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The Impact of Modern Technology on Demand for Money in Iran

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Abstract

This paper examines the impact of modern technology including credit cards, automatic teller machines (ATM) and electronic funds of transfer at the Point-Of-Sale (POS) on money demand for Iran Using seasonal data for Iran 2001-2008. For this purpose, money demand function has been estimated on the basis of Rinaldian model (2001) by ARDL approach. Our findings indicate that the long-run impact of modern technology on demand for money is strongly greater than short-run. We have also shown that, as a result of increase in the number ATMs and credit cards, the demand for currency will increase in both short and long runs. Whereas the impact of increase in POS on demand for currency is negative. In addition, the error correction coefficient is 0.49 indicates that 49 percent of short-run fluctuations in money demand will be settled in long-run.

Keywords: Money demand, ATM, POS, Credit card, ARDL

1- Introduction

Recent developments in information and communication technology and all so technical innovations have added new words to current literature in the contemporary world. Due to high-speed and low-cost data transfer, the knowledge above was broadly accepted by economic activists in different

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countries. Using new electronic technologies caused more than ever the expansion of e-commerce. Obviously, this high-speed and low-cost method of business needs the monetary instruments and proportionate payments. In other words, transfer of funds by paper-based method is considered as a major obstacle to the trade. For this reason, electronic transfer of funds has been developed along with the development of e-commerce in various forms. Security, convenience, speed, low cost and high efficiency are considered to be the most important characteristics of electronic payment method (Crede, 1996) [1]. These methods of transfer, which can be made by automatic teller machines (ATMs) and electronic funds of transfer at the point-of-sale (POS) devices, include electronic money (e-money), electronic cards (e-cards) and electronic check. Widespread publishen of electronic money has considerable business, economic, political and social impacts. Economically, most important effects of expanding the use of electronic money will be manifest on the money supply, money demand, monetary policy and central bank; and then will target the necessary capital, job and goods to create new economy with the development of money markets. Replacement of electronic money, whether in terms of the influence on money supply and of the influence on the demand for money, is especially important because firstly, fluctuations in money market will cause fluctuations in other macro markets; and secondly, influence of monetary policy will be questioned, considering the money demand reduction under circumstances similar to Keyness liquidity trap. Unlike money published by the central bank, electronic money is internal money. In other words, electronic money is like demand deposit owed by the holder from money publisher (Pifareti, 1998) [2]. So, it is obvious that while reducing the central bank's income from budget of publishing banknotes (Humphrey, 2003) [3], publishing electronic money increases the money supply. In addition to the above, considering that the electronic money is able be replaced instead of banknote and coin, it will be possible to gradually replace electronic money instead of the central bank's money.

Thus, the central bank's monopoly position in the field of monetary policy, bank supervision, monitoring payments system, financial system stability and especially its independence will be at risk. In other words, reducing the slope of the LM curve will decrease the efficiency and effectiveness of monetary policies, through reduction in publishing electronic money (Winston, 2007) [4]. Since electronic payment is one of the payment methods, it does not affect maintenance, transaction, precautionary and speculation incentives of money. However, it may reduce demand for money. In fact, the demand for money is decreased by increasing the speed of money circulation, increasing supply, greater diversity of goods whose money values are transferred by electronic payment instruments, as well as allocation of electronic balance by some publishers (Nsouli, 2004) [5]. Experience of using electronic payment instruments in Iran, which was stopped after the Islamic Revolution until the early 1991s (Ministry of Commerce, 2004) [6], dates back the late 1961. In 1994, the first step in creating and operating electronic banking in the country was taken after the approval of the comprehensive plan of bank automation in the General Assembly of banks. The second step was to establish Center of Interbank Information Exchange Network (called "Shetab" or acceleration system) in the Central Bank in 2001. In the present paper, the effect of new electronic payment technologies on demand for cash will be examined as a case study. For this purpose, first, the empirical studies will be presented. Section 3 of the study is dedicated to introducing research method. Research findings have been discussed in Section 4, and final section has presented conclusion and suggestions.

