairwise Granger Causality Tests-Block Exogeneity Wald Tests

VAR MODELS / *CAUSALITY*	*GDP M2 CPI*	*GDP M2 CPI ADR*
H_0 = No Granger Causality		
Probability of the Chi-Square Statistic		
M2 → GDP	*0.004*	*0.039*
M2 → CPI	*0.003*	*0.001*
GDP → CPI	*0.026*	*0.045*
M2 → ADR	-	*0.000*
CPI → ADR	-	*0.049*
CPI → M2	*0.036*	-

IV.3 Cointegration Analysis

Although the VAR results provide information about the short-run relationship between the macroeconomic variables, nevertheless we do not know what their long-run behaviour is. The VECM not only gives an answer to the question of whether the short-run relationship of the variables is persistent, but also allows us to perform forecasting.

The estimation of the VECM requires first to test for the existence of cointegration. We follow the Johansen and Juselius (1990, 1992) approach which is based on canonical correlations. Moreover, since the estimated Likelihood Ratio statistic is valid only asymptotically, we calculate finite critical values as Cheung and Lai (1993) proposed.

Table 5 suggests that, taking into account the finite sample critical values, we identify the existence of one cointegrating relationship in the four-variable VAR at the 5%. Specifically, we accept the null hypothesis that the rank of $\Pi \leq 1$ since the Trace Statistic is greater from the finite critical values when $H_0 : Rank\,(\Pi) = 0$ (69.62 $>$ 66.28), but smaller from the critical values when the null hypothesis is $H_0 : Rank\,(\Pi) \leq 1$ (38.75<42.01). Notice that, the adjustment of the asymptotic critical values rejects the existence of one cointegrating relationship using the Maximal Eigenvalue Statistic (Under $H_0 : Rank\,(\Pi) = 0$, Max Eigenvalues Statistic=30.86<Finite Critical Value=36.97). On the other hand, the three-variable VAR model does not exhibit a cointegrating relationship since, under the null, both Maximal Eignenvalue and Trace Statistic are smaller from the Finite Critical Values (25.19<27.88 and 34.95<40.26 respectivelly) and thus we can not proceed with VECM estimation. Again, the adjustment of the finite critical values rejects the existance of one cointegrating relationship using the Maximal Eignvalue Statistic.

As a result, since the four-variable model exhibits a cointegrating relationship between the variables, we move a step further for the estimation of a VEC model which requires not only the variables to be linked in the short run, but to be related in the long run via the existance of cointegration.

Table 5: COINTEGRATION ANALYSIS

Quadratic Deterministic Trend Assumption							
VAR Models	$H_0 : Rank(\Pi) = p$	*Maximal Eigenvalue Statistic*	*Asymptotic Critical Values (5%)*	*Finite Critical Values (5%)*	*Trace Statistic*	*Asymptotic Critical Values (5%)*	*Finite Critical Values (5%)*
GDP,M2,CPI, ADR	$p=0$	*30.86*	*30.81*	*30.81*1.2=36.97*	*69.62*	*55.24*	*55.24*1.2=66.28*
	$p\leq 1$	*21.36*	*24.25*	*24.25*1.2=29.10*	*38.75*	*35.01*	*35.01*1.2=42.01*
	$p\leq 2$	*10.28*	*17.14*	*17.14*1.2=20.56*	*17.11*	*18.39*	*18.39*1.2=22.06*
	$p\leq 3$	*6.83*	*3.84*	*3.84*1.2=4.60*	*6.83*	*3.84*	*3.84*1.2=4.60*
GDP,M2,CPI	$p=0$	*25.19*	*24.25*	*24.25*1.15=27.88*	*34.95*	*35.01*	*35.01*1.15=40.26*
	$p\leq 1$	*9.24*	*17.14*	*17.14*1.15=19.71*	*9.75*	*18.39*	*18.39*1.15=21.14*
	$p\leq 2$	*0.51*	*3.84*	*3.84*1.15=4.41*	*0.51*	*3.84*	*3.84*1.15=4.41*

V. VECTOR ERROR CORRECTION MODEL

V.1 Vector Error Correction Estimation

In this section we estimate a VEC model based on the four-variable VAR model in which we identify a cointegrating relationship. The VECM results are presented in Table 6.

Table 6: VECM estimation

Cointegrating Equation	CointEq1			
ADR(-1)	1.000			
M2(-1)	1.610 (1.197)			
GDP(-1)	-1.024 (0.713)			
CPI(-1)	-2.575 (1.384)			
@TREND(81:4)	-0.0006			
C	3.628			
Error Correction:	**D(ADR)**	**D(M2)**	**D(GDP)**	**D(CPI)**
CointEq1	-0.241 (0.067)	0.035 (0.014)	0.077 (0.070)	0.016 (0.010)
D(ADR(-1))	0.152 (0.103)	-0.023 (0.022)	0.005 (0.107)	-0.0008 (0.016)
D(ADR(-2))	0.208 (0.100)	-0.002 (0.021)	-0.042 (0.105)	0.014 (0.015)
D(ADR(-3))	-0.078 (0.134)	-0.041 (0.029)	0.101 (0.140)	0.015 (0.021)
D(ADR(-4))	-0.210 (0.133)	-0.010 (0.029)	-0.072 (0.139)	0.025 (0.021)
D(M2(-1))	1.303 (0.596)	0.120 (0.130)	1.335 (0.623)	0.116 (0.094)
D(M2 (-2))	-0.056 (0.583)	-0.050 (0.127)	-0.814 (0.610)	0.037 (0.092)
D(M2(-3))	2.250 (0.586)	-0.252 (0.128)	-0.277 (0.613)	0.127 (0.092)
D(M2(-4))	-1.116 (0.637)	-0.180 (0.139)	0.478 (0.666)	0.040 (0.100)
D(GDP(-1))	-0.230 (0.120)	0.018 (0.026)	-0.384 (0.125)	0.019 (0.019)
D(GDP (-2))	-0.235 (0.118)	-0.002 (0.025)	-0.211 (0.123)	0.0005 (0.018)

Table 6-*Continued*

Error Correction:	D(ADR)	D(M2)	D(GDP)	D(CPI)
D GDP (-3))	-0.189 (0.114)	0.024 (0.024)	-0.309 (0.119)	-0.011 (0.018)
D(GDP (-4))	-0.064 (0.103)	0.014 (0.022)	-0.349 (0.108)	-0.020 (0.016)
D(CPI(-1))	-1.295 (0.763)	-0.044 (0.166)	0.524 (0.799)	-0.165 (0.120)
D(CPI (-2))	0.134 (0.746)	0.032 (0.163)	1.280 (0.781)	-0.145 (0.117)
D(CPI(-3))	-0.299 (0.753)	-0.202 (0.164)	-0.966 (0.787)	0.158 (0.118)
D(CPI(-4))	0.077 (0.763)	-0.183 (0.166)	0.414 (0.798)	-0.029 (0.120)
C	-0.057 (0.038)	0.045 (0.008)	0.046 (0.040)	0.004 (0.006)
@TREND(81:4)	0.0006 (0.0005)	0.000 (0.0001)	-0.0008 (0.0005)	0.000 (0.000)
DT01Q1	-0.0009 (0.0003)	0.0001 (0.000)	0.0004 (0.0004)	0.0001 (0.000)
DT*92Q3	0.000 (0.001)	-0.0006 (0.0002)	0.0003 (0.001)	-0.0001 (0.0001)

