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E-Banking and the Stability of Money Demand in Iran: A Bound Test Approach

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Abstract: Electronic Banking has been developed in recent decades. By significant increase in the use of electronic banking tools in ten years, a meaningful transformation in the style services of banking system have been existed, parallel to development of information and communication in other sectors. In general, Electronic banking is a special type of banking services that uses electronic medium such as internet, POS and ATM for giving services to customers. In this paper by using quarterly data between 2002- 2011 and ARDL model, demand function has been estimated and the effects of electronic banking on stability of the function have been surveyed. According to result of CUSUM and CUSUMQ tests, this function is unstable during period. Also, correlation between electronic banking and money demand is positive. Therefore, new electronic tools are essential more than ever and should be considered by policymakers.

Key words: Long term relationship · Short term relationship · Error correlation model · Stability test

INTRODUCTION

Theory of money demand can be divided into three distinguished theories namely inventory models, asset theories and consumer demand theory. Although, in these models demand for money is being surveyed in various aspect, but in whole these theories the optimal volume of real money has direct correlation with asset returns and is correlated with real income inversely. However, in practice these patterns are different in terms of using scale variable and opportunity cost of holding money [1].

In recent decades, the calculations showed that the patterns of demand for money, predicts the amount of real money demand more than reality [2]. Therefore, the case of Missing Money has been expressed and after that researchers tried to define missing variable which lead to stability of money demand. If demand of money is unstable and has an unpredictable variation, authorities can not anticipate the effect of changing in amount of money on other parameters in economy. Therefore, based on this finding, stability of money demand is essential for determining the effectiveness of monetary policy. Informing about effective factors on demand of money function can help decision-makers in macroeconomic field to choice appropriate monetary policies.

Recent studies have revealed instability of money demand function in lots of areas. This phenomenon on money demand modeling leads to effectiveness of monetary policies, clearly face challenges. Also, surveying the trend in monetary system has revealed changing in structure of money demand in countries. One main reason for instability in money demand can be attributed to financial innovation. Basically, monetary theories which embody financial innovation in their analysis are expressing, the role of financial innovation in stability of money demand is being showed in demand for sight deposits [3].

According to importance of Demand of money function in monetary system and its impact on other monetary and non- monetary components, it is necessary for policy makers to understand the nature of demand of money for overcoming difficulties.

Therefore, in this study first the literature review will be surveyed. After that the data and methodology will be explained and at the end of this research the result for giving some suggestion will be analyzed.

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Literature Review: An investigation into the level and stability of money demand (M_1) for Australia and New Zealand over the 1960-2009 analyzed by Kumar and Webber [4] and their paper presented that both countries experienced regime shifts; Australia also experienced an intercept shift. Application of four time series methods provide consistent results with 1984 and 1998 break dates. CUSUM and CUSUMSQ stability tests revealed that M_1 demand functions were unstable over the 1984 to 1998 period for both countries although tests for stability were not rejected thereafter.

The determinants and stability of money demand functions, as per new definitions of monetary aggregates, have been analyzed in the work of Chandra [5]. Quarterly Data from $1996Q_2$ to $2009Q_2$, for various monetary aggregates, interest rates, exchange rates, stock prices and GDP were in use. The cointegration tests, error correction mechanism, Granger causality and CUSUM tests have been applied for empirical analysis. The estimated results disclosed the existence long-run and short-run relationship among the variables. Unidirectional Granger causality found from GDP and Stock Prices to monetary, new monetary as well as liquidity aggregates. Also similar result repeated from interest rates to money demand functions. The CUSUM and CUSUMQ tests support the existence of stability of each money demand functions. All the three variables, except exchange rate, affect the money demand of both types of specification.

Dagher and Kovanen [6], in their paper adopted the bounds testing procedure developed by Pesaran *et al*. [7] to test the stability of the long-run money demand for Ghana. The results provided strong evidence for the presence of a stable, well-identified long-run money demand during a period of substantial changes in the financial markets. The empirical evidence points to complex dynamics between money demand and its determinants while suggesting that deviations from the equilibrium were rather short-lived.

