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The Long-run Money Demand Function: Empirical Evidence from Italy

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ABSTRACT

The stability of money demand is fundamental in ensuring a county's effective monetary policy and it is being threatened when major shocks are taking place. The current paper aims to examine the factors that influence money demand in Italy for the period 1960-2017. Auto regressive distributed lags technique and error correction model were applied to test for long-run and short-run coefficients respectively, while cumulative sum of recursive residuals stability test (CUSUM) evaluated parameters' stability. The results show that there is both a long- run and short-run relationship among the variables used. Real income, long run interest rate and inflation comply with the expectations of monetary theory. Furthermore, the stability tests and unit circle confirm the long - run relationship among variables. Finally, the stability condition is satisfied when money demand for Italy is estimated using the demand for narrow money (M1) for the examined period.

Keywords: Money Demand Stability, Auto Regressive Distributed Lags Model, Vector Error Correction Model, Stability of the Coefficients, Monetary Aggregates, Italy
JEL Classifications: E41, E52, C22

1. INTRODUCTION

The idea that the amount of money in an economy can be accurately measured and analysed, and that changes in this quantity may be related to changes in interest rates, production, and prices has attracted researchers' attention for a long time. Since Keynes's work in 1936, demand for money has been extensively studied by many economists. Friedman's work in 1956 (the money demand function and the role of money in the economy) has prompted the interest of researchers and those in charge of setting monetary policy in the various countries. Central banks use money demand to control inflation and interest rates as a means of adjusting money supply appropriately. The money demand function gives us information on portfolio distribution and plays an important role in the creation and strategy of an effective monetary policy strategy. Following Friedman's work, much work has been done to show the appropriate monetary policy for the countries in which such research was conducted.

However, nowadays many of the issues concerning the determinants and dynamics of the demand for money remain unclear. In particular, given the importance of quantification of demand and money supply for policy purposes, economists have focused their attention on specific features of monetary aggregates that appear to vary between countries and time. Such a feature is the stability of money demand. Indeed, due to the volatility of interest rates, exchange rate, inflation and production, demand for money may be very unstable. Therefore, the degree of volatility in demand for money will depend not only on the fluctuations in the aforementioned components of money demand but also on the degree of correlation between these components. Therefore, the dynamics of money demand varies from country to country, as the short - and long - term dynamics of these components may vary considerably from country to country and from time to time. This is particularly true when shocks change the composition and structure of the financial market. For example, the formation of the European Monetary Union (EMU) has undoubtedly provoked a major shock to the monetary and financial market in all EU countries. The progressive increase in economic integration, the liberalization of capital movements and the increased exchange rate stability in Europe has caused the balance of domestic and foreign citizens to hold international diversified portfolios. In this case, one expects that in these European countries the stability of money demand has been affected (Capasso and Napolitano, 2012).

The function of money demand is one of the macroeconomic relationships that has been examined the most, by researchers. This great interest comes from the fact that money demand stability plays an important role when conducting and adopting monetary policies for each country. Therefore, the central banks of all countries should apply monetary models and policies based on the estimated relationships between money demand and its determinants. Few economists would disagree with this view, especially after centralized targets for monetary policy control and implementation were adopted by central banks. However, despite analytical and empirical efforts, there is no general consensus on the stability (or volatility) of the money demand function. This shows some doubts about one of the fundamental assumptions of monetary targeting, namely the existence of a stable and predictable relationship between money supply and total nominal income (Andersen, 1985). According to Andersen (1985), instability in the money demand function is sometimes evidenced by unexpected changes in the monetary income velocity. More often, the instability problem is analysed in terms of the function of money demand, the relationship between money stocks and some key macroeconomic variables, such as total income and interest rates.

All central banks underline the importance of analyzing money growth and the fixed function of money demand for monetary policy purposes. Deutsche Bundesbank, for example, has been following a clear monetary targeting strategy since 1975 and the analysis of monetary aggregates is one of the two pillars of the European Central Bank (ECB) monetary policy strategy. The bank's investigation into the existence and stability of money demand is due, inter alia, to the following two observations:

- The increase of money is related to inflation. Therefore, monetary policy makers use development money as an indicator of future risks to price stability (McCandless and Weber, 1995)
- The procedure of transmitting monetary policy continues being a "black box." If we are able to identify a stable function of money demand, an important element of the monetary transmission mechanism is revealed, which can help to learn more about the transmission of monetary policy (Mishkin, 1995).

The paper is organized as follows. Section 2 highlights the main historical events in monetary regimes and policies that potentially could have affected the demand for money in Italy. Section 3 presents the findings of the literature review of money demand stability in the Italian economy. Section 4 describes the economic theory of money demand. Section 5 describes the methodologies employed, Section 6 reports the main results obtained and Section 7 concludes.

2. A HISTORICAL PERSPECTIVE OF MONEY DEMAND IN ITALY

The first fundamental law on monetary and financial integration was introduced in Italy in 1862, with the creation of a single currency, the Italian lira, which replaced the old coins after national unification. In the period 1861-1870, in the Kingdom of Italy, there were five banks: the Banca Nazionale degli Stati Sardi, the Banca Nazionale Toscana, Banca Toscana di Credito, Banco di Napoli and Banco di Sicilia. Banca Romana then joined the other five, so the issue of banknotes by many banks was of particular theoretical interest, and this Italian experience was in fact regarded as an example of a competitive money-issuing system (Gianfreda and Janson, 2001).

