

Alternative Payment Systems implication for Currency Demand and Monetary Policy in Developing Economy: A Case Study of Nigeria

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Abstract

This paper investigates the implication of the alternative payment systems on currency demand and monetary policy using monthly data between 2008 and 2010. Vector Error Correction Model (VECM) was used due to endogenous assumption that predicated our model and the co-integrating behaviour of variables employed. Previous theoretical and empirical studies on this issue are scarce for developing economies and to best of our knowledge none exists for Nigeria. The empirical results from Impulse-Response reveal that internet payment and mobile money substitute currency while credit card (ATM) and Point of Sale (POS) compliment it. Similarly, Apart from debit card (ATM) and internet payment (WEB) all other payment channels respond negatively to innovation in interest rate throughout the periods including currency. This finding may have serious implication for the conduct of monetary policy especially in developing countries as it alternative payment systems seem to dampen the effectiveness of monetary policy.

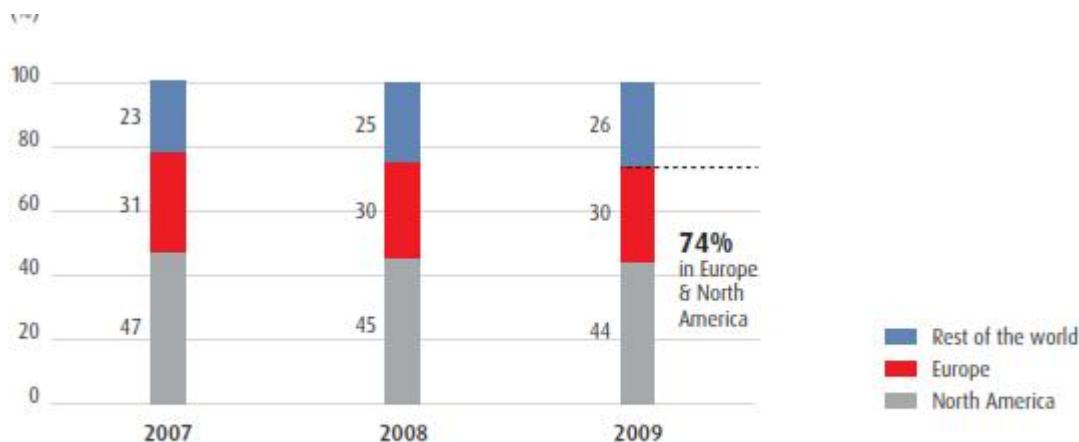
Keywords: Impulse-Response, co-integration, currency and payment

1.1 Introduction

The improvement in information and telecommunication technology especially in the last two decades has provided opportunity for alternative payment systems thereby reducing emphasis on cash as a major payment channel. Huge effort has been made especially in developed economies to empirically investigate how emerging alternative payment systems have impacted on currency demand. Since the whole world has become a global village, developing countries of the world have keyed into the idea of provision of financial infrastructure that will provide platform for alternative payment systems as well. Despite this effort, very scanty studies exist as regard the implication of these alternative payment systems for currency demand and monetary policy within the context of developing economy especially in sub-Saharan Africa.

In developed economies, studies have revealed that there has been a substantial increase in the adoption of alternative payment systems. Taking U.S.A., for instance, the share of debit card increased significantly from around 21% in 1999 to around 37% in 2009, while the share of cash declined from around 39% to around 28% during the same period. European countries have also witnessed similar experience. According to Kohler and Seitz (2004) the number of debit cards transactions in most European countries increased from nearly 10 transactions in 1990s to more than 20 transactions per person in 2000s. According to SEPA report, Europe and North America account for the highest density and strongest markets with regard to existing electronic payment volumes and traffic.