2- Experimental Evidences

Considering the development of electronic payment instruments during the past two decades, major empirical studies have been made about the effects of the instruments above on money demand since the early 1990's, the most important of which will be mentioned in this section. By proposing an microanalysis for the fund payment model in the Netherlands in 1990, Boeschoten (1992) [7] showed that the use of automatic teller machines, check and credit and debit cards have reduced demand for cash in this country. Using cross-sectional data related to American households in 1983, Duca and Whitesell (1994) [8] examined the effect of credit cards on money demand. Using probit and regression model, they concluded that expansion of credit cards has reduced demand for money in the United States. Attanasio (1998) [9] estimated money demand function in Italy using time-series and cross-sectional data (1989 - 1995). His estimate model is based on Baumol-Tobin theory of money demand. Result of his study showed that demand money of the households that use the card payments, is more sensitive to the interest rate than the households that do not use these cards; and welfare loss of inflation in the households with more complex transaction technology is much higher; because payment of interest to the deposits that are required for issuing cards will also affect transactions demand for money. Humphrey, Pully and Vesalla (1996) [10] carried out a cross-sectional study for 14 advanced countries during 1993-1987. Using ordinary least squares (OLS), they concluded the results similar with Whitesell and Duca studies. Snellman, Vesala and Humphery (2000) [11] estimated the money demand equation for 10 European countries, by using the panel data for 1987-996. Ordinary least squares method and learning curve analysis led them to conclude that the expansion of using electronic payment instruments creates the lowering effect on the demand for money. Furthermore, studies of the above-mentioned economists showed that the nature of cash substitution is similar in the measured countries; and progress steps of the substitution in each country depend on the development of electronic payment infrastructures. Based on time-series data for 1960-1990, Rinaldi (2001) [12] estimated the demand for money in Belgium. The researcher's studies showed that the development of card payments will reduce the demand for money. Using the data time-series, Humphery (2001) [12] presented a model for explaining the share of cash payments in the United States since 1973 to 2000. His research results showed that using electronic payment instruments has reduced the share of cash in the consumer payments from 39 percent in 1971 to 16 percent in 2000. Stix (2004) [13] examined the effect of debit cards on the demand for cash in Austria in 2003, by using micro data. In this study, using two methods of ordinary least squares and sample selection model (SSM) with maximum likelihood, he concluded that the people using the cards in their payments keep less cash, nearly 18 percent, compared to those who have not used this card. Pippow, Scholder, and Ludwigs (2008) [14] achieved potential demand for payment cards according to microanalyses. They concluded by using the principles of utility maximization and profit for the three main participants in the electronic payment systems (ie, customers, traders and exporters) that first, the customers normally use electronic payment systems in their transactions only when the benefits of employing this method is more than the traditional state of payment; and secondly, traders and exporters invest in the electronic payment systems only when its profit is maximized. This model also adds that exporters of payment cards can maximize demand for these cards and thus their profit through interest payment and/or insurance against losses.

3- Methodology

In the present study, all statistical information related to the variables used has been collected as seasonal time-series with library method through referring to the Central Bank of Islamic Republic of Iran. The present study which includes 2001-2008, is focused on the economy of Iran. Considering The Rinaldi model in the time-series method, the following model is recommended for estimating the money demand function in Iran:

$$Logcu_t = \beta_0 + \beta_1 LogGDP_t + \beta_2 LogI_t + \beta_3 LogP_t + \beta_4 LogArz_t + \beta_5 ATM_t$$
$$+ \beta_6 POS_t + \beta_7 Card_t + \beta_8 D_{2004} + T + \varepsilon_t \qquad (1)$$

Where:

cu_{t} = Real volume of coins and banknotes handled by the people $\frac{CURR}{P}$ (where, CURR is volume of coins and banknotes handled, and P, is the price level)

