ULUSLARARASI SOSYAL ARAŞTIRMALAR DERGİSİ
THE JOURNAL OF INTERNATIONAL SOCIAL RESEARCH

Uluslararası Sosyal Araştırmalar Dergisi/The Journal of International Social Research
Cilt: 14 Sayı: 78 Temmuz 2021 & Volume: 14 Issue: 78 July 2021
www.sosyalarastirmalar.com Issn: 1307-9581

FINANCIAL INNOVATION AND MONEY DEMAND IN TURKEY: EMPIRICAL EVIDENCE

Işıl Tellalbaşı Mengüç*

Abstract

This study investigates the impact of financial innovations on the money demand in Turkey by means of using the autoregressive distributed lagged (ARDL) bounds testing model as proposed by Pesaran et al. (2001) and Toda-Yamamoto from the period 1986-2019. The conclusions of our estimates have revealed that the real production, inflation and nominal interest rates are the variables that determine the money demand and which shows that the financial innovations do influence the money demand in Turkey in the short term and in the long term. The results obtained indicate that the ARDL bound testing approach confirm the existence of a long-term and short-term association between the financial innovations and the money demand. According to empirical analysis, the financial innovations positively affected the money demand in the long-term as well as in short-term..

Keywords: Financial Innovation, Money Demand, ARDL, Toda Yamamoto.

*Dr.Öğr.Üyesi, Abant İzzet Baysal University, Gerede School of Applied Sciences Banking-Finance Department, Bolu/Turkey
0000-0002-4357-9935, isiltel@gmail.com

1. Introduction

The main objective of this study is to analyze the effects of the financial innovations on the money demand in Turkey. The financial innovations objectively modify the reliability of not only monetary aggregates and but also the effectiveness of monetary policy (Hsing Y., 2007) to the extent these are considered as a shock having permanent effects on the money demand as identical to the shock of the productivity in the production function (Arrau et al. 1995). However, the central bank can influence the macroeconomic policy only in case it fully controls the money demand. The success of this policy strongly depends on the stability of the correlation between the money demand and its factors. In the literature, there are several studies regarding the effect of the financial innovations on the money demand (Milbourne, 1986; Akinlo, 2006; Taylor, 2007).

In fact, the CUSUM and CUSUMQ tests enable us to highlight the stability of the long-term correlation between the money supply and its determinants in a more proper way. However, it should be emphasized that, for some authors, the existence of the co-integration correlation between the variables does not always give rise to a stable long-term correlation between the demand of money and its determinants. This requires taking into account other variables in the specification of the money demand functions.

However, although there are a few studies on financial innovation and the money demand in Turkey, it could be concluded from this literature review that the vast majority of them is concentrated in the developed and underdeveloped countries and industrialized countries. Based on our knowledge, we have not identified any studies on the money demand in Turkey by means of using the new methodological approach which is developed by Pesaran et al. (2001). We also note the absence of studies that explicitly includes a variable that captures the financial innovations in the money demand function following the structural reforms experienced by the Turkish economy. This study aims to fill this void in the literature.

2. Literature Review

After Johansen's (1988) introduction of the co-integration techniques, Johansen and Juselius (1990) used the tool in a number of studies which have developed the long-term correlation between the money demand and its causal variables. These studies include but not limited to Miller (1991), Hoffman and Rasche (1991), McNown and Wallace (1992) country case studies such as; Muscatteli and Papi for USA (1990 studies; Odularu and Okunrinboye (2009) for Italy; Roa and Kumar (2007), for Nigeria Singh and Pandey (2009) for Bangladesh; Hsing (2007), Hussain et al. (2006) for Pakistan. The major results explaining that what is emerged from this literature is that there exists a long-term constant correlation between the broad money supply (M2) and income and the interest rate. The recent studies which followed, in particular, those of Bahmani-Oskooee and Wang (2007) and Akinlo (2006) have been strongly criticized with the claim that the stability of the demand of money becomes evident (Baharumshah et al. 2009) only on the presence of the co-integrated determinants. The development of the co-integration technique of Pesaran et al. (2001) revolutionized the researches on the stabilization for the money demand in the economies in terms of its advantages, including:

- Taking into account the series as independently of their order of integration, unlike previous techniques which required that all of the series had to be in same order of integration;
- The endogeneity for all variables of the model;
- Simultaneous estimation of the long-term and short-term coefficients.