Bhatta [8] has examined the long run and short run demand for money functions and their stability issues for Nepal using the annual data set of 1975-2009 by using ARDL. The bounds test showed that there existed the long run cointgrating relationship among demand for real money balances, real GDP and interest rate in case of both narrow and broad monetary aggregates. Further, the CUSUM and CUSUMSQ test revealed that both the long run narrow and broad money demand functions were stable. The results showed that demand for real money balance in Nepal were stable and predictable function of a few variables and the central bank can rely on the monetary aggregates as intermediate targets for achieving the broad economic objectives.

Anh Lai [9] investigated the dynamics of money demand in Vietnam from 1999 to 2011. The empirical result delivered strong evidence for a long-run relationship between money demand and income, expected inflation, stock market index, exchange rates and gold price. More crucially, the stability test conclusion pointed out the presence of stable money demand in Vietnam during this period of substantial changes proceeding in the economy, suggesting that the Central bank should continue its monetary targeting strategy.

The other empirical literature offered mixed evidence as to the impact of financial and economic liberalization on money demand stability. For instance, in the case of China, Lee and Chien [10] find that economic and financial deregulation affected the stability of money demand; while Baharumshah *et al*. [11] and Wu [12] showed that a stable money demand function would continue to exist when proper accounting for other financial assets was made Bahmani-Oskooees and Rehman [13], examined the stability of money demand for a group of Asian emerging market countries (India, Indonesia, Malaysia, Pakistan, the Philippines, Singapore and Thailand) and their results suggested that in many of these countries money demand could be unstable, based on recursive CUSUM and CUSUMSQ residual tests, even when monetary aggregates are cointegrated with their determinants.

Buch [14] found some evidence of parameter instability in the money demand for Hungary and Poland during the transition period. Pradhan and Subramanian [15] suggested that financial deregulation and innovation in India affected the stability of the demand for money.

Darrat and Al-Sowaidi [16] has examined whether recent financial changes in three emerging market economies in the Gulf region (Bahrain, the UAE and Qatar) has distorted the character and the stability of their underlying long-run money demand relations. Money demand instability prompts concerns about the appropriateness of targeting monetary aggregates and could weaken the presumed link between monetary policy and its ultimate objectives. Their results suggested that the quick pace of financial changes in the three emerging market economies did not cause undue shifts in their equilibrium money demand relations. Further evidence from direct tests of cointegration stability indicated the

uperiority of targeting M_1 in the UAE and M_2 for Qatar. In Bahrain, both M_1 and M_2 proved equally appropriate to guide monetary policy. Thus, despite the wave of financial developments that has recently swept the three Gulf economies, the evidence suggested that monetary authorities in these countries should maintain a close watch on monetary growth as a principal policy guide.

Also, there is some empirical evidence that further financial advancements in several developed countries in the late 1980s had destabilized their underlying money demand relationships [see, for example, Taylor [17], Mullineux [18], Mariscal, Trautwein, Howells, Hendry and Ericsson [19], Ericsson and Sharma [20], Gowland [21], Arestis, Hadjimatheou and Zis [22].

AS it mentioned in these studies, there are many researches in the world which study about stability of money demand and the effect of financial innovation such as electronic banking on stability of money demand. But in Iran almost there is no researches which exactly evaluate the effect of electronic banking (in this study total transaction of point of sale (POS) and terminal branches and transaction of automated teller machine represent E-banking), beside other impressive variable in demand of money function. Hence, in the following we will discuss about this important issue.

MATERIALS AND METHODS

Exchange rates, Real Gross Domestic Product (GDP) (is used as a proxy of income), equilibrium interest rate, total transaction of point of sale and terminal branches and transaction of automated teller machine are collected from the central Bank in Iran [23]. Also, equilibrium interest rate has been collected from Shahmoradi's paper [24] and some period has been estimated by Genetic algorithm Approach. The data is seasonal and spans the time period 2002 to 2011.

In terms of methodology, the paper adopts the recently developed autoregressive distributed lag (ARDL) framework by Pesaran and Shin [25], Pesaran *et al.* [26] and Pesaran [27]. to establish the direction of causation between variables. This approach does not involve pre-testing variables, which means that the test on the existence relationship between variables in levels is applicable irrespective of whether the underlying regressors are purely I(0), purely I(1) or mixture of both.