GDP_t = gross domestic product, in constant price of 1997 (per 1000 people)

P_t = inflation rate

I_t = short-run interest rate of bank deposits

Arz_t = exchange rate, in constant price of 1997

ATM_t = number of automatic teller machines (per 1000 active people)

POS_t = number of point-of-sale terminals (per 1000 active people)

$Card_t$ = number of credit cards (per 1000 active people)

D_{2005} = dummy variable of Shetab system which has been used since 2002 in the country's banking system

T = trend variable

ε_t = disturbance component

Hence, the gross domestic product has been considered based on Cambridge approach to transaction money demand; and short-run interest rate, based on Keynes speculation demand for money theory. Therefore, the coefficients β_1 and β_2 are expected to be positive and negative, respectively. Furthermore, according to the theory of Cagan [15] money demand, the inflation rate has been entered in the model, based on which rising inflation increases the demand for money. Therefore, the coefficient β_3 in relation (1) is expected to have values greater than zero (positive). Real exchange rate variable is also considered based on the theories of Friedman's and Mundell's money demand. Changes in exchange rate have two effects: substitution and wealth. In the case of the dominance of substitution effect over wealth effect, the increased exchange rate reduces the demand for money; and as a result, the coefficient β_4 will be negative. All so, in case of the dominance of wealth effect over substitution effect, the opposite of this case will be satisfied. Considering Rinaldi's money demand model, number of automatic teller machines, point-of-sale terminals, debit and credit cards are considered as alternative variables of the new electronic payment instruments. Then, the coefficients $\beta_5, \beta_6, \beta_7$ are expected to be negative. Since Shetab system was launched in 2002 in Iran to develop electronic banking network, values 0 and 1 have been considered in the dummy variable D_{2005} for the years before and after 2002, respectively, in order to examine effect this network. To examine short- and long-run effects of electronic payment instruments on the demand for cash, method of auto regressive distributed lag (ARDL) econometrics is used. It is important remarkable to use time-series in experimental studies and econometric analyses. As one of the primary assumptions in using these data, it can be said that time-series variables are stationary. But according to the recent studies, the assumption above seems to be incorrect in many time-series; and most variables are non-stationary. This may cause spurious regression which destroys confidence in the estimated coefficients. "This problem is because that both types of time-series variables (dependent variables and explanatory variables show strong trend with respect to time (ascending and descending movements). Therefore, the above R^2, which often is observed, is caused by the variable of time, instead of significant economic relationship between variables (Gujarati, 2007) [16]. So, according to the co integration theory in modern econometrics, when using time-series it is necessary to use those methods for estimating functions which have considered the problem of reliability and co integration. Unlike the method of Johanson-Juselious co integration in which all variables must be stationary of the same degree, in the auto regressive distributed lag method, degree of variables reliability do not need to be similar. The appropriate model can be selected simply by determining the proper lags for variables without prejudice and the use of economic theories. So considering the benefits of auto regressive distributed lag econometrics, the method above will be used to estimate in the present paper. Auto regressive distributed lag method simultaneously estimates the short-run and long-run patterns in model, and eliminates the problems relating to the elimination of variables and autocorrelation. So the estimations of the auto regressive distributed lag method are unbiased and efficient, due to lack of some problems like autocorrelation and endogenity. Inference and analysis in auto regressive distributed lag method include three dynamic, long-run and error correction equations. Dynamic equation is based on an auto regression model, which can be showed for a model ARDL (p, q, q_2,…, qk), as follows:

$$\alpha(L,p)Y_t = \sum_{i=1}^{k} \beta_i(L,q_i)X_{it} + \delta^t W_t + U_t \tag{2}$$

$i = 1,2,...,k$

Where:

W_t= a vector of certain (non-random) variables such as the intercept, the trend variable, dummy variables or endogenous variables with constant lags.