The recent studies which have used this new approach include those of Azam (2010) for Indonesia; Akinlo (2006) for Nigeria; Bahmani-Oskooee and Rahman (2005) for all Asian countries; Wang (2011) for the United States. Moreover, the major results in long-term are related with the money supply, income, inflation and interest rate.

Dune and Kasekende (2018) have widely analyzed the industrialized 34 Sub-Saharan African countries with regard to the financial innovations on the demand of money. Throughout the period of 1980-2013, the financial innovation determinants cover M2/M1, ATM machine, lending credits; money demand variable appointed as an independent variable. According the results which are revealed between the money demand and financial innovation, there is a negative impact of these determinants.

Mavejje and Lakuma (2017) analysis is concerning the macroeconomic performance of the mobile money in Uganda. The results indicate that the mobile money is a new financial innovation phenomenon and it has positive effect on the macroeconomic variables and the economic performance. Basharyreh et.al (2019) studies are about the financial innovation and digitalized banking sector. Their analyses cover the 2011-2016 term of the GDP growth, visa cards and demand of money effects on the growth. The analysis shows that the financial innovations have a positive impact on the GDP growth, banking sector and the money demand. It is also indicated that the money demand reduces the interest rate, by means of facilitating the banking credits provided. Aliha et. al (2019), studies are regarding the impact of the financial innovations on the money demand, by means of using the panel data method for 10 Asian states between the years 2004 and 2012 and forecasting the money demand between the years 2013-2016. The results obtained shows that ATM machine which denotes to the financial innovations has not significant impact on the money demand in the Asian countries. Muli's (2019) study contains the digital finance on the money demand by means of using time series between data for the periods of 2007Q2-2018Q4. The results shows that the digitalization of finance has a certain negative impact on the money demand in Kenya.

In accordance with all these studies, concerning those which have evaluated the effect of the financial innovations on the money demand, firstly it appears that the financial innovation has a negative impact on the money demand (Muscatelli and Papi, 1990; Odularu and Okunrinboye, 2009; Singh and Pandey, 2010).

3. Data, Specification and Methodology

We subsequently present the data used, the pre-processing of the data by the unit root test and the estimation strategy of the empirical model.

3.1. Data Presentation

The data used in this study come mainly from the Indicators of the World Development databases of the World Bank and the Central Bank of Turkey. They have an annual dimension and cover the period of 1980-2019 for the Turkey. Table 1 shows the expected signs.

Table 1: Expected Signs

Variables	Notions	Signs
Real Production	**RGDP**	+
Inflation	**INF**	-
Nominal Interest Rate	**INTRATE**	-
Financial Innovation[1]	**FI**	+

Note: Table is based on the theory and the empirical studies.

3.2. Description of the Data

It emerges from the normality test that all the variables are Gaussian (normally distributed) because the Jarque-Bera probabilities are greater than the 5% threshold. With the exception of the Financial Innovation (FI) series, in which case we will use the stationary tests of Dickey-Fuuller Augmented, Phillips-Perron and Andrews and Zivot, which take into account the change of regime or rupture.

[1] Measured by $\frac{M_2}{M_1}.\varepsilon_t$, with ε_t which is the error term. This indicator is used almost in all studies that cover up this literature.

3.3. Unit Root Test

According to the analyze of integration of the variables, we will use the unit root tests of Augmented Dickey-Fuller (ADF), Phillippe - Perron (PP) and Andrews and Zivot (AZ).

It is advisable to note that the series concerning the Money Demand, Real Production, Inflation and the interest rates are integrated in the order 1 (stationary after the first difference), while the financial innovations are at the level (without differentiation). The series are thus integrated in different orders, which renders the co-integration test of Engle and Granger and that of Johansen ineffective and makes the application of the co-integration test appropriate to the terminals (Pesaran, 2001).

3.4. Specification of the Model

The drawing inspired from the work of Arango and Nadiri (1981) and Bahmani-Oskooee and Pourheydariam (1990). The model is specified as follows:

$$M_t = \beta_0 + \beta_1 RGDP_t + \beta_2 INF_t + \beta_3 R_t + \beta_4 FI_t + \varepsilon_t \quad (1)$$

In the case of our analysis, we are interested in the ARDL methodology which is proposed by Pesaran et al. (2001) and for which the bound co-integration and Toda-Yamamoto causality test is associated.

3.5. Methodology

This subsection will present the ARDL models, the terminal co-integration test and Toda and Yamamoto causality test.