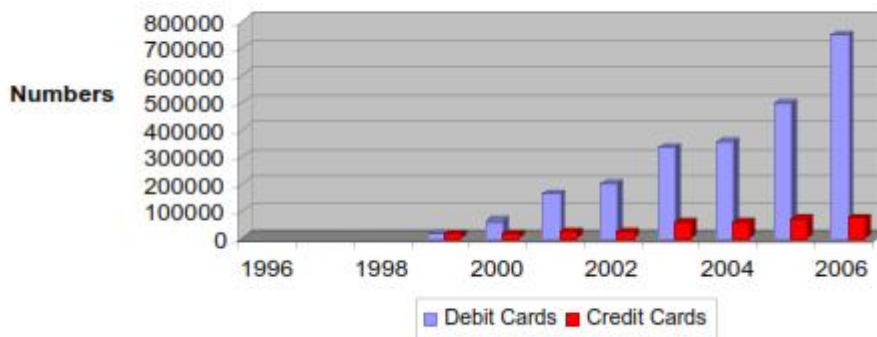
Chart I



Source: World Payments Report 2011, Capgemini, RBS, EFMA

Also in developing countries, scanty available evidences as contained in the work of Hataiseree and Banchuen (2010) for Thailand, Anderson-Reid(2008) for Jamaica and Yazgan and Yilmazkuday (2007) for Turkey indicate that alternative payment systems are fast becoming acceptable thus increasing the trend in the usage of debit cards, credit cards and internet based payment. In Sub-Saharan Africa, steady increase has been witnessed in the use of cards and internet as alternative means of payment. Countries like South Africa, Ghana, Kenya and Nigeria are doing relatively well in this regard. In Kenya particularly, the growth rate of debit and credit cards is presented in chart II

Chart II: Growth in No. of Debit & Credit Cards

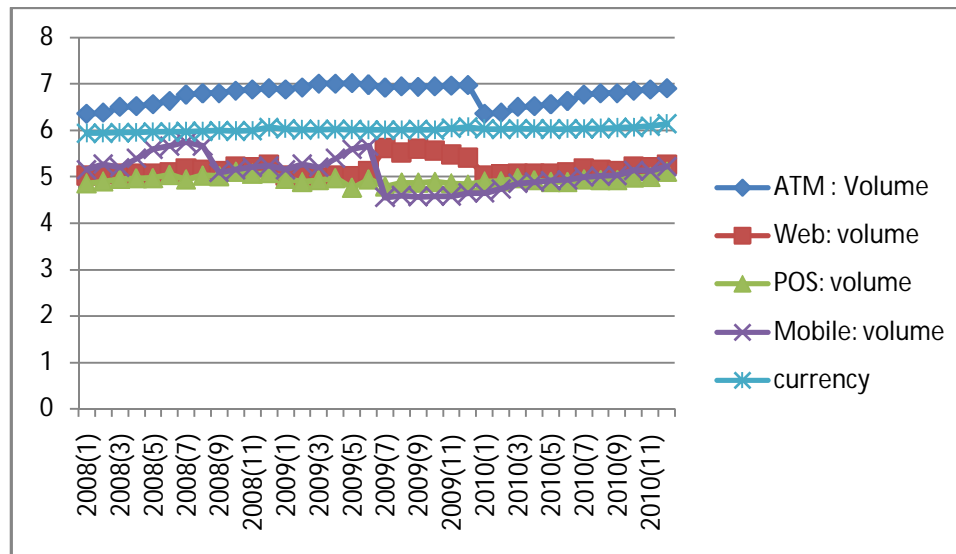


Source: Central Bank of Kenya (CBK) Annual Reports

1.2 Stylized Facts About Payment Systems In Nigeria

Nigerian economy has inherently been dominated by a large informal sector and this has necessitated heavy used of cash for transactions. According to Central Bank of Nigeria(CBN) as at 2011, cash based transaction accounted for 85% of total transactions if cheque payment is excluded and increase to 99% upon inclusion. Also, cash withdrawal using ATM cards accounted for 60.4% of total cash withdrawal and this signals high usage of debit cards though for withdrawal purpose. In the same year, Web based transactions accounted for just 1% while the contributions of POS and Mobile transaction failed to assume a significant proportion. Between 2008 and 2010 as shown in chart iii, the use of ATM cards for withdrawal enjoyed a steady increase amidst fluctuations with a major break in January 2010. The volume of Web based transactions also fluctuated during the period ditto for POS and Mobile money. The currency in circulation was stable throughout the period despite the increment experienced in other payment channels.