P= the lags used for dependent variable

q_t= the lags used for independent variables

X_t= the independent variable;

Y_t= the dependent variable

L= the lag operator which is defined as follows:

$$L^j Y_t = Y_{t-j} \tag{3}$$

In equation (2), the following relations are satisfied:

$$\alpha(L,p) = 1 - \alpha_1 L - \alpha_2 L^2 - ... - \alpha_p L^p \tag{4}$$

$$\beta_i(L,q_1) = 1 - \beta_{i1} - \beta_{i2} L^2 - ... - \beta_{iq} L_{qi} \tag{5}$$

Estimation of long-run relationship can be done in two stages with the auto regressive distributed lag method. In the first stage, long-run relationship between the study variables is tested in the above manner:

If the total estimated coefficients related to the lags of dependent variable (α_i) is smaller than 1, dynamic pattern tends to long-run equilibrium. So, to test co integration, it is necessary to test the following hypothesis:

$$H_0 = \sum_{i=1}^{p} \alpha_i - 1 \geq 0$$

$$H_1 = \sum_{i=1}^{p} \alpha_i - 1 \leq 0$$

Quantity of T statistic required for the above test is calculated as follows

$$t = \frac{\sum_{i=1}^{p} \hat{\alpha} - 1}{\sum_{i=1}^{p} S \hat{\alpha}_i} \qquad (6)$$

Where, $S\hat{\alpha}_i$ indicates standard deviation of dependent variable lags coefficients. If the absolute value of the obtained t statistic is greater than the absolute value of critical values presented by Banerjee, Dolado, and Mester, null hypothesis will be rejected and a long-run relationship will be accepted. If the long-run relationship between model variables is proved, the estimation and analysis of long-run coefficients and inference about their value can be done in the second stage. Long-run coefficients of explanatory variables are calculated according to the following equation:

$$\hat{\theta}_i = \frac{\hat{\beta}_{i0} + \hat{\beta}_{i1} + \hat{\beta}_{i2} + \dots + \hat{\beta}_{i\hat{q}_i}}{1 - \hat{\alpha}_1 - \hat{\alpha}_2 - \dots - \hat{\alpha}_{\hat{p}}}$$

Where, $\hat{P}$ and $\hat{q}_i$, for i = 1, 2, 3, ..., k are values selected P and $\hat{q}_i$, based on one of the criteria to determine lag. One important goal concerning the auto regressive distributed lag model is to determine the optimal lags. Pesaran and Shin have shown that if the suitable lags are considered for this model, estimators of ordinary least squares are compatible in the short run parameters; and estimations obtained from the autoregressive pattern with distribution lag in long-run are ultra-compatible. The number of optimal lags for each explanatory variable can be determined by one of Akaik, Schwartz-

Bayesian, and Hannan-Quin statistics. Considering that Schwartz-Bayesian criterion saves in employing the number of lags, the above criteria will be used in the present study. Then, the error correction mechanism is examined using general to specific approach to investigate how to adjust short-run disequilibrium's in movement toward the long-run equilibriums. Cointegration between a set of economic variables is a basis for using this model. Error correction model relates short-run fluctuations in the values to their long-run equilibrium variables. For Engel and Grenger, any long-run relationship has a short-run error correction model, which ensures to achieve the equilibrium, and vice versa. To set the error correction model, error terms related to co integration regression with a time lag is placed, as an explanatory variable, along with first order difference of other pattern variables; and then model coefficients are estimated with the help of ordinary least squares method (Inder: 1993) [17]. Δ is a first order difference operator, and $\hat{U}_{t-1}$ is the remaining amount of estimated regression of long-run equation with a lag time period. In other words, empirical estimate is obtained from the error term of the equilibrium; and E is the error term with standard features. In this regression, ΔLqX shows short-run changes in LqX, while the error correction term $\hat{U}_{t-1}$ expresses adjustment toward long-run equilibrium. If β_2 is statistically significant, it shows what proportion of LPY disequilibrium in a round can be corrected by the next period (Gujarati, 2007) [16]. In software Microfit, when the equilibrium model related to autoregressive with distributive lag was extracted, it will be possible to offer correction pattern associated with it.