3.5.1. ARDL Models

Autoregressive Distributed Lag / ARDL models or self-regressive models with staggered or distributed delays in Turkey which are dynamic models. They have the particularity of taking into account the temporal dynamics in the explanation of a variable, thus improving forecasts and the effectiveness of the policies. Staggered delay autoregressive models (ARDL) combine the characteristics of two models (Autoregresives, AR) and (Staggered delays or distributed lag, DL). Among the explanatory variables (X_t), we find the lagged dependent variable (Y_{t-p}) and the passed values of the independent variable (X_{t-q}). They have the general form as follows:

$$Y_t = f(X_t, Y_{t-p}, X_{t-q}) \quad (2)$$

$$Y_t = \lambda + \varphi_1 Y_{t-1} + \cdots + \varphi_1 Y_{t-p} + \alpha_0 X_t + \cdots + \alpha_1 Y_{t-p} + \mu_t \quad (3)$$

$$Y_t = \lambda + \sum_{i=1}^{p} \varphi_i Y_{t-i} + \sum_{j=1}^{p} \alpha_i Y_{t-i} + \mu_t \quad (4)$$

With the error term, "μ_t" denotes «α_0» as the short-term effect of on X_t. If Y_t considers the long-term equilibrium relation following « $Y_t = k + \varphi X_t + \mu_t$ », we can calculate the long-term effect of X_t on Y_t (is «∅») as follows:

$$\emptyset = \sum b_j \Big/ 1 - \sum a_i \quad (5)$$

As to any dynamic model, we will use the information criterion (AIC, SIC and HQ) in order to determine the optimal shift (*p* or q**), an optimal shift is the one for which the estimated model offers the minimum value of one of the stated criteria. Akaike Information Criterion (AIC), that of Schworz Information Criteria (SIC) and that of Hannan and Quinn (HQ). Their values are calculated as follows:

$$\mathrm{AIC(p)} = \log|\Sigma| + \frac{2}{T}n^2p \quad (6)$$

$$\mathrm{SIC(p)} = \log\left|\hat{\Sigma}\ \right| + \frac{\log T}{T}n^2p \quad (7)$$

$$\mathrm{HQ(p)} = \log\left|\hat{\Sigma}\right| + \frac{2\log T}{T}n^2p \quad (8)$$

With Σ, variance-covariance matrix of the estimated residuals; T, number of observations; p lag or lag of the estimated model; and n is number of repressors.

We will deduce from an ARDL model that, as a part of the family of dynamic models, it enables us to estimate the short-term dynamics and the long-term effects for the series as co-integrated or even integrated into different orders as we can see. We can see it with the boundary test approach of Pesaran et al. (1996) and Pesaran et al. (2001).

3.5.2. The Terminal Test or Co-integration Test Approach of Pesaran et al. (2001).

The co-integration between the series assumes the existence of one or more long-term equilibrium relations between them, which relations can be combined with the short-term dynamics of these series in an error correction vector model which takes the following form:

$$\Delta \mathrm{Y}_t \ = \ \mathrm{AY}_{t-1} + \sum_{i=1}^{p} B_i\,\Delta\mathrm{Y}_{t-1} + U_t \quad (9)$$

With $\Delta\mathrm{Y}_t$, vector of stationary variables under study; B_i, matrix whose elements are parameters associated with $\Delta\mathrm{Y}_{t-i}$; A, matrix of the same dimension as (or $\Delta\mathrm{Y}_t$, (or r(A) = number of Co-integration relations); Δ, first difference operator.

The co-integration test of Engle and Granger (1991) only helps to verify the co-integration between two integrated series of the same order. It is therefore adapted to the bivariate case and thus proves to be less efficient for the multivariate cases (Pesaran et al. 2001). Johansen's Co-integration test (1988, 1992) rather allows the co-integration to be verified on more than two series and it was designed for the multivariate cases. However, although the Johansen test is based on autoregressive error correction vector modeling (VECM) and it addresses to the limitations of the Engle and Granger test for the multivariate case, it also required that all series or variables be included in the same order, which is not always the case in practice.

Thus, when several integrated variables in different order [I(0), I(1)] are available, one can resort to the co-integration test of Pesaran et al. (2001) called «terminal co-integration test» or «Bounds test of Co-integration», as it is initially developed by Pesaran and Shin (1999). If we use the Pesaran co-integration test to verify the existence of one or more co-integration correlations between variables in a model ARDL, we will say that we use the approach «ARDL approaches to Co-integrating» or that we apply the test of co-integration by the staggered delays.