Basically, the ARDL approach to cointegration involves estimating the conditional error correction (EC) version of the ARDL model for Money Demand and its determinants:

$$\Delta M_t = a_0 + \sum_{i=1}^{p} \phi_i \Delta M_{t-i} + \sum_{i=0}^{p} \theta_i \Delta ER_{t-i} + \sum_{i=0}^{p} \lambda_i \Delta GDP_{t-i} + \sum_{i=0}^{p} \varphi_i \Delta R_{t-i} + \sum_{i=0}^{p} \kappa_i \Delta POS_{t-i} + \sum_{i=0}^{p} \rho_i \Delta ATM_{t-i} + \delta_1 M_{t-1} + \delta_2 ER_{t-1} + \delta_3 GDP_{t-1} + \delta_4 R_{t-1} + \delta_5 POS_{t-1} + d_6 ATM_{t-1} + \upsilon_t \quad (1)$$

where *M, ER, GDP, R, POS* and *ATM* are money demand (M2), real exchange rates, Real gross domestic product, equilibrium interest rate, total transaction of point of sale and terminal branches and transaction of automated teller machine, respectively. Also, *p* is the optimal lag length.

The *F* test is used for testing the existence of long-run relationship. When long-run relationship exists, *F* test indicates which variable should be normalized. The null hypothesis for no cointegration among variables in equation (1) is H_0: $\delta_1 = \delta_2 = \delta_3 = \delta_4 = \delta_5 = \delta_6 = 0$ against the alternative hypothesis H_1: $\delta_1 \neq \delta_2 \neq \delta_3 \neq \delta_4 \neq \delta_5 \neq \delta_6 \neq 0$. The *F*-test has a non-standard distribution which depends on (i) whether variables included in the model are I(0) or I(1), (ii) the number of regressors and (iii) whether the model contains an intercept and/or a trend. Given a relatively small sample size in this study of 32 observations, the critical values used are as reported by Narayan [28] which based on small sample size between 30 and 80[1]. The test involves asymptotic critical value bounds, depending whether the variables are I(0) or I(1) or a mixture of both. Two sets of critical values are generated which one set refers to the I(1) series and the other for the I(0) series. Critical values for the I(1) series are referred to as *upper* bound critical values, while the critical values for I(0) series are referred to as the *lower* bound critical values.

If the *F* test statistic exceeds their respective upper critical values, we can conclude that there is evidence of a long-run relationship between the variables regardless of the order of integration of the variables. If the test statistic is below the upper critical value, we cannot reject the null hypothesis of no cointegration and if it lies between the bounds, a conclusive inference cannot be made without knowing the order of integration of the underlying regressors.

[1]Pesaran and Pesaran [27]and Pesaran *et al*. [7], however, generated critical values based on 500 and 1000 observations and 20,000 and 40,0000 replications, respectively, which suitable for large sample size.

If there is evidence of long-run relationship (cointegration) of the variables, the following long-run model is estimated.

$$M_t = \alpha_1 + \sum_{i=1}^{p} \phi_{1i} M_{t-i} + \sum_{i=0}^{p} \beta_{1i} ER_{t-i} + \sum_{i=0}^{p} \theta_{1i} GDP_{t-i} + \sum_{i=0}^{p} \lambda_{1i} R_{t-i} + \sum_{i=0}^{p} \eta_{1i} POS_{t-i} + \sum_{i=0}^{p} \omega_{1i} ATM_{t-i} + \mu_t \quad (2)$$

The orders of the lags in the ARDL model are selected by either the Akaike Information criterion (AIC) or the Schwarz Bayesian criterion (SBC), before the selected model is estimated by ordinary least squares. For annual data, Pesaran and Shin [25] recommended choosing a maximum of 2 lags. From this, the lag length that minimizes SBC is selected.

The ARDL Specification of the short-run dynamics can be derived by constructing an error correction model (ECM) of the following form:

$$\Delta(M)_t = \alpha_2 + \sum_{i=1}^{p} \phi_{2i} \Delta(M)_{t-i} + \sum_{i=0}^{p} \theta_{2i} \Delta(ER)_{t-i} + \sum_{i=0}^{p} \lambda_{2i} \Delta(GDP)_{t-i} + \sum_{i=0}^{p} \varphi_{2i} \Delta(R)_{t-i} + \sum_{i=0}^{p} \eta_{2i} \Delta(POS)_{t-i} + \sum_{i=0}^{p} \omega_{2i} \Delta(ATM)_{t-i} + \psi ECM_{t-1} + \vartheta_t \quad (3)$$

where ECM_{t-1} is the error correction term, defined as

$$ECM_t = M_t - \alpha_1 - \sum_{i=1}^{p} \phi_{1i} M_{t-i} - \sum_{i=0}^{p} \beta_{1i} ER_{t-i} - \sum_{i=0}^{p} \theta_{1i} GDP_{t-i} - \sum_{i=0}^{p} \lambda_{1i} R_{t-i} - \sum_{i=0}^{p} \eta_{1i} POS_{t-i} - \sum_{i=0}^{p} \omega_{1i} ATM_{t-i} \quad (4)$$