According to the table we obtain the following cointegrated equations:

$$ADR_{t-1} = 1.024 * GDP_{t-1} + 2.575 * CPI_{t-1} - 1.610 * M2_{t-1} + 0.0006 * t - 3.628 \quad (7)$$

$$M2_{t-1} = 0.630 * GDP_{t-1} + 1.599 * CPI_{t-1} - 0.621 * ADR_{t-1} + 0.0003 * t - 2.253 \quad (8)$$

$$CPI_{t-1} = 0.388 * ADR_{t-1} - 0.397 * GDP_{t-1} + 0.625 * M2_{t-1} - 0.0002 * t + 1.408 \quad (9)$$

$$GDP_{t-1} = 0.976 * ADR_{t-1} - 2.514 * CPI_{t-1} + 1.572 * M2_{t-1} - 0.0005 * t + 3.542 \quad (10)$$

The above equations summarize the long-run relationship of the variables which is consistent with the theory: ADR is related positively with GDP and CPI, but for the case of M2 the relationship is negative. In addition, M2 is related positively with GDP and CPI, CPI has negative relationship with GDP, whereas GDP is influenced positively by M2.

V.2 Impulse Response Function Analysis

Using this model, which provides information for the long-run relationship of the variables, we perform Impulse Response Function analysis. The Impulse Response Functions provide information to analyze the dynamic behavior of a variable due to a random shock or innovation in other variables. Specifically, the Impulse Response Functions trace out the effects on current and future values of the endogenous variables of one standard deviation shock to a variable. We perform the analysis using Generalized Impulse Responses which are invariant with respect to the order of the variables. In what follows, we consentrate on shocks to the M2 equation which has particular policy interest. According to Figure 3 and Figure 4 a random innovation in M2 has positive effects on GDP and prices. These effects are reasonable and in line with theory which suggets that money matters in the short run.

Figure 3: Impulse Response Function Analysis in the context of VECM

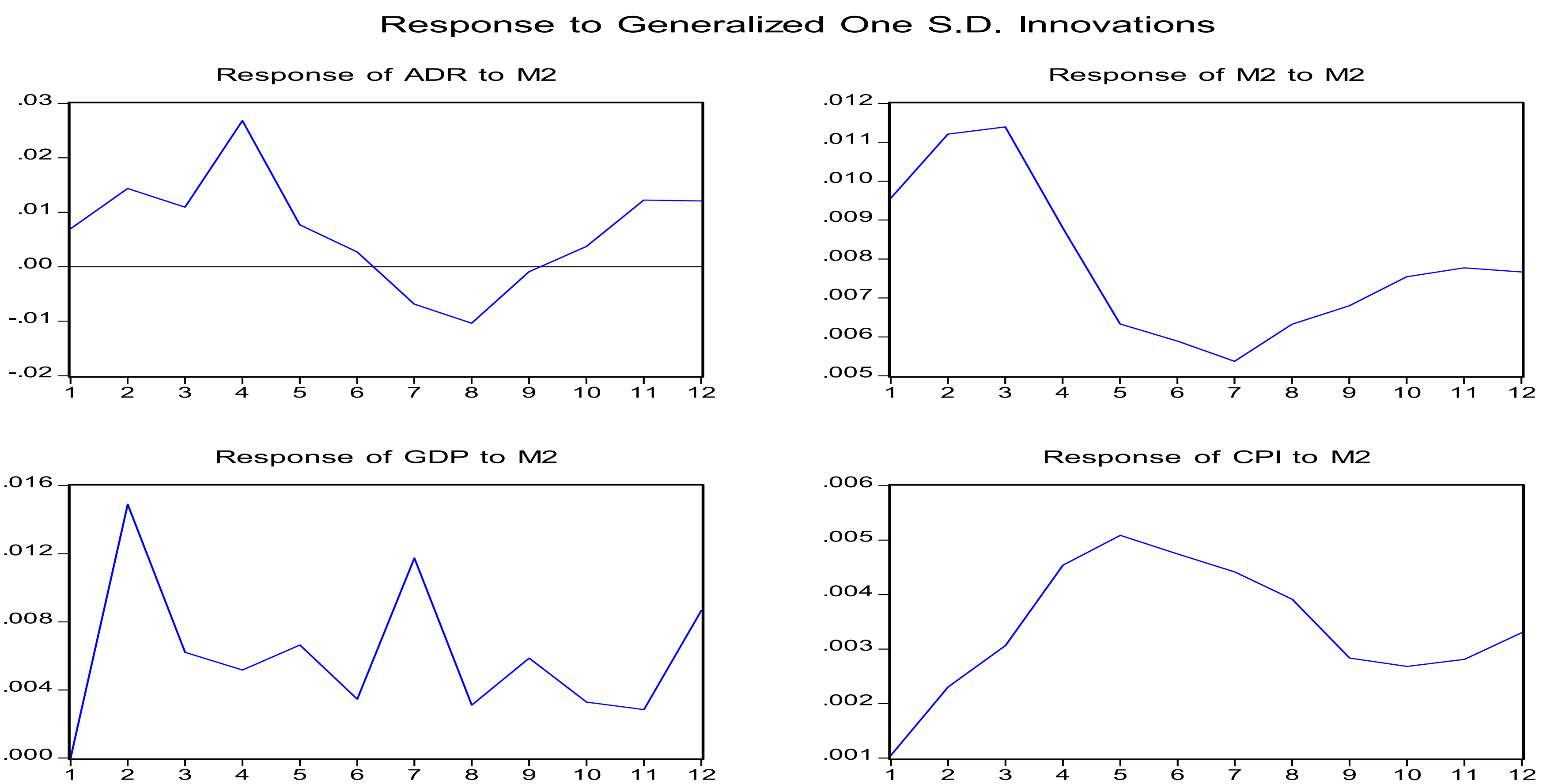
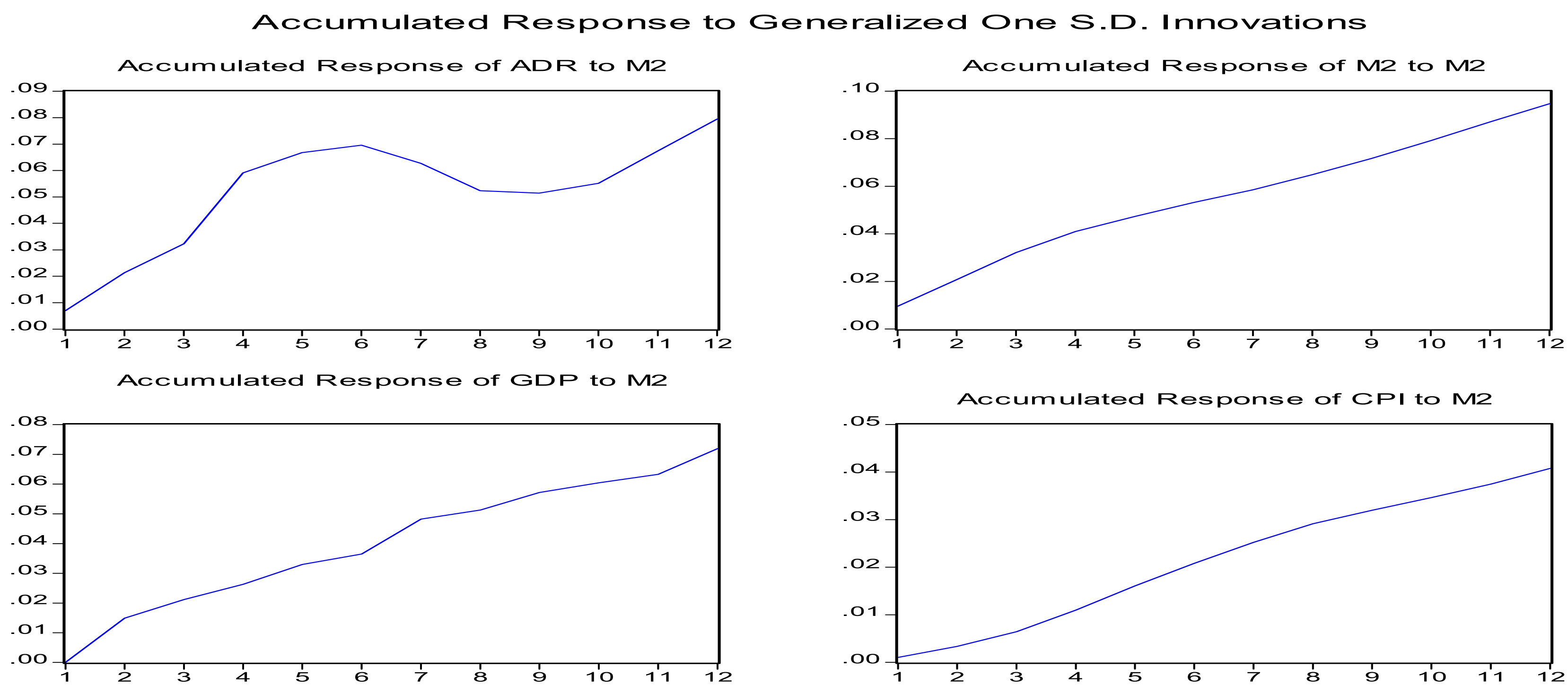