The model which serves as a basis for the co-integration test by the staggered delays (test of Pesaran et al. 2001) is the following co-integrated ARDL specification (it takes the form of an error correction model or a VECM), whenever we study the dynamics between two series «Y_t and X_t»:

$$\Delta\mathrm{Y}_t \ = \ \lambda_1\mathrm{Y}_{t-1} + \lambda_2\mathrm{X}_{t-1} + \sum_{i=1}^{p} a_i\Delta\mathrm{Y}_{t-i} \ + \sum_{j=1}^{q} b_i\Delta\mathrm{Y}_{t-j} \ + \ \Pi_0 \ + \ \Pi_t \ + \ \varepsilon_t \quad (10)$$

The previous correlation could also be written as follows:

$$\Delta Y_t = \Pi_0 + \Pi_t + \sum_{i=1}^{p} a_i \Delta Y_{t-i} + \sum_{j=0}^{q-1} b_i \Delta Y_{t-j} + \theta\mu_{t-1} + \varepsilon_t \quad (11)$$

Where "θ" is the term for error correction, adjustment coefficient or restoring force. Based on the previous correlation, following the estimation, we will conclude that there is a co-integration relation between Y_t and X_t and if 0 < |Ŏ| < 1;Ŏ < 1 and rejection H_0: θ = 0" (θ, is statistically significant).

There are two steps to follow to apply the Pesaran Co-integration test, namely:

(i) The determination of the optimal offset before all (AIC, SIC) and,

(ii) The recourse to the Fisher test to verify the hypotheses,

$H_0 : \lambda_1 : \lambda_2 = 0$: Existence of a co-integration relation

$H_1 : \lambda_1 \neq 0$: Lack of a co-integration correlation

The test procedure is such that we will have to compare the Fisher values obtained with the critical values (limits) simulated for several cases and different thresholds by Pesaran et al. (1999). It will be noted from the critical values that the upper bound (2nd set) contains the values for which the variables are integrated in order (1st set) and the lower bound (set) concerns the variables. So *I* (0),

(i) If Fisher calculated > upper bound: Co-integration exists,

(ii) If Fisher calculated <lower bound: Co-integration does not exist,

(iii) If lower bound < Fisher calculated < upper bound: No conclusion.

3.5.3. Causality of Toda and Yamamoto

The weakness of the co-integration results, composed or biased of unit root tests, reduces the efficiency of the Granger causality test and leads to Toda and Yamamoto (1995) in order to propose the non-sequential procedures for testing causality between the series. According to these authors, the preliminary tests of stability and co-integration (Granger's sequential procedures) do not matter much to the economists who must worry about testing the theoretical restrictions instead (they secure the level information).

These two authors will propose to estimate a corrected level VAR (over-parameterized), which should serve as a basis for the probable co-integration test between the series that they integrate into the model without studying it as such (explicitly). The causality test between two series « Y_t and X_t » enables us to estimate the increased VAR, within the analysis of Toda and Yamamoto as follows:

$$\begin{cases} Y_t = a_0 + \sum_{i=1}^{k} a_{1i} Y_{t-i} + \sum_{j=k+1}^{k+d_{max}} a_{1j} Y_{t-j} + \sum_{i=1}^{k} a_{1i} X_{t-i} + \sum_{j=k+1}^{k+d_{max}} a_{1j} Y_{t-j} + \mu_{1t} \\ Y_t = b_0 + \sum_{i=1}^{k} b_{1i} X_{t-i} + \sum_{j=k+1}^{k+d_{max}} b_{2j} X_{1t-j} + \sum_{i=1}^{k} \beta_{1i} X_{t-i} + \sum_{j=k+1}^{k+d_{max}} \beta_{1j} Y_{t-j} + \mu_{2t} \end{cases} \quad (12)$$

The causality test on an increased or voluntarily over-parameterized VAR test will consist of the testing restrictions on the " *k* " first coefficients, as the other parameters being zero (they reflect a probable co-integration between series in the VAR). Thus, within the analyze of Toda and Yamamoto, the test hypotheses are (the test is based on the W statistic of Wald which is distributed according to a X with one degree of freedom, n: number of restriction, this statistic of the series and their co-integration):

$H_0 = a_{oi} = 0$ ($X_t^2, p - value\ X^2 > 5\%$): Y_t does not cause X_t

$H_0 = \beta_{1j} = 0$ ($X_t^2, p - value\ X^2 > 5\%$): X_t does not cause Y_t

4. Results and Discussions

This section will present and discuss the different results which have been obtained from our econometric estimates.