4- The Results

Table 1 presents the information about the results of estimating money demand function in Iran with autoregressive method with distributive lag, using software Microfit. To determine the number of optimal lags, the Schwartz-Bayesian criterion is used. Based on the criterion above, for dummy variable D_{2004}, optimal lag 0 is defined; and for other variables, optimal lag 1. According to the results reported in Table 1, value of F statistic related to the regression totality test is equal to 818.25, which implies the correctness of regression totality, with the probability of error less than 5 percent. In equation (1), coefficients of not all variables have high t statistic value; and their significance will be confirmed with the probability of error less than 4 percent. Therefore, equation (1) will be introduced as short-run model of money demand in the economy of Iran

Table1: Estimation of Money Demand Model Using ARDL* Method (Dependent Variable Lcu)

Variable	Coefficient	t Statistic
Lcu(-1)	0/5	4/21
LI	5/11	3/35
LP	0/19	3/60
LArz	0/12	2/78
LArz(-1)	0/12	2/82
LGDP	0/155	0/62
ATM	3/61	4/26
POS	-0/27	4/865
Card	0/00065	11/60
Card(-1)	-0/0037	-4/21
D_{2004}	0/4481	2/90
C	-5/51	-0/90
T	-0/048	-2/74
R^2	0/99	
F	818/25	
D.W	2/63	

* ARDL (1, 1, 1, 1, 1, 1, 1, 0)
Source: Authors calculations

As can be seen from table 1, as expected, logarithm coefficient of current value of the inflation rate is positive, equal to 0.05, showing that elasticity of cash demand versus inflation is less than unit. Logarithm coefficients of current values with lag real exchange rate are positive, being .11 and 0.12, respectively. Its rate shows that there is no elasticity of money demand versus exchange rate. Unlike the theoretical principles, among electronic payment instruments, the coefficients of the number of automatic teller machines, bank cards and Shetab system are positive, and increase the demand for money; but the coefficient of point-of-sale terminals, as expected, is negative and reduces the demand for money. In this paper, demand for money refer to as the desire to hold money (Bitrus,2011)[26]. According to Whitesell[8], Attanasio[9] and Rinaldi[12],demand for money is define as a part of M_1 ,include only cash. Therefore it is expected POS coefficient negative in the estimated model (Rinaldi, 2011) [12]. Also, due to rise in nominal income and using ATM over time, demand for money maybe increase. As was seen, unlike the theoretical principles, coefficients of the number of automatic teller machines and the number of bank cards are positive: the reason should be sought in improper use of these instruments, because automatic teller machines and bank cards are used more in Iran to receive funds. It should be noted here that although the effect of electronic payment instruments on money demand in Iran is statistically significant, amount of their influence is not significant. The following are among the reasons:

• Lack of acceptance of the instruments above as money among the people; as well as • Lack of the necessary infrastructure facilities for developing use of payment instruments in electronic exchanges; and

• Lack of e-commerce development in the country

In other words, although money and electronic banking are considered as e-commerce requirements, in the conditions that dominant part of the retail and wholesale trades is performed by traditional (physical and paper-based) method, and the necessity of electronic transactions has not felt, development of electronic payment instruments don't have significant effect on physical cash equilibrium among the individuals. After estimating the dynamic model, long-run correlation between variables is tested. If the absolute value of total variable coefficients with the lag related to the dependent variable is smaller than 1, dynamic model will tend to the long-run equilibrium. Comparison of computational statistic (-12.39) with the critical quantity provided by Banerjee, Dolado, and Master at the confidence level of 94 percent confirms the hypothesis of long-run relationship between the model variables. Thus, there will be a long-run equilibrium relationship between the variables of money demand model. The results of estimating the long-run relationship between the variables of the money demand model proposed are given in Table 2, which confirms the interpretations related to the short-time period of variables.