Figure 4: Impulse Response Function Analysis in the context of VECM-Accumulated Impulses



V.3 Variance Decomposition Analysis

Further evidence is provided with Variance Decomposition Analysis which is another way to characterize the dynamic behavior of the model. Table 7 suggests that in the long run, the variation of ADR depends also on shocks to other variables. Specifically, this percentage increases through time and, in the last period, 30% of the total change on the variance is due to the rest variables. A similar situation holds for M2, since the impact on the variation from GDP and CPI increases. The impact of ADR is small but it is important to mention that through time, the role of ADR shocks becomes more significant. For GDP the increase of the impact from the other variables through time is notable, where M2 and ADR play the most important role. The CPI variable is the case where the impact on variance decomposition from the other variables is very strong: Through time, the influence increases and in the last period, 18% and 15% of the variation of CPI is due to ADR and M2 respectively.

Table 7: Variance Decomposition Analysis

VARIANCE DECOMPOSITION	PERIOD	S.E	ADR	M2	GDP	CPI
DADR	1	0.043	100.000	0.000	0.000	0.000
	2	0.059	97.620	1.832	0.002	0.544
	3	0.072	97.922	1.677	0.002	0.397
	4	0.081	90.677	8.822	0.082	0.417
	5	0.082	89.361	9.044	1.060	0.532
	6	0.084	86.605	8.683	3.280	1.429
	7	0.087	81.808	8.926	7.287	1.977
	8	0.090	77.139	10.074	10.120	2.666
	9	0.094	74.761	9.491	11.686	4.060
	10	0.097	73.735	8.786	12.331	5.146
	11	0.102	72.480	8.788	12.407	6.324
	12	0.105	70.677	8.949	13.039	7.333
DM2	1	0.009	0.000	100.000	0.000	0.000
	2	0.014	0.129	99.213	0.376	0.280
	3	0.018	0.990	96.597	2.004	0.407
	4	0.021	1.152	93.337	3.012	2.497
	5	0.022	1.355	88.467	3.999	6.177
	6	0.024	1.337	85.383	4.498	8.780
	7	0.025	1.368	82.943	4.783	10.904
	8	0.026	1.455	81.401	5.123	12.018
	9	0.027	1.601	80.328	5.467	12.602
	10	0.029	1.939	79.186	6.004	12.869
	11	0.030	2.227	78.120	6.496	13.154
	12	0.032	2.517	77.010	6.933	13.537

Table 7-*Continued*

VARIANCE DECOMPOSITION	PERIOD	S.E	ADR	M2	GDP	CPI
DGDP	1	0.045	0.000	0.000	100.000	0.000
	2	0.054	0.920	6.360	91.741	0.977
	3	0.059	1.389	5.955	89.872	2.782
	4	0.061	5.960	5.951	85.425	2.662
	5	0.061	6.639	6.826	83.913	2.621
	6	0.064	7.199	6.498	83.865	2.436
	7	0.067	7.137	8.696	81.960	2.205
	8	0.071	6.544	8.059	83.390	2.005
	9	0.073	7.188	8.029	82.895	1.886
	10	0.074	7.415	7.899	82.811	1.873
	11	0.076	8.347	7.653	82.185	1.813
	12	0.078	8.975	8.300	80.994	1.729
DCPI	1	0.006	0.000	0.000	0.000	100.000
	2	0.009	0.785	2.111	0.016	97.087
	3	0.010	4.326	5.101	0.550	90.021
	4	0.013	8.543	8.791	2.175	80.490
	5	0.016	13.750	11.848	4.300	70.101
	6	0.017	16.071	13.955	5.104	64.868
	7	0.019	16.653	15.198	5.307	62.840
	8	0.019	16.703	15.975	5.331	61.989
	9	0.020	16.678	15.861	5.337	62.122
	10	0.021	16.720	15.473	5.465	62.340
	11	0.022	17.017	15.106	5.631	62.244
	12	0.023	17.543	14.920	5.823	61.712

Consequently, in the long run, the link between the variables becomes more significant, since the variation of a variable is due not only to own, but to shocks from other variables too.

V.4 Weak Exogeneity Analysis

Weak Exogeneity tests are very significant for policy implication purposes. In Table 8 we examine if M2 is weakly exogenous in the model, using a Likelihood Ratio Test where we adjust for the sample size.

Table 8: Weak Exogeneity Analysis

H_o : *a(2,1)=0*	
LR =4.89	$X^2(1)$ =3.84
LR^M =4.89*(93-20)/93=3.83	$X^2(1)$ =3.84

According to the above results, the null hypothesis is accepted, and thus, M2 is weakly exogenous in the system. This result coincides with the findings of Spanos *et al* (1997), where the money variables (M1, M2) are weakly exogenous in almost all the estimated VAR systems.