4.1. Optimal Delay Number

We present choosing the Schwarz Information Criteria. Since they lie in the dynamics of SC minimization for which the optimal model is ARDL.

4.2. Bounds Tests

In order to analyze the fact that the long-term and the dynamic short-term interactions of the variables are real production, inflation, nominal interest rate and financial innovation; we prefer to implement the ARDL co-integration technique which is developed by Pesaran et al (2001).

The Bounds Test is mainly based on an attached F-stat whose bound-standard distribution is under the null hypothesis of absence of co-integration. The first step of the test is to test for the presence of a long-term correlation between the variables. We use the Schwarz Criteria criterion to select the order of the maximum delay for the conditional ARDL-VECM. We firstly estimate the first differences of the equation by OLS and then test the joint significance of the parameters. The following table indicates the results of the Bounds Test.

Table 2: Bounds F-test (Wald)

Models	Test Statistics	P Value	Alternative
Model 1	193.7979687	0.0000010000	Possible co-integration
Model 2	55.5252394	0.0000010000	Possible co-integration
Model 3	304.4943068	0.0000010000	Possible co-integration
Model 4	8.1218523	0.0007996198	Possible co-integration
Model 5	3.5740145	0.0710490067	Possible co-integration
Model 6	0.5561797	0.9805717208	Possible co-integration

Source: Table based on Eviews 9 from authors.

For the model 1, model 2, model 3, model 4 and model 5, we can say that there is a long-term level correlation between the variables. However, for the model 6, we can't say that there is a long-term correlation as such.

4.3. Estimation results

To estimate our equation, we apply the ARDL modeling. The results of the analysis model estimates are shown in the Table 3 as follows:

Table 3: ARDL Long Term Models

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
(Intercept)	-9.596	12.071*	42.986**	-48.795	-48.720	45.205
	(4.505)	(3.619)	(2.481)	(32.760)	(55.832)	(51.361)
L(moneydem.ts, 1)	-0.124	0.331	-0.412*	0.688	-0.471	0.123
	(0.059)	(0.114)	(0.058)	(0.393)	(0.467)	(0.820)
L(moneydem.ts, 2)	-0.330*		-0.375*			
	(0.051)		(0.050)			
lrgdp.ts	-10.749**				-20.000	
	(0.384)				(6.962)	
L(lrgdp.ts, 1)	9.417**				23.151	
	(0.636)				(8.205)	
L(lrgdp.ts, 2)	2.857					
	(0.772)					
intrate.ts		0.272***				0.399
		(0.020)				(0.408)
L(intrate.ts, 1)		-0.159**				-0.359
		(0.022)				(0.419)
L(intrate.ts, 2)		-0.039				
		(0.026)				
inf.ts			0.160**			
			(0.006)			
L(inf.ts, 1)			0.009			
			(0.009)			
L(inf.ts, 2)			-0.114**			
			(0.009)			
financial_innovation.ts				18.065*	-11.280	-13.097
				(4.436)	(6.800)	(18.290)
L(financial_innovation.ts, 1)				1.899	7.612	2.365
				(3.792)	(7.284)	(15.666)

L(financial_innovation.ts, 2)				3.988		
				(3.764)		
Num.Obs.	7	7	7	7	8	8
R2	0.999	0.991	0.999	0.936	0.873	0.565
R2 Adj.	0.994	0.973	0.994	0.808	0.557	-0.524
AIC	-3.0	10.5	-2.7	24.1	33.1	43.0
BIC	-3.4	10.2	-3.1	23.8	33.6	43.5
Log.Lik.	8.500	0.746	8.365	-6.072	-9.534	-14.477

(.) : Probabilities; ***: Significant at 1%; ** Significant at 5%; * Significant at 10%.