Chart III



Source: Author's computation

1.3 Literature Review

The bulk of empirical findings come from developed economies either as cross country studies or single country. Starting with work of Boeschoten (1992) though the study was micro in nature but it depicts the payment habits in the Netherlands in 1990. The study clearly reveals that the use of ATMs, cheques and POS terminals significantly reduces cash holdings. Majorly, Boeschoten discovers that the users of alternative payment media pay the same amount of cash with 20 percent lower cash balances. Similar study by Humphrey, Pulleyand and Vesala (1996) where 14 developed countries were analyzed had similar conclusion.

The study presented by Snellman and Vesala (1999) portrays a less glooming picture of cash substitution .They examined the electronification of non-cash payment in Finland and observed that during the 1980sand 1990s the process moved very fast.In the study, effort was also made to determine the extent to which noncash payment means are used as substitutes for cash. The process of cash substitution andelectronification of payment wasmodelled as "S"-shaped learning curves and generates forecasts by extrapolating these curves. The result of the study suggests that the 'S'-shaped curves are steep and have short slow-growth phase at both the ends and this is an indication that cash substitution was getting saturated during the study period. The use of cash remains quite high in retail payments and is forecasted not to fall below the 65% during next ten years.

In another study by Snellman *et al.* (2000) using panel data, they came up with the estimate of money demand equation for several European countries and found strong evidence of a substitution effect between cash and cards, ATMs and POS terminals. More recently, Attanasio *et al.* (2002) estimates the money demand for Italy and analyzes the welfare cost of inflation for card holders and non-holders. They find that ATM users hold significantly lower cash balances than non-users. Also,Stix (2004) examines the effects of POS payments and ATM withdrawals on the Austrian cash demand. He finds that the cash demand is significantly and sizably affected by debit card usage and that there are significant differences in cash demand for individuals with different debit card usage.

In developing countries as well, Mustafa and Hakan (2007) analyzes the effects of credit and debit cards on the currency in circulation in Turkey by using GMM estimation .The results show that an increase in the usage of credit and debit cards leads to a decrease in the currency demand and particularly the usage of the debit cards has a bigger effect on the money demand, compared to the usage of credits cards. But in somewhat contrary finding, Karen (2008) estimated currency demand model for Jamaica and the result suggests that the demand for currency is positively affected by the volume of ATM transactions in the previous two periods and negatively affected by EFTPOS transactions in the prior period. Also in Kenya, the study by Misati, Lucas, Anne and Shem (2010) contends that financial innovation which is poxied by debit and credit cards usage dampens effectiveness of monetary policy.

Apart from the fact that empirical evidences on the implication of alternative payment systems for currency demand are scarce in developing economies especially in Sub-Saharan Africa very few studies have examined the effect of the new payment systems on currency demand and efficacy of monetary policy altogether. In fact, to the best of our knowledge no single study of this perspective exists for Nigeria. Thus, the study of this nature which aims to bridge this important empirical gap is crucial for better understanding of monetary policy mechanism in developing countries and Nigeria in particular.

1.4 Data Description

To achieve the objective of the study, monthly data that spanned between 2008M1-2010M12 for debit cards usage, web payment, POS and Mobile money were used as alternative payment channels. Also contrary to many other studies, a much narrower definition of money was used (currency in circulation) and this is based on the understanding that demand deposit serve as conduit that connects most payment systems. In a bid to examine the implication of these payment systems on monetary policy, monthly data on interest rate which has been identified as a major monetary policy instrument in Nigeria within the same period is included in the estimated model. Also, control variables such as GDP and CPI are employed. Due to the seemingly endogenous nature of variables used in the study, method of estimation that is capable of preventing endogenous bias is adopted and this necessitated the use of VAR.

The estimated model stems from long-run money demand function of the following form:

$$M^d/P = g, (Y, RC) \dots \dots \dots (1)$$

Where M^d , is the nominal money demand and P is the price level, invariably the demand for money is a demand for real balance and it is a function of scale variables (Y), as a measure of economic activity, and opportunity cost variables (R), to indicate the foregone earnings by not holding assets or instruments which are alternatives to money. Finally (C) stands for other control variables. Presenting equation one explicitly:

$$M^{d*} = \beta_0 + \beta_1 Y + \beta_2 R \dots \dots \dots (2)$$

Where M^{d*} still stands for real money balance. Intuitively, an economic agent has different options as regard the forms he wants his real balance kept. Extremely, he can either have it in cash or cards and he can have combination of the two. But since real demand balance is fixed at a particular point in time he can only have more of cards with less cash and vice versa. Thus, real money balance can be presented in form of identity:

$$M^{d*} = Cur + Crd \dots \dots \dots 3.$$

Where Cur and Crd stand for currency and cards respectively. Substituting eq(3) in (2) gives:

$$Cur = \beta_0 + \beta_1 Y + \beta_2 R - \beta_3 Crd \dots \dots \dots (4)$$

Finally, a long-run money demand relation in log-linear form, over a period of 30 months was estimated.