V.5 Stochastic Simulation Analysis

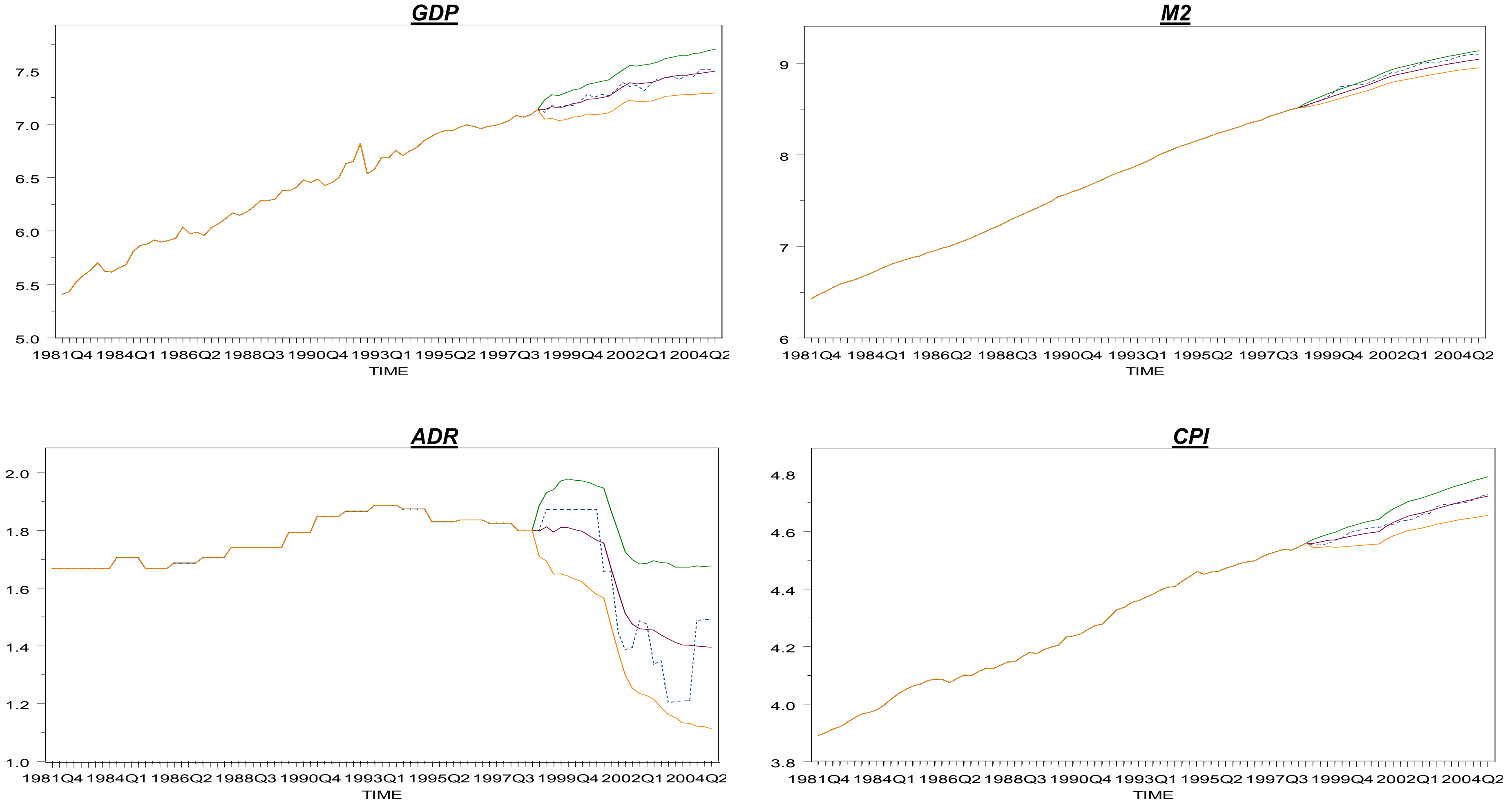
Following Anderson et al (2002), we estimate the VECM, and in a second stage, we assess its forecasting performance. The results of dynamic solution for the forecasting of many periods ahead within sample boundaries, are presented in Figure 5. A large period of 8 years forward (1998:4-2004:4) is selected, using the Gauss-Seidel algorithm.

According to the results, on the one hand the real values of the endogenous variables move within the interval of variance of the mean value of forecasts for the whole period of the sample, and on the other, the forecasts follow closely the path of real values. Note that when we move away from the starting point of the forecasting, the spread of variance around the mean value of forecasting for the endogenous variables increases.

Figure 6 presents the forecasting results when we expand the time limits out of sample. Specifically, using the Gauss-Seidel algorithm we perform forecasts for the period 2005:1-2007:4. The forecast mean moves upward and within the boundaries for GDP, M2, and CPI. For the case of ADR, although the movement is within boundaries, however, is not increasing, but rather cyclical. The crucial question at this point is how close we are in our forecasts? We can answer this question by comparing those results with the available actual values. The available data for 2005 suggest a remarkable consistency between our ADR forecasts and the actual data (in 2005 the logged actual values were 1.4, 1.3, 1.2, 1.2, where our forecasts were 1.4, 1.2, 1.2,1.2).

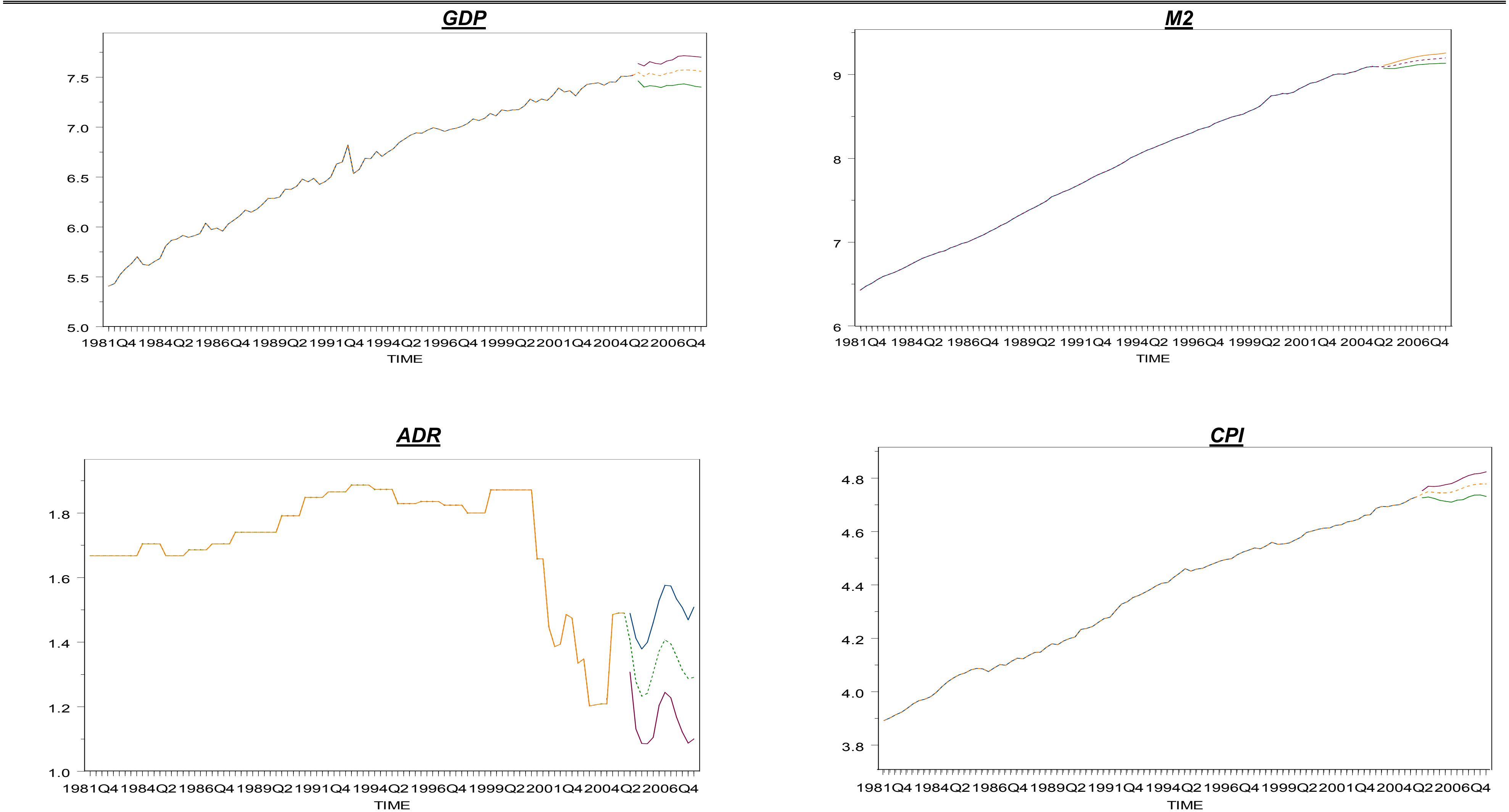
Consequently, we assess that even in the case of forecasts within and out of sample, for a large number of periods ahead, the VECM is characterized by efficient forecasting properties.