Therefore, we can estimate the UECM (Unrestricted Error Correction Model) of the underlying ARDL models as follows:

Table 4: UECMs

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
(Intercept)	-9.596	12.071*	42.986**	-48.795	-48.720	45.205
L(moneydem.ts1)	(4.505)	(3.619)	(2.481)	(32.760)	(55.832)	(51.361)
	-1.454**	-0.669**	-1.787**	-0.312	-1.471*	-0.877
	(0.081)	(0.114)	(0.079)	(0.393)	(0.467)	(0.820)
L(lrgdp.ts, 1)	1.525*				3.150	
	(0.191)				(1.540)	
d(L(moneydem.ts, 1))	0.330*		0.375*			
	(0.051)		(0.050)			
d(lrgdp.ts)	-10.749**				-20.000	
	(0.384)				(6.962)	
d(L(lrgdp.ts, 1))	-2.857					
L(intrate.ts, 1)	(0.772)	0.074*				0.041

		(0.017)				(0.139)
d(intrate.ts)		0.272***				0.399
		(0.020)				(0.408)
d(L(intrate.ts, 1))		0.039				
L(inf.ts, 1)		(0.026)	0.055			
			(0.010)			
d(inf.ts)			0.160**			
			(0.006)			
d(L(inf.ts, 1))			0.114**			
L(financial_innovation.ts, 1)			23.953 (0.009)		-3.668	-10.732
				(10.116)	(8.830)	(18.944)
d(financial_innovation.ts)				18.065*	-11.280	-13.097
				(4.436)	(6.800)	(18.290)
d(L(financial_innovation.ts1))				-3.988		
				(3.764)		
Num.Obs.	7	7	7	7	8	8
R2	0.999	0.995	0.999	0.967	0.930	0.758
R2 Adj.	0.997	0.986	0.997	0.902	0.753	0.152
AIC	-3.0	10.5	-2.7	24.1	33.1	43.0
BIC	-3.4	10.2	-3.1	23.8	33.6	43.5
Log.Lik.	8.500	0.746	8.365	-6.072	-9.534	-14.477

(.) : Probabilities; ***: Significant at 1%; ** Significant at 5%; * Significant at 10%.

There is a significant correlation between the money demand, GDP, inflation, interest rates and financial innovations. In addition to this, the RECM (Restricted Error Correction Model) of the underlying ARDL models enables to be the constant to join the short-term correlation, instead of the long-term.

Table 5: RECMs for Short-Term Correlation

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
d(L(moneydem.ts, 1))	0.330***		0.375***			
	(0.025)		(0.027)			
d(lrgdp.ts)	-10.749***				-20.000***	
	(0.161)				(3.257)	
d(L(lrgdp.ts, 1))	-2.857***					
	(0.339)					
ect	-1.454***	-0.669***	-1.787***	-0.312***	-1.471***	-0.877*
	(0.035)	(0.037)	(0.034)	(0.045)	(0.246)	(0.372)
d(intrate.ts)		0.272***				0.399*
		(0.010)				(0.162)
d(L(intrate.ts, 1))		0.039**				
d(inf.ts)		(0.014)	0.160***			
			(0.003)			
d(L(inf.ts, 1))			0.114***			
d(financial_innovation.ts)			(0.005)	18.065***	-11.280**	-13.097
				(1.766)	(3.235)	(7.890)
d(L(financial_innovation.ts, 1))				-3.988*		
				(1.863)		
Num.Obs.	7	7	7	7	8	8
R2	0.999	0.995	0.999	0.968	0.931	0.763
R2 Adj.	0.999	0.992	0.999	0.944	0.890	0.621
AIC	-7.0	6.5	-6.7	20.1	27.1	37.0
BIC	-7.3	6.3	-7.0	19.9	27.4	37.3
Log.Lik.	8.500	0.746	8.365	-6.072	-9.534	-14.477

(.) : Probabilities; ***: Significant at 1%; ** Significant at 5% at * Significant at 10%.

The fact that the absolute value of the coefficient of the error correction term (ECT) is greater than 1 indicates that the system fluctuates and comes to equilibrium and this fluctuation will decrease each time and will return to balance in the long term. As a result, it was negative and statistically significant as expected. A positive and statistically significant correlation was found between the financial innovations and the money demand in the short term. According to this result, an increase in the financial innovations in the short term also has a positive effect on the money demand.

4.4. Toda-Yamamoto Causality Test

Toda-Yamamoto causality test (1995) is used when the non-stationary series are not co-integrated or are integrated in different orders. Note that in this case the traditional Granger causality becomes ineffective.

According to this table, we deduce from the following Toda-Yamamoto causality test as follows:

Table 6: Toda-Yamamoto Causality Test

Variables					
	GDP	Demand	Inflation	Interest rate	Financial innovation
Money Demand	2.053311*** (0.3582029)	-	1.130753*** (0.5681461)	8.402712*** (0.0149753)	3.407334*** (0.1820148)

(.) Probabilities (p-value); *** : significant at 1%.