$$\ln Cur = \ln \beta_0 + \ln \beta_1 GDP - \ln \beta_2 Int - \ln \beta_3 ATM - \ln \beta_4 POS - \ln \beta_5 innt - \ln \beta_6 mob + e_t \dots (5)$$

Where Cur is proxied by total currency in circulation which includes banknotes and coins deducted by demand deposit held by commercial banks. Also, GDP is used to proxy economic activities for the whole country. While volume of transactions with ATM, POS, internet payment and Mobile money are used to represent the usage of the alternative payment systems. Similarly, interest rate on government securities is used as proxy for interest rate and as Sriram (1999) noted that researchers adopting the transaction demand view of money generally employ short-term rates like the yields on government securities, commercial paper or savings deposits with a notion that these instruments are closer substitutes for money and their yields are especially relevant among alternatives that are forgone by holding cash.

1.5 Methodology

The study employed vector autoregression (VAR) methodology to study the effect of alternative payment systems on currency demand and monetary policy. The model specification is of the form:

$$x_t = \left(ATM, POS, INT, MOB, CUR, INT, GDP, \right) \dots \dots \dots (6)$$

ATM, POS, INT and MOB are the log of volume of transaction in the respective channel. Also, CUR and GDP are log of currency in circulation and gross domestic product while INT stands for interest rate on government securities.

1.5.1 Preliminary analysis

Before estimating VAR, it is econometrically required to report unit-root and co-integration analysis. No rejections are found from the augmented Dickey–Fuller (ADF) and Philips Perron tests for all the variables in levels, which is an indication that each series has at least one unit root. The first difference of all variables using ADF and PP tests showed strong rejection of the null hypothesis of unit roots in both tests. We further examined whether any co-integrating relationship exists in our 7-variable system. The tests revealed that at 5% significance level, the trace test rejects the null hypothesis of a rank of 0, but not the null hypothesis of a rank of 2 (see Johansen, 1991). This means that the system has two co-integrating equations, and estimation of vector error correction model is more appropriate.

Also of importance in VAR framework is the issue of optimal lag selection. Prior the estimation of our model, effort was made to determine the optimal lag for the model and apart from Akaike information criterion (AIC) all other selection criteria suggested optimal lag length of one. To resolve this, stability test was conducted to determine which of the two suggested lag length is stable using inverse root of AR characteristic polynomial and optimal lag length of proved stable. See the results for lag selection and AR characteristic in appendix.

1.5.2 Model Estimation Results

Majorly, to achieve the main objective of this study impulse-response component of the estimated Vector Error Correction Model (VECM) was adopted. Generally, impulse-response shows how one variable responds to shock or innovation in other variables within the equation system. This important feature makes this component relevant to examine how currency responds to innovations in alternative payment systems (Debit Cards (ATM), Mobile Money, Point of Sales, and Web Payment).

The results of impulse response from table one reveal that currency demand shows negative response to innovations in mobile money and internet payment in the short, medium and long horizon while it shows positive response to innovations in debit card and Point of sales throughout the horizons. This invariably implying that internet payment and mobile money substitute currency while debit card (ATM) and point of sale compliment it. The results is not surprising for debit card (ATM) as it is largely used for withdrawal purpose which will later add to the volume of cash in circulation. Similarly, the complimentary relationship that seems to exist between currency and POS might be as result of insignificant use of POS channel as a medium of payment in Nigerian economy. In addition, the results also reveal that apart from currency, some of these other payment channels substitute one another.