Competition between banks was mainly accountable for the financial crises of 1866 and 1893. The main causes, however, were the high Italian external debt, the growing public debt, and the upcoming war against Austria. In order to finance the war on May 1, 1866, the government, by decree, required from the Banca Nazionale nel Regno to provide the Ministry of Finance with a loan of 250,000,000 Italian lire and in exchange, suspended the convertibility of the banknotes (Gigliobianco and Giordano, 2012).

The gold and silver coins, which were still widely used, had been gathered and disappeared from circulation, while the banknotes began to spread among the population. The 1866 decree introduced a fundamental asymmetry between the Banca Nazionale nel Regno and the other banks. Only the Banca Nazionale nel Regno could issue money, while banknotes issued by other institutions could be redeemed in banknotes of the Banca Nazionale. As the latter became a monetary base, there was an increase in total money circulation (Gianfreda and Mattesini 2015).

In 1893, a deep economic and financial crisis culminated in the liquidation of the two main commercial banks, the bankruptcy of others, and the liquidation of Banca Romana, which participated in a political and financial scandal (Pecorari, 2015). In the same year, the Bank of Italy was created with the merger of the two banks of Tuscany Banks and Banca Nazionale. Although Banco di Napoli and the Banco di Sicilia maintained their issue rights up to 1926, the Bank of Italy became the Central Bank of the country.

Before WWI, the convertibility of paper money into gold was maintained in the following periods: 1861 - 1866, 1882 - 1885, 1902-1914. At other times, the government exercised its control with policies that set limits on the issue of paper money and minimum reserves (and in minimum reserve ratios). In addition, the government controlled the banks' official discount rate. This system, however, did not avoid the situation when the banknote issue limits were exceeded due to the fact that the banks were also commercial banks (Muscatelli and Spinelli, 2000).

Similarly to other countries, Italy was also affected by the Great Depression. Between 1929 and 1932, industrial production declined by 25.1%. Given the close relationship between banks and industry, the recession had a direct impact on the banking sector by threatening the stability of both the financial system and of the real economy (Gigliobianco and Giordano, 2012).

The new banking law of 1936, which remained in force until 1993, radically reformed the banking system. First, the Bank of Italy was designated as a public institution and deposits and credit activities were considered to be public services. Secondly, the credit system was modernized thanks to the distinction between long-term and short-term credit that distinguishes commercial banks from industrial banks. The supervision of the system was then focused on the inspection to protect savings and the exercise of credit, under the Presidency of the Governor of the Bank of Italy (Fratianni and Spinelli, 1997).

The banking regulation of 1936 remained radically unchanged until the 1980s and managed to support the growth of the Italian economy. It is worth noting that the banking system has improved the efficiency of its distribution and has become much more stable. After the World War II, fixed exchange rates were maintained in the context of the Bretton Woods agreements. The 1950s and 1960s were characterized by strong economic growth and low inflation. In the 1970s, the end of the Bretton Woods system, oil shocks, and welfare state development have put pressure on facilitating monetary policies that were incompatible with price stability (Fratianni, 2011).

The main objectives of monetary policy were to stabilize interest rates and facilitate the financing of public deficits. Only towards the end of this decade, did the Bank of Italy begin to pay attention to monetary aggregates and gain independence from fiscal policy.

In 1979, Italy kept the European exchange rate mechanism (ERM) of the European monetary system. The independence of monetary policy from the tax authority, the need for which was initially set by the Governor of the Bank of Italy, Paulo Buffy, in 1975, was achieved in 1981 by the Bank of Italy's "divorce" from the Ministry of Finance. It was suggested that the Bank of Italy was no longer obliged to be the residual buyer in government bond auctions (Favero and Spinelli, 1999).

The ERM was abandoned in 1992 due to unsustainable speculative attacks on the Italian Lira. Italy's exit from the ERM required a change in monetary policy to avoid a spiral between exchange rate devaluation and inflation. In the same year, another step was taken towards the independence of the Central Bank, as the treasury was no longer allowed to borrow from the Bank of Italy. In addition, the power to amend the discount rate, which was previously formally held by the Ministry of Finance in 1992, was officially entrusted to the Italian bank by imposing sanctions to allow for legal independence. Overall, the 1980s and 1990s marked a change in the monetary regime. Not only did the correlation between public deficits and money generation disappear, but the regulatory framework also underwent significant changes (2012). In November 1996, the Italian currency re-entered the ERM through the introduction of a wider exchange rate band in August 1993. The Lira was the official currency until the end of 2001, as the euro began in 2002 and the ECB became the issuing body and the reference monetary policy institution for all members of the Eurozone (Gaiotti and Secchi 2012).