According to this table, we deduce from the following Todo-Yamamoto causality test as follows:

- A causality between the Money Demand and Real Production: Real Production does not have any certain impact on the Money Demand.
- A causality between the Money Demand and the Nominal Interest Rate: the Nominal Interest Rate has certain impact on the Money Demand.
- A causality between the Money Demand and the Inflation: Inflation does not have any certain impact on the Money Demand.
- A causality between the Money Demand and the Financial Innovations: Financial Innovation does not have any certain impact on the Money Demand.

Therefore, the nominal interest rate is the key factor in explaining the money demand in Turkey.

4.5. ADF Test Results

	statistic	p.value	parameter	method	alternative
d.financial_innovation	-2.921536	0.2166301	3	Augmented Dickey-Fuller Test	stationary
d.lrgdp	-2.111073	0.5299739	3	Augmented Dickey-Fuller Test	stationary
d.inf	-1.624904	0.7179377	3	Augmented Dickey-Fuller Test	stationary
d.intrate	-1.460094	0.7816572	3	Augmented Dickey-Fuller Test	stationary
d.moneydem.ts	-4.225865	0.0133023	3	Augmented Dickey-Fuller Test	stationary

5. Conclusion

This study has the essential objective which is analyzing the correlation between the financial innovation and the money demand in Turkey. In order to attain this objective, we have relied on the methodological approach which is proposed by Pesaran et al. (2001) and Toda-Yamamoto (1995) by means of using the Autoregressive Staggered-Delay Model (ARDL).

The results of our estimates revealed that the real production, inflation and the nominal interest rates are the variables which determine the money demand and it further indicates that the financial innovations do influence the money demand in Turkey both in the short term and in the long term. A

positive and statistically significant relationship was found between financial innovation and money demand in the long run. According to this result, an increase in financial innovation in the short run also has a positive effect on money demand.