Figure 5: Dynamic Forecasting (Within Sample) [1]



[1] The bounds denote $\pm$ 2 standard deviations from the forecast mean, whereas the slashed line denotes the actual value of the variable.

Figure 6: Dynamic Forecasting (Out of Sample) [1]



[1] The bounds denote ± 2 standard deviations from the forecast mean (slashed line).

An alternative way of evaluating the model is to examine how the model performs when we allow a one time change in M2. As previously mentioned, M2 is weakly exogenous in the system and undoubtly plays a significant role for the right economic policy implementation by the authorities. Specifically, we perfom dynamic forecasts for the period 2001:4-2009: 4 using the Gauss-Seidel algorithm, allowing a 15% (roughly one standard deviation from the mean) increase in M2 at the beginning of the forecast sample.

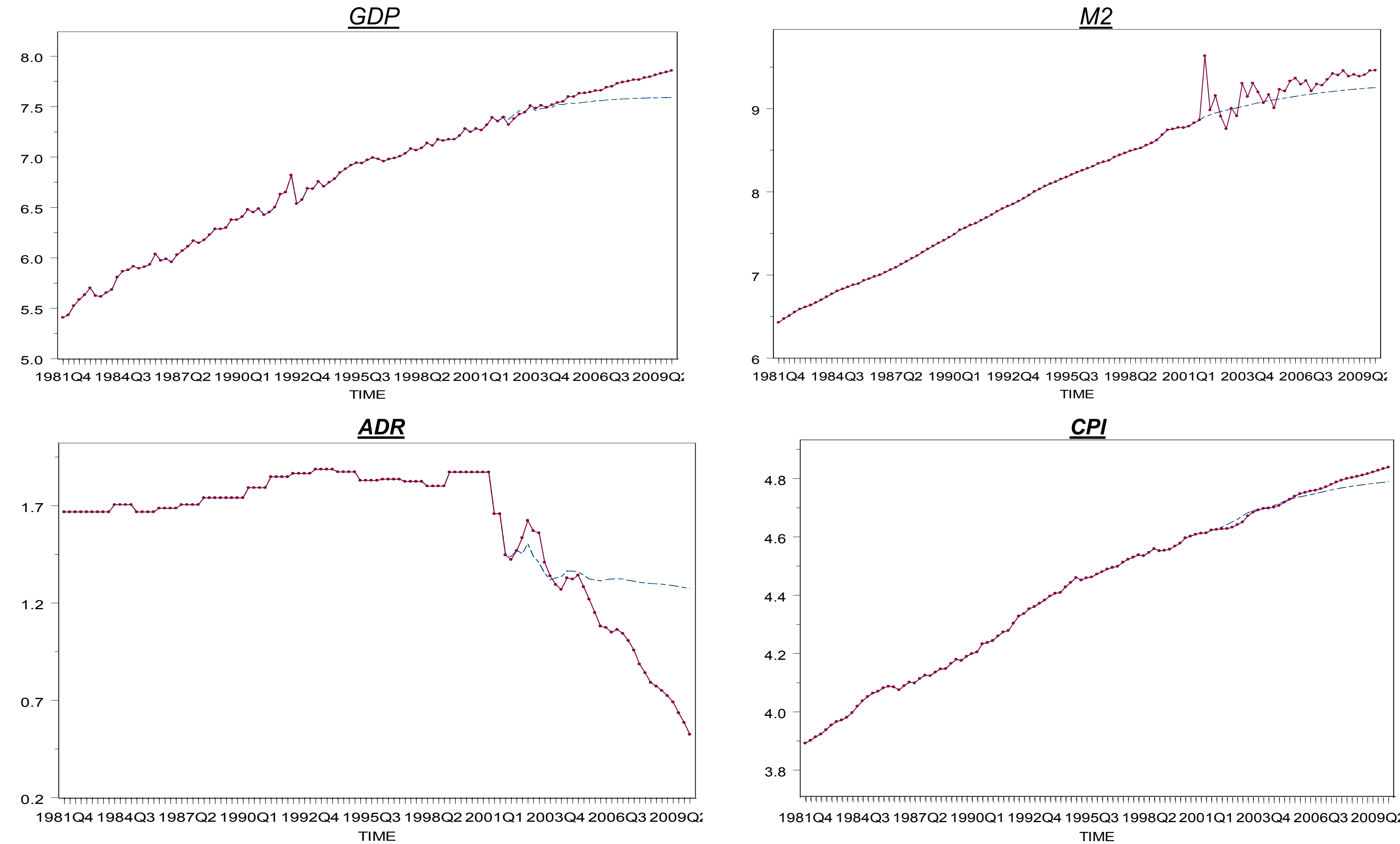
According to Figure 7, when M2 has a sudden one time increase in 2001:4, GDP starts, after a short period, following a growing path. It is noticeable that through time, this increase in GDP diverges more and more from its baseline value with no change in M2. Thus, we conclude that an expanding monetary policy, causes a substantial growth in the long run.

The effects of M2 are also remarkable for CPI. After 1-2 years from the change, CPI increases as well, a result which is consistent with the theory. Nevertheless, the rate of increase of CPI is lower than GDP.

The largest effect from the 15% increase in M2, occurs (after a short temporary rise) in ADR: We notice an decline in ADR compared to its baseline value with no change in M2. Again, economic theory is vindicated: An increase in money variables, decreases the interest rate in order to control the excess money supply and restore the initial equilibrium.

Based on the above results which are consistent with the economic theory, we conclude that the model is characterized by very good forecasting properties, and, thus, is a useful instrument for an effective economic policy implementation by the authorities.

Figure 7: Dynamic Forecasting under a one time change in M2 [1]



[1] The slashed line denotes the Baseline Mean, whereas the solid line the Mean after the one time change in M2.