Table One

<i>Accumulated Response of LOGCUR:</i>							
Period	LOGCUR	LOGATM	LOGMOBILE	LOGPOS	LOGWEB	INTEREST	LOGGDP
1	0.022136	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
3	0.062861	0.006373	-0.003432	0.009331	-0.000306	-0.004193	0.004013
6	0.121946	0.017370	-0.010114	0.023559	-0.001593	-0.008065	0.010068
9	0.177647	0.029456	-0.013955	0.035422	-0.001868	-0.011188	0.016552
10	0.196233	0.033495	-0.015287	0.039446	-0.002015	-0.012279	0.018744

Another major finding from the impulse-response results as shown in table two is how each of the payment channel responds to interest rate (monetary policy instrument). Apart from debit card (ATM) and internet payment (WEB) all other payment channels respond negatively to innovation in interest rate throughout the periods including currency as expected but the positive disposition of debit card and internet payment to interest rate can pose a threat to the efficacy of monetary policy. This finding may have serious implication for the conduct of monetary policy especially in developing countries as it may dampen the effectiveness of monetary policy.

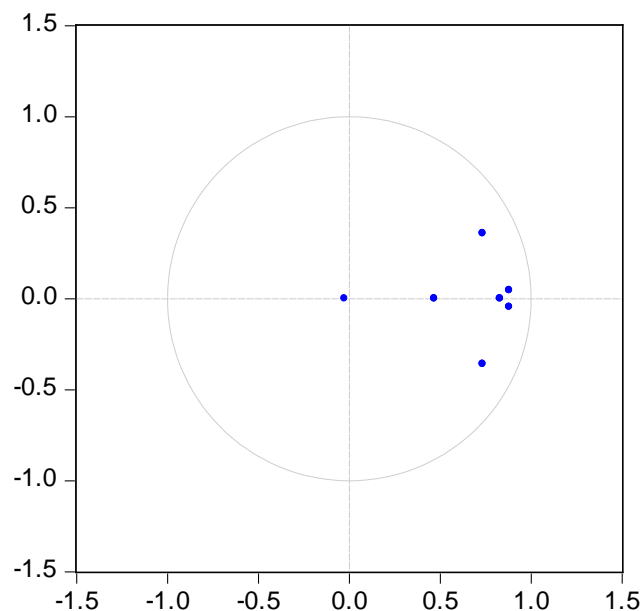
Table Two

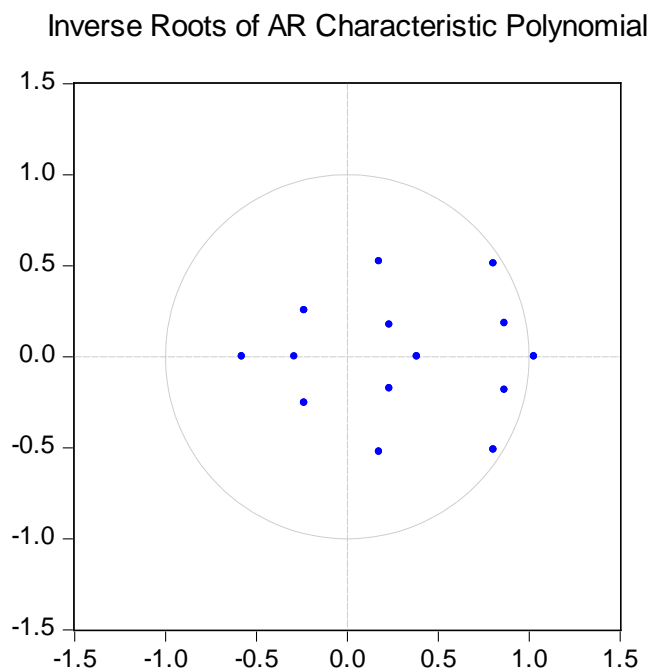
Accumulated Response of LOGATM:							
Period	LOGCUR	LOGATM	LOGMOBILE	LOGPOS	LOGWEB	INTEREST	LOGGDP
1	0.051054	0.117057	0.000000	0.000000	0.000000	0.000000	0.000000
3	0.060834	0.398256	-0.019773	0.034710	0.008223	-0.009799	0.009826
6	0.048662	0.821748	-0.024681	0.045823	0.035301	0.005867	0.016639
9	0.028422	1.246985	-0.023231	0.055283	0.061815	0.017982	0.026082
10	0.021943	1.388755	-0.023179	0.058699	0.070476	0.022009	0.029214
Accumulated Response of LOGMOBILE:							
Period	LOGCUR	LOGATM	LOGMOBILE	LOGPOS	LOGWEB	INTEREST	LOGGDP
1	-0.018192	0.046809	0.160215	0.000000	0.000000	0.000000	0.000000
3	-0.009435	0.134929	0.371619	0.053113	-0.100419	-0.213881	0.053399
6	0.215700	0.211851	0.471535	0.351606	-0.350082	-0.591239	0.120834
9	0.428255	0.291142	0.598630	0.624217	-0.570937	-0.938057	0.179337
10	0.499488	0.317281	0.639822	0.716024	-0.646116	-1.055572	0.199176
Accumulated Response of LOGPOS:							
Period	LOGCUR	LOGATM	LOGMOBILE	LOGPOS	LOGWEB	INTEREST	LOGGDP
1	0.021320	-0.010751	0.011303	0.067723	0.000000	0.000000	0.000000