REFERENCES

Akinlo A.E. (2006): "The Stability of Money Demand in Nigeria: An Auto-regressive Distributed Lag Approach", *Journal of Policy Modelling*, Vol: 28(4), pp. 445-452.
Arango S. and Nadiri M.I. (1981): "Demand for Money in Open Economies", *Journal of Monetary Economics*, Vol: 7, pp. 69-83.
Aliha. P.M., Sarmidi. T., Said. F.F., (2019): "Forecasting Money Demand With the Inclusion of Financial Innovation For The Association of Southeast Asian Nations: Evidence From Panel Data Analysis", Advanced International Journal of Banking, Accounting and Finance, Vol:1(1). December, pp. 59-74.
Bashayreh. A., Alomari.M.W., Abdelhadi.S.,Mryan.N., (2019): "Banks Financial Innovation and The Demand On Money", International *Journal of Monetary Economics* and Finance, Vol: 12(3).
Arrau P. and Gregorio J.D. (1995): "Financial Innovation and Money Demand: Application to Chile and Mexico", The Review of Economics and Statistics.
Azam N.A. (2010): "Stability of Money Demand in an Emerging Market Economy: An Error Correction Model and ARDL Model for Indonesia", *Research Journal of International Studies*, Vol: 13, pp. 54-62.
Baharumshad A. Z., Mohd S.H. and Masih A.M. (2009): "The stability of Money Demand in China: Evidence from the ARDL Model", *Economic Systems*, Vol: 33(3), pp. 231-244.
Bahmani-Oskooee M. and Pourheydarian M. (1990): "Exchange Rate Sensitivity of the Demand for Money and Effectiveness of Fiscal and Monetary Policies", *Applied Economics*, Vol: 22, pp. 917-925.
Bahmani-Oskooee M. and Rehman H. (2005): "Stability of the Money Demand Function in Asian Developing Countries", *Applied Economics*, Vol: 37, pp. 773-792.
Bahmani-Oskooee M. and Wang Y. (2007): "How Stable Is the Demand for Money for China", Journal of Economic Development, Vol: 32, pp. 21-33.
Bashayreh. A., Alomari.M.W., Abdelhadi.S.,Mryan.N., (2019): "Banks Financial Innovation And The Demand On Money", International *Journal of Monetary Economics* and Finance, Vol. 12(3), last accessed https://www.inderscienceonline.com/doi/pdf/10.1504/IJMEF.2019.100626 22.02.2019
Engle, R.F. et Granger C.W.J. (1991): "Co-Integration and Error Correction Representation: Estimation and Testing", in Econometrica, Vol.55(2), pp. 251-276.
Johansen, S. (1988): "Statistical Analysis of Co-integrating Vectors", in Journal of Economic Dynamic and Control, Vol.12, pp. 231-254.
Johansen, S. and Juselius, K. (1990): "Maximum Likelihood Estimation and Inference on Co-Integration – With Applications To The Demand For Money", in Oxford Bulletin of Economics and Statistics, Vol.52(2), pp. 169-210.
Johansen S. (1992): "Testing Weak Exogeneity and the Order of Co-integration in UK Money Demand Data", Journal of Economic Dynamics and Control, Vol. 12, pp. 231-254.
Hoffman D.L. and Rasche R.H. (1991): "Long-run Income and Interest Elasticities of Money Demand in United States", The Review of Economics and statistics, Vol. 73, pp. 665-674.
Hsing Y. (2007): "Currency Substitution, Capital Mobility and Functional Forms of Money demand in Pakistan", *The Lahore Journal of Economics*, Vol. 12, pp. 35-48.
Hussain Z. and al. (2006): "Demand for Money in Pakistan", International Research Journal of Finance and Economics. Vol. 5, pp. 209-218.
McNown R. and Wallace M.S. (1992): "Co-integration Tests of a Long-term Relation Between Money Demand and the Effective Exchange Rate", Journal of International Money and Finance, Vol. 11, pp. 107-114.
Milbourne R. (1986): "Financial Innovation and the Demand for Liquid Assets", *Journal of Money, Credit and Banking*, Vol. 18(4), pp. 506-511.
Miller S.M. (1991): "Monetary Dynamics: An Application of Co-integration and Error Correction Model", *Journal of Money, Credit and Banking*, Vol. 23, pp. 455-460.
Muscatelli A.P. and Papi L. (1990): "Co-integration, Financial Innovation and Modelling the demand for Money in Italy", The Manchester School, Vol. 58, pp. 242-259.
Odularu G.O. and Okunrinboye O.A. (2009): "Modeling the Impact of Financial Innovation on the Demand for Money in Nigeria", African *Journal of Business Management*, Vol. 3, pp. 39-51.
Pesaran, M. H. and Pesaran, B. (1997): "Working With Micro Fit 4.0: Interactive Econometric Analysis", Oxford, *Oxford University Press*.
Pesaran, M. H. and Shin, Y. (1999): "An Autoregressive Distributed Lag Modelling Approach to Co-Integration Analysis", Econometrics and Economic Theory in the 20th Century: the Ragnar Frisch Centennial Symposium. Cambridge Univ. Press, Cambridge, pp. 1-31.
Pesaran M.H., Shin Y. and Smith R.J. (2001): "Bounds Testing Approaches to the Analysis of Level Correlations", *Journal of Applied Econometrics*, Vol.16(3), pp. 289-326.
Rao B.B. and Kumar S. (2007): "Structural Breaks, Demand for Money and Monetary Policy in Fiji", Pacific Economic Bulletin Vol. 22, pp. 53–62.
Singh P. and Pandey M.K. (2010): "Financial Innovation and Stability of Money Demand Function in Post–Reform Period in India", *Economics Bulletin*, Vol. 30, pp. 2895-2905.
Taylor M.P. (2007): "Financial Innovation Inflation and the Stability of Demand for Broad Money in the United Kingdom", Bulletin of Economic Research, Vol. 39(3), pp. 225-233.
Toda, H.Y. and Yamamoto, T. (1995): "Statistical Inference in Vector Auto-regressions with Possibly Integrated Processes", Journal of Econometrics, Vol. 66, pp. 225-250.
Wang Y. (2011): "The Stability of Long-Run Money Demand in the United States: A New Approach", Economics Letters, Vol. 111, pp. 60-63.
Dune, J.P. and Kasekende, E. (2018): "Financial Innovation and Money Demand: Evidence from Sub-Saharan Africa", *South African Journal of Economics*, Vol. 86, Issue 4. pp. 428-448.
Mawejje, J. and Lakuma E.C.P: ((2017): "Macroeconomic Effects of Mobile Money in Uganda", Economic Policy Research Centre (EPRC), Vol. 135.https://ageconsearch.umn.edu/record/260017/ last accesed 22.02.2021.
Muli. C.M. (2019): "The Effect of Digital Finance On Money Demand In Kenya", *Research Project*, University Nairobi.
http://erepository.uonbi.ac.ke/bitstream/handle/11295/109385/MASTERS%20RESEARCH%20REPORT%20FINAL.pdf?sequence=1&isAllowed=y last accessed 22.02.2021