Table 2: Long- Run Estimation of Money Demand Using the ARDL Method (Dependent Variable Lcu)

Variable	Coefficient	T- Statistic
LI	10/22	2/17
LP	0/391	2/52
LGDP	0/310	0/61
LARZ	0/46	3/85
ATM	7/23	3/13
POS	-0/544	-5/86
Card	0/0054	5/51
D_{2004}	1/34	3/41
C	-11/031	-0/86
T	-0/097	-2/17

Source: Authors calculations

In addition, by comparing short-run and long-run coefficients of explanatory variables, the intensity of their influence on the money demand in both short and long run can be examined. The result of this comparison shows that the severity of influence of all intended variables on the money demand is higher in the long-run than short-run. Long- run relationship between set of variables of money demand function in the economy of Iran provides a basis for the use of error correction model, in which short-run fluctuations are attributed to the long-run equilibrium values. The results of estimation of error correction model are given in Table 3. It can be seen from the information of the table above and coefficient ECM that 49 percent of short-run disequilibrium's are adjusted in each period, in line with the long-run equilibrium values.

Table 3: Results of Error Correction Model for Money Demand Function (Dependent Variable dLcu)

Variable	Coefficient	t Statistic
dL1	5/11	3/35
dLP	0/195	3/60
dLGDP	0/155	0/623
dLARZ	0/111	2/788
dATM	3/61	4/266
dPOS	0/272	-5/053
dCard	0/0065	11/604
dD_{2004}	0/448	2/900
dC	-5/51	-0/902
dT	-0/048	-2/748
ECM(-1)	-0/499	-4/12

Source: Authors calculations

In other words after both seasonal periods, short-run fluctuations are fully settled.

5- Concluding Remarks

In the present world, under circumstances that the exchange methods in global markets are changing toward electronic ones, lack of attention to this development means loss of a significant part of global markets. As a high-speed and low-cost trade, e-commerce requires the new payment instruments. In fact, the evolution of money instruments makes clear that the degree of economic growth and development have led to create monetary instruments in proportion to them. Money and electronic banking are considered as a basis for e-commerce, which can prepare, more than before, the way to provide growth and development of e-commerce through facilitating the electronic payment and transfer of transactions' funds. Nowadays, to reduce as much as possible the actual costs of banking services, banks entrust their physical duties as far as possible to new electronic payment instruments. In addition to such advantages as the increased transaction speed, lower cost, and so on, the instruments above increase the rate of money circulation. Furthermore, theoretical and experimental studies show that expanding new electronic payment instruments affects the economic variables such as money demand and the influence level of the monetary policies. In other words, new payment technologies, such as automatic teller machines, point-of-sale terminals, debit and credit cards and Shetab system can reduce the demand for money. In this paper, the effects of electronic payment instruments on cash demand in the economy of Iran were considered. For this purpose, first, considering the theoretical principles in monetary economics literature, money demand function in Iran was defined as a function of GDP, interest rate, inflation rate, the number of automatic teller machines, the number of point-of-sale terminals, the number of debit and credit cards and Shetab system. Using seasonal time-series data for the period of 2001 -2008, the money demand function above was estimated in the short-run and long-run while correction method was estimated with auto regressive distributed lag method. The results of this study showed that increasing the number of automatic teller machines can increase the demand for cash. Furthermore, according to the findings of this study, increase in the number of point-of-sale terminals, and credit and debit cards reduces the demand for money. It should be noted in this regard that in Iran, the automatic teller machines have been installed more for receiving funds in the banks, so the results obtained about the effect of automatic teller machines on demand in money) are different from some other countries. Considering the need to significantly develop the electronic exchanges as well as the efforts of the country's banking system to become electronic, the thwarting effect of the instruments above on performance of monetary policies should be taken into consideration to develop economic planning and especially to determine monetary policies.

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