All coefficients of short-run equation are coefficients relating to the short run dynamics of the model's convergence to equilibrium and ø represents the speed of adjustment.

The last step in this research was testing the stability of received relations. In order to do it the CUSUM and CUSUMQ tests worked out by Brown, Durbin and Evans [29] were used. They use recursive regression received from the ordinary least squares (OLS) method in the sequence of first r observations. This set is subsequently lengthened. Each error of the forecast appearing in a period r+1 is called a recursive residual after proper scaling. CUSUM test uses the series of ratio of cumulated sums of recursive residuals and standardized errors of recursive regression. It is exposed on a chart with the boundaries depending on the significance level. The constancy in time of the parameters of the earlier received model which was examined means that the expected value of CUSUM test is zero, while crossing the significance lines may be understood as instability of parameters of the analyzed economic relation.

CUSUMQ test is based on the cumulative sum of squares of recursive residuals and scaling is done by dividing by a sum of squares of recursive residuals. As result, the expected value of testing series of CUSUMQ equals zero for the first observance and one for the last observance. Again, one can draw conclusions by observing the CUSUMQ series on a chart with the boundaries depending on the level of significance. Crossing the significance lines should be understood as instability of parameters or variation of the starting model.

RESULTS AND DISCUSSION

Surveyed of Short- Run Periods: In order to calculate the autoregressive distributed lag (ARDL) cointegration framework, the dynamic model of short term basis is calculated.

After calculation of this dynamic model, to verify the presence or absence of long-run relationship between the variables in the model, the bound test should be computed, but because of linear relationship between variables, the estimation of long-run relationship is not possible. Therefore, the other dynamic short- run model has been estimated. According to results the number of innovation variable (ATM and POS) causing linear relationship in model. Hence, after elimination of the number of this variable, the other model has been estimated (Table 1).

Table 1: Dynamic model for Short- Run Period

Regressor	Coefficient	T-Ratio
m(-1)	0.61046	7.6234
ER	-251.1441	-2.4344
GDP	0.20479	0.3898
GDP(-1)	2.6544	4.3536
R	-1351731	-2.5829
POS	-1.2019	-2.7653
ATM	-0.82019	-2.8143

Reference: Research computed

According above the result of final estimate can be represented as bellow:

- In short- term, demand of money first lag has significant effect on money demand function. If demand of money increases one unit, demand of money in next year will be rise about 0.6 units.
- Exchange rate has negative and significant effect on dependent variable and if there is one unit increase in exchange rate demand of money increases by 251.14 units. This is due to the replacement nature in exchange of the national currency when inflation rises.
- The first lag of gross domestic product has positive and significant effect on demand of money.
- One unit ascendant in equilibrium rate, lead to 1351731 reductions in dependent variable. Large coefficient on this variable reflects the meaningful impact of this variable on the demand of money.
- Every one unit increase in transaction of total transaction of point of sale and terminal branches and transaction of automated teller machine lead to decrease in liquidity of money.

Surveyed of Long- Run Periods: In order to determine the long-run relationship between the variables using ARDL, at first should find optimal choice. In this study, by putting up to three lags, in order to determine optimal lags the Akaike's information criteria (AIC) has been used.

In Table (2) the result "p value" statistic of Bound test has been expressed. The first column is estimation without intercept, the second one shows existence of intercept but not trend in model and the last one has no trend and intercept.