VI. SUMMARY AND CONCLUSIONS

The interest in empirical studies for the relationship between various macroeconomic variables and forecasting has increased in the last decade. In this study we attempt to answer questions considering the relatioship of GDP, M2, ADR, and CPI by estimating a VAR model. The results obtained from the estimated model are consistent with the theory: There is a negative bond between ADR and M2, and between GDP and CPI. Furthermore, M2 and CPI exhibit a positive relationship. In this model, there is a significant role for structural breaks. The ADR liberalization in 2001:1, and the substantial decline in tourists arrivals and revenue in 1992:3, are included in the model using dummy variables. Performing a Granger Causality Test in the model, we find that CPI and GDP are Granger-Caused by M2 in a great extend, a result which is important for policy implementation issues.

The dynamic interrrelationships of the variables are examined in the context of a VECM estimation. The first step of a VECM estimation requires a cointegration analysis. Following Johansen and Juselius(1990, 1992) we test the cointegration hypothesis adjusting the critical values for a finite sample, as Cheung and Lai proposed(1993). Since we reveal the existance of a cointegrating relationship, we estimate a VECM, where the obtained results are in line with the theory: ADR is related positively with GDP and CPI, but for the case of M2 the relationship is negative. In addition, M2 is related positively with GDP and CPI, CPI has negative relationship with GDP, whereas GDP is influenced positively by M2. Performing Impulse Response Function Analysis, and consentrating on shocks to the M2 equation, we find that a random innovation in M2 has positive effects on GDP and prices. Also, through Variance Decomposition Analysis which is another way to characterize the dynamic behavior of the model, we find that through time, the impact on the variance of a variable, due to shocks from the remaining endogenous variables, increases: In the last period, 30% of the total change on the variance of ADR is due to the rest variables. In addition, 18% and 15% of the variation of CPI in the last period is due to ADR and M2 respectively.

A significant property of a VECM is forecasting. Consequently, following Anderson et al (2002), after estimating the VECM, we assess its forecasting performance in a second stage, using an iterative Gauss-Seidel method. The results of dynamic forecasts within and out of sample, show that our model is characterized by very efficient forecasting properties. In addition, in the context of out of sample forecasts, we allow an 15% increase in M2, where the estimated results are in line with the economic theory: GDP and CPI increase, whereas ADR decreases.

In this study we verify that GDP, M2, ADR and CPI are linked by a short-run, as well as a long-run relationship. Undoubtly, our results represent a significant source of information, especially for the efficient designation and implementation of monetary policy, from the authorities.

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APPENDIX A

Table A1:VARIABLE DESCRIPTION AND SOURCES

VARIABLE	DESCRIPTION	SOURCES
GDP	Nominal Gross Domestic Product (Value Added Based). Since the series was available only on yearly basis, the Economic Research Centre created quarterly data. Specifically, Christofides and Mitsis (2004) constructed that series using quarterly representative indices of the main sectors of the economy	ERC [1]
M2	Total Liquidity= M1+ Savings Deposits + Time Deposits.	CBC [2]
ADR	Average Deposit Rates. Over the period 1981-1998 this series is constructed by averaging the Deposit Rates of all commercial banks. From 1999-2004 we average the retail three-month interest rates only from the three biggest commercial banks.	CBC
CPI	Consumer Price Index (Base year 2000)	IFS [3]

[1] Economic Research Centre

[2] Central Bank of Cyprus

[3] International Financial Statistics

APPENDIX B

Table B1: VAR MISPECIFICATION TESTS (Four-Variable)

Model: GDP,M2, ADR, CPI			
Test	**Lags**	**Value**	**Probability**
Autocorrelation LM Test			
H_o = ***No Serial Correlation***	1	17.332	0.364
	2	10.605	0.833
	3	11.389	0.784
	4	22.627	0.124
	5	14.355	0.572
	6	27.153	0.039
Heteroskedasticity Tests			
H_o = ***Homoskedasticity***	-	443.591	0.013
Multivariate Arch-LM Test			
H_o = ***No arch***	8	810.000	0.395
Normality Test			
H_o = ***Normality***			
Jarque –Bera		43.065	0.000
Skewness (Chi-sq)		15.089	0.004
Kurtosis(Chi-sq)		27.975	0.000
Stability Tests			
AR Roots Stability Test	***No root lies outside the Unit Circle***		

Figure B1: Cusum Tests (5%)