3. LITERATURE REVIEW OF THE MONEY DEMAND STABILITY IN ITALIAN ECONOMY

In his work, Thornton (1998) presents estimates of a stable long-term function of money demand in Italy for the period 1861-1980. The results from Johansen's approach regarding the integration of variables have shown that there is a long-term integrated relationship, both in terms of the demand function and the supply of money function. In both functions, the elasticity of income and interest rates are in line with the size and the sign of monetary theory.

Muscatelli and Spinelli (2000) examine the stability of money demand in Italy for a fairly long time, covering the period of 1861-1996. In particular, they look at how the evolution of the financial system in Italy and policy shifts (changes) have affected the behavior of long-term demand for money, while presenting the structural changes in the stability of money. A second noteworthy conclusion of their work is that there is a two-way causal relationship between money demand, income, interest rate and the price index.

Caruso (2006) in his work examines the impact of fluctuations in the Milan stock exchange on the long-term demand for money in Italy. The empirical results of this work show that stock market fluctuations help to explain temporary movements in liquidity preference. In conclusion, Caruso concludes that though there is a positive correlation between the stock market index that includes dividends and real money balances, the estimated long-term relationship is unstable.

Capasso and Napolitano (2012) investigated the stability of money demand by applying the most recent econometric control procedures in Italy, one of the largest EMU countries, before and after the EMU. Among others, the objective of their work was to ascertain the effect of a change in the currency regime on the monetary aggregates and provide a valid empirical model that would serve as a viable tool for policy performance.

Daniele et al. (2017), following the application of recent econometric technique auto regressive distributed lags (ARDL), examine the stability of money demand in Italy for the period 1861-2011. The results of their work have shown that instability cannot be ruled out when a function of money demand is assessed irrespective of the use of M1 or M2. Then, it is observed that the reason for possible instability in money demand resides in the omission of relevant variables, as it is shown that a fully stable demand for narrow money (M1) can be obtained from an augmented money demand function involving real exchange rates and its volatility as additional explanatory variables.

4. THE ECONOMIC THEORY OF MONEY DEMAND

The money demand function is of great importance in an IS-LM (Investment/Saving equilibrium-liquidity preference/money supply equilibrium) model developed by John Hicks as an attempt to connect Neoclassical and Keynesian theory. The IS/LM model presents the relationship between interest rates and productive output not only in market of goods and services but also in money market. The IS curve represents real economy meaning the production of goods and services. The reduction of Interest rates increases output, thus IS curve is declining. LM curve is increasing and represents the effect of financial sector. A well-known macroeconomic relationship of money demand is the following:

$$\frac{M}{P} = f\left(Y, OC\right) \tag{1}$$

Where:
M represents nominal value of money
P is price level
Y is the income, and
OC is the vector of opportunity cost of money holding.

In empirical studies, for the nominal value of money M1, M2 and M3 are mainly used as variables. For price level, the consumer price index – (CPI) or the GDP deflator is used. For the opportunity cost, the choice differs. Mainly, the nominal short and long term interest rates are used. In other studies, inflation rate represents the opportunity cost of money holding instead of holding assets. Moreover, for countries exposed to high inflation, exchange rate equilibrium can be regarded as an alternative variable of opportunity cost.

The long- run relationship of money demand can be formulated as follows:

$$m_t - p_t = \alpha_0 + \beta_1 g_t + \beta_2 R_t + \beta_3 \pi_t + \varepsilon_t \tag{2}$$

where:
m_t is the logarithm of the nominal M1 level.
p_t is the logarithm of the CPI.
g_t is the logarithm of real GDP.
R_t is long-term interest rate.
π_t is the annual inflation rate.

Parameters β_1, β_2 and β_3 of the above equation denote income elasticity, semi-elasticity in relation to interest rate and semi-elasticity in relation to inflation rate respectively. According to economic theory, real GDP has a positive effect on nominal M1. On the other hand, variables representing opportunity cost meaning nominal interest rate and inflation rate, should have negative effect on M1. Moreover, it should be noted that income elasticity is important for the determination of monetary expansion which is consistent with the long-run price stability level. Also, the semi-elasticity of interest rate helps to compute the welfare cost of long term inflation (Mark and Sul, 2003).

5. METHODOLOGY

5.1. Unit Root Tests

The first step is to test for integration order for model's variables. For this purpose, we use three basic unit root tests. Dickey and Fuller (1979, 1981) test, τον Phillips and Peron (1988) test, as well as Kwiatkowski et al. (1992).

Dickey and Fuller (1979, 1981) have constructed an asymmetric distribution for unit root test while with Augmented Dickey Fuller test (ADF) they have constructed a parametric test correcting autocorrelation of high rank, assuming that the series follows an autoregressive procedure k order AR(k).

Phillips and Perron (1988) suggested a non-parametric test and examined autocorrelation and heteroscedasticity on errors modifying statistical tests. Phillips-Perron test is suitable in any form of autocorrelation as well as assuming that the series follows an ARMA procedure (p,q) unknown order.

Kwiatkowski et al. (1992) test is employed with Lagrange multiplier where the null hypothesis denotes that random walk has zero variance.

Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root test in their null hypothesis denote the existence of unit root, meaning that time series is not stationary. On the contrary, Kwiatkowski et al. (KPSS) test in null hypothesis denote that there is no unit root, thus time series