The critical values used are as reported by Narayan (2004) which based on small sample size between 30 and. Pesaran and Pesaran (1997) and Pesaran *et al*., (2001), however, generated critical values based on 500 and 1000

Table 2: Result of Bound Test

P=1	F-iii	F-iv	F-v
	2.307168	5.024921	6.273322

Reference: Research computed

Table 3: The critical value for three bound test

	1%		5%		10%	
K=3	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
Case III	5.018	6.610	3.548	4.803	2.933	4.020
Case IV	5.258	6.526	3.850	4.782	3.264	4.094
Case V	6.238	7.740	4.510	5.643	3.760	4.795

Reference: Narayan, 2004

Table 4: Dynamic model for long- Run Period

Regressor	Coefficient	T-Ratio
ER	-51.0388	-1.9261
GDP	7.3398	13.2743
R	-3470089	-2.5168
POS	-2.73981	-2.1456
ATM	-1.432	-2.9808

Reference: Research computed

Table 5: Error Correction Model

Regressor	Coefficient	T-Ratio
DER	-251.1441	-2.4344
DGDP	0.20479	0.3898
DR	-1351731	-1.5829
DPOS	-2.9841	-2.1409
DATM	-1.6021	-3.0171
ECM(-1)	-0.38954	-4.8645

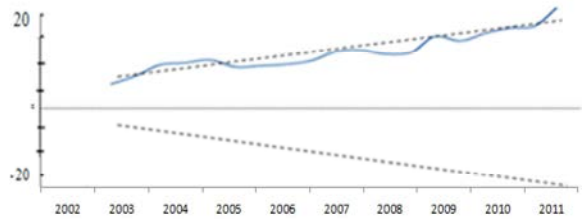
Reference: Research computed

observations and 20,000 and 40,0000 replications, respectively, which suitable for large sample size. The sample of this study is 32, therefore the Narayan's critical value has been chosen (Table 3).

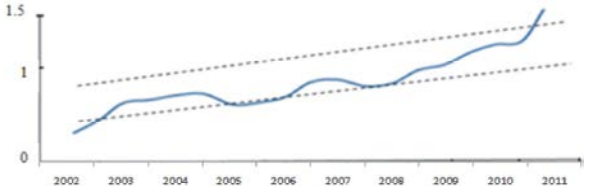
According to result the calculated critical values is larger than the commutated critical value at 5% by Narayan. Therefore, there is long- term relation between variables which this relationship has been shown in the following:

According to Table (4), the significant coefficients in dynamic long- run model indicate that there is positive correlation between GDP and money demand. However there are negative relationship between other effective variables and dependent variable in demand of money function.

The results of the error correction model for demand of money are presented in Table (5). We applied a number of diagnostic tests to the error correction model. We find no evidence of serial correlation, heteroskedasticity and



Graph (1): CUSUM statistical
Reference: Research computed



Graph (2): CUSUMQ statistical
Reference: Research computed

ARCH (Autoregressive Conditional Heteroskedasticity) effect in the disturbances. The model also passes the Jarque-Bera normality test which suggesting that the errors are normally distributed.

The significant of an error correction model shows the evidence of causality in at least one direction. The lagged error term (ECM_{t-1}) in our results is negative and significant at 1% level. The coefficient of -0.38954, indicates high rate of convergence to equilibrium. It is expect by a sudden shock in exchange rate, GDP, equilibrium interest rate and transaction of innovation variables, demand of money will return to equilibrium path after about 2.6 years.

Result of Stability Test: As mentioned before, CUSUM and CUSUMQ tests were used in order to do an analysis of money demand stability over study period. They use series of properly cumulated recursive residuals of regression estimated at the gradually growing set of starting observations. The CUSUM and CUSUMQ test results together with significance lines (highlighted with thin lines), for 5 percent significance level, are plotted in graph 1 and 2.

The results of the CUSUM and CUSUMQ test indicate that the series passed the significance lines. As result, the evaluation of coefficients of relations describing demand of money in Iran can be considered unstable over the study period. In other word, the relation between equilibrium exchange rate, GDP, exchange rate electronic banking can be interpreted unstable in recent years.

CONCLUSION

According to the research results, by entering the e-banking in monetary and banking system, money demand function is unstable. With unstable money demand function, we cannot specify the position and slope of the money demand function; this leads to performing of monetary and financial policy by central bank of Iran sometime does not be effective. Therefore, the policy results may be doubtful.

As a result, the effect of transaction of ATM and POS on money demand function is negative and significant. Hence, central bank should change the composition of money stock or demand of money pattern. They should monitor on advertising, implementation and maturity of activities.

Also, there will always be new innovations in the field of monetary and it formed according to human's needs; it seems that better management of terminal branches, POS and ATM to increase transactions should be considered in monetary policy.

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