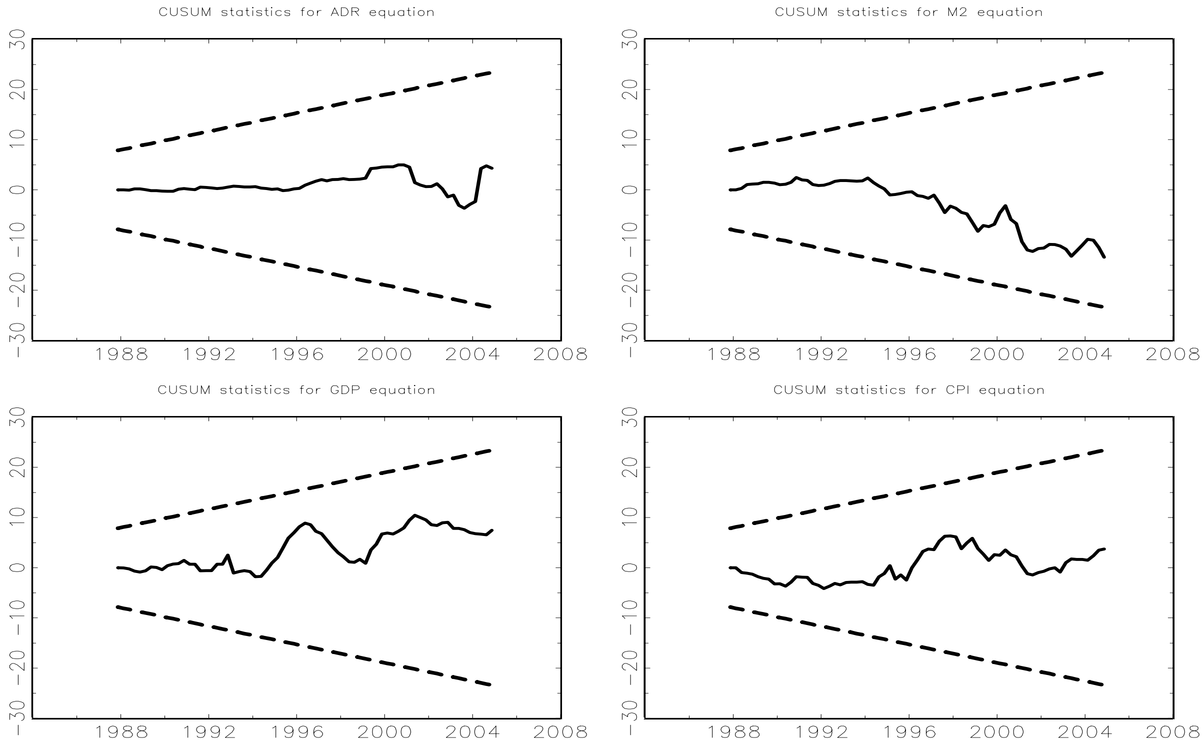
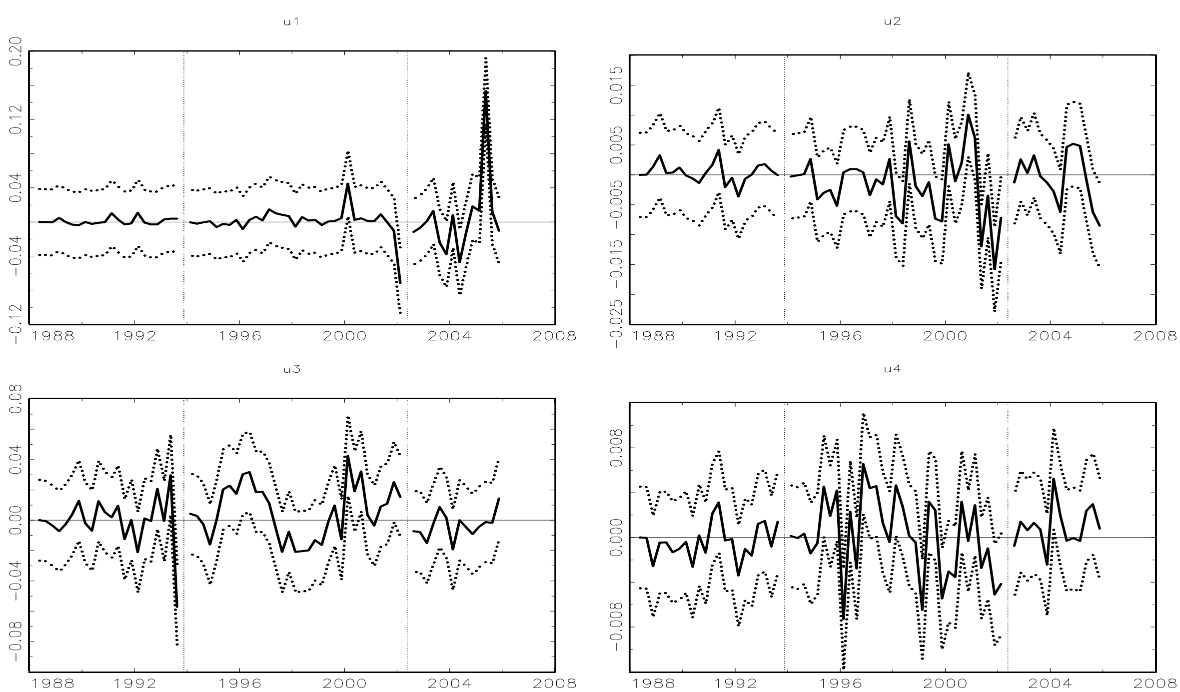
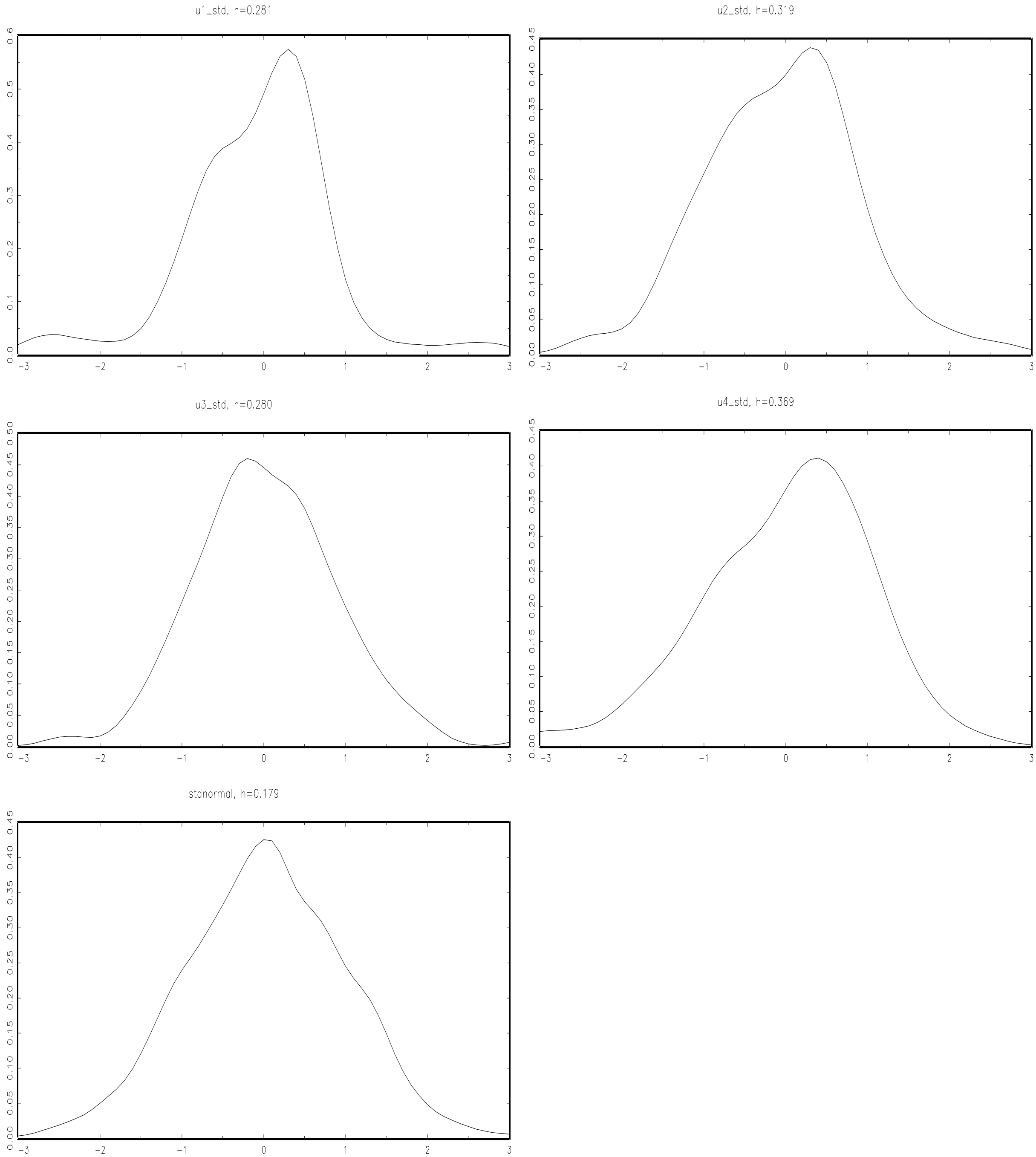


Figure B2: Recursive Residuals Tests (5%) [1]



[1] The figures for u1,u2,u3,u4 correspond to ADR, M2, GDP and CPI respectively.

Figure B3: Gaussian Kernel Densities [1]



[1] The figures for u1,u2,u3,u4 correspond to ADR, M2, GDP and CPI respectively, whereas the last figure is the Standard Normal Density. The bandwidth was chosen automatically by JMulti Statistical Program.

Table B2: VAR MISPECIFICATION TESTS (Three-Variable)

Model: GDP,M2, CPI			
Test	**Lags**	**Value**	**Probability**
Autocorrelation LM Test			
H_o = ***No Serial Correlation***	1	10.292	0.327
	2	8.460	0.489
	3	6.644	0.674
	4	8.926	0.444
	5	8.410	0.493
	6	8.571	0.478
Heteroskedasticity Tests			
H_o = ***Homoskedasticity***		206.206	0.087
Multivariate Arch-LM Test			
H_o = ***No arch***	8	287.562	0.496
Normality Test			
H_o = ***Normality***			
Jarque –Bera		23.811	0.000
Skewness (Chi-sq)		9.370	0.024
Kurtosis(Chi-sq)		14.440	0.000
Stability Tests			
AR Roots Stability Test		***No root lies outside the Unit Circle***	

Figure B4: Cusum Tests (5%)

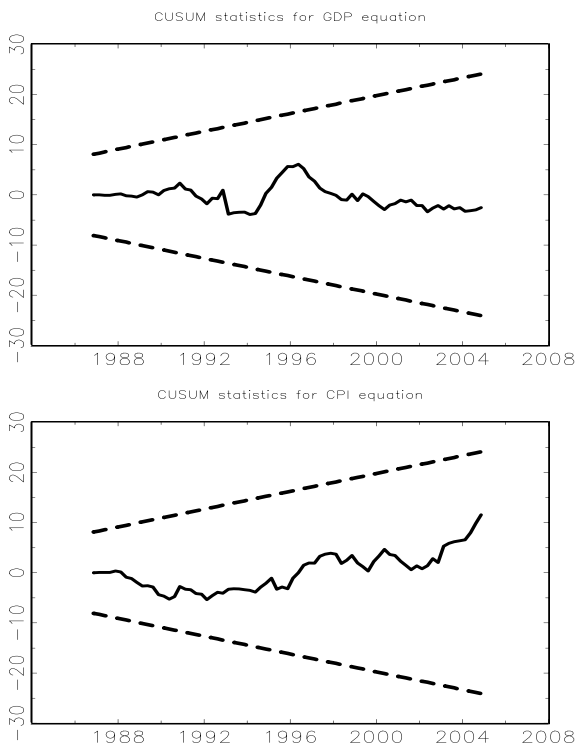
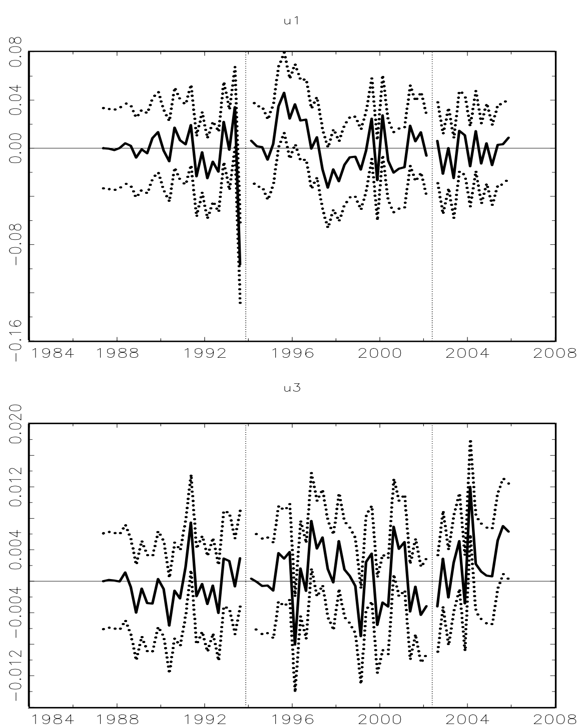
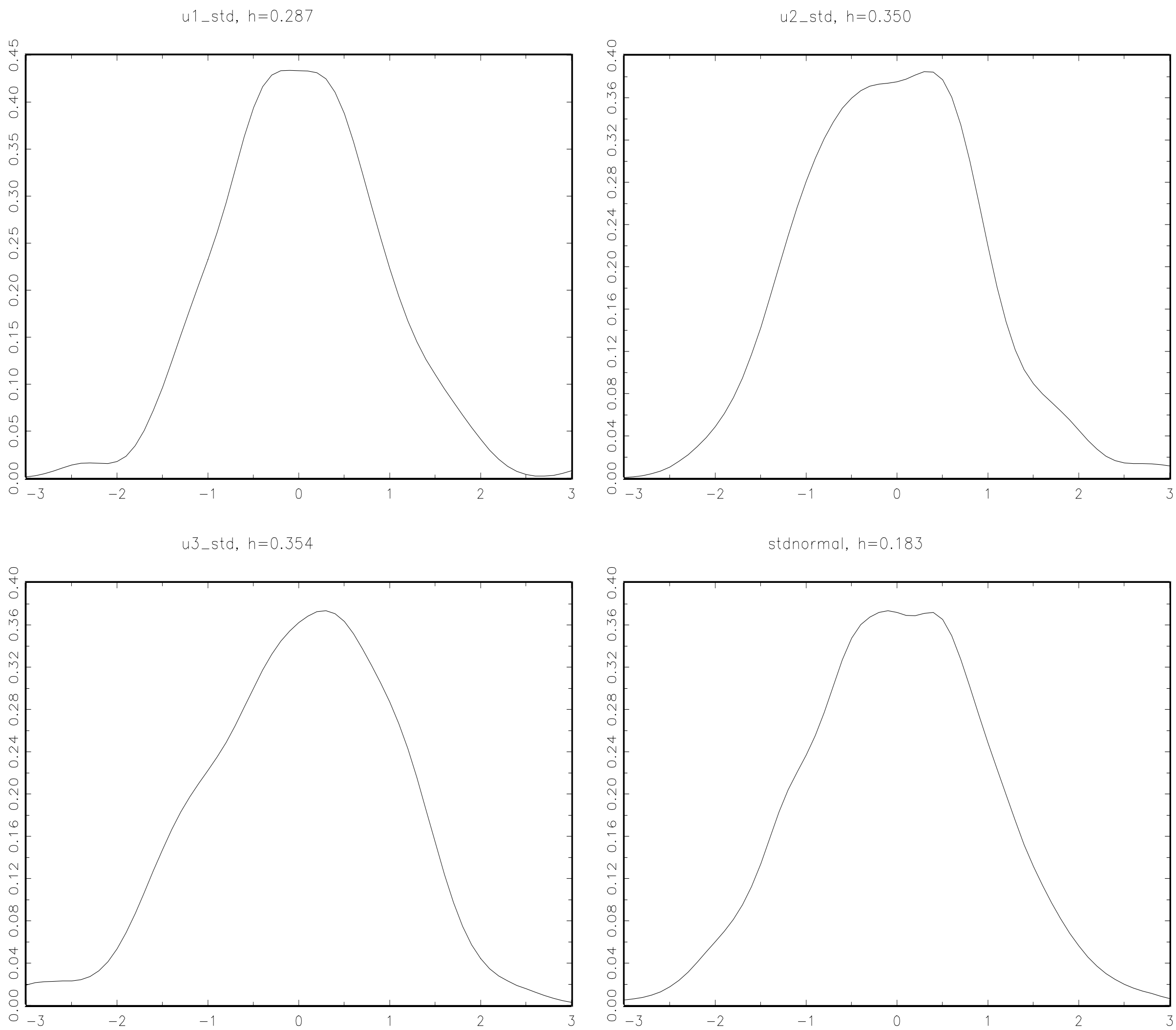


Figure B5: Recursive Residuals Tests (5%) [1]



[1]The figures for u1,u2,u3 correspond to M2, GDP and CPI respectively.

Figure B6: Gaussian Kernel Densities [1]



[1] The figures for u1,u2,u3 correspond to M2, GDP and CPI respectively, whereas the last figure is the Standard Normal Density. The bandwidth was chosen automatically by JMulti Statistical Program.

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