3	0.049525	-0.021645	0.029753	0.151549	-0.009937	-0.008746	0.008327
6	0.070151	-0.026850	0.069737	0.275981	-0.021937	-0.016826	0.026173
9	0.087555	-0.030470	0.115782	0.399344	-0.029975	-0.021428	0.045352
10	0.092882	-0.031474	0.131218	0.440235	-0.032817	-0.023087	0.051862
Accumulated Response of LOGWEB:							
Period	LOGCUR	LOGATM	LOGMOBILE	LOGPOS	LOGWEB	INTEREST	LOGGDP
1	0.046886	0.038511	-0.014683	0.006636	0.081812	0.000000	0.000000
3	-0.002892	0.157390	0.007085	0.009124	0.248382	0.074954	0.008162
6	-0.195590	0.374541	0.159143	-0.105059	0.554265	0.232381	0.032584
9	-0.403312	0.598381	0.313173	-0.218703	0.849933	0.377984	0.065367
10	-0.473074	0.673360	0.365204	-0.256969	0.949138	0.427361	0.076357
Accumulated Response of INTEREST:							
Period	LOGCUR	LOGATM	LOGMOBILE	LOGPOS	LOGWEB	INTEREST	LOGGDP
1	0.324945	-0.018836	-0.365783	-0.196550	0.037327	0.696933	0.000000
3	0.826306	-0.020847	-1.516968	-0.332191	-0.169558	1.648031	-0.295691
6	2.156791	-0.363388	-3.454290	-0.495254	-0.405843	3.123184	-0.946102
9	3.724572	-0.808825	-5.561137	-0.520758	-0.695666	4.533764	-1.645164
10	4.256733	-0.961507	-6.269618	-0.526106	-0.792333	5.004361	-1.881749
Accumulated Response of LOGGDP:							
Period	LOGCUR	LOGATM	LOGMOBILE	LOGPOS	LOGWEB	INTEREST	LOGGDP
1	0.002489	0.004425	0.005089	0.001146	0.002220	-0.000453	0.007521
3	-0.018618	0.029818	0.024679	0.003858	0.005319	0.002310	0.032644
6	-0.085051	0.083589	0.079240	-0.013438	0.019564	0.018942	0.077262
9	-0.162209	0.141656	0.141270	-0.035888	0.034931	0.036234	0.124853
10	-0.188247	0.161195	0.162138	-0.043452	0.040083	0.042064	0.140844
Cholesky Ordering: LOGCUR LOGATM LOGMOBILE LOGPOS LOGWEB INTEREST LOGGDP							

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Appendix One Inverse Roots of AR Characteristic Polynomial





Appendix Two

VAR Lag Order Selection Criteria

Endogenous variables: LOGCUR LOGATM LOGMOBILE LOGPOS LOGWEB
INTEREST LOGGDP

Exogenous variables: C

Date: 04/15/13 Time: 21:05

Sample: 2008M01 2010M12

Included observations: 34

Lag	LogL	LR	FPE	AIC	SC	HQ
0	152.2650	NA	4.59e-13	-8.545001	-8.230750	-8.437832
1	303.6629	231.5497*	1.18e-15*	-14.56841	-12.05440*	-13.71106*
2	356.1959	58.71334	1.42e-15	-14.77623*	-10.06247	-13.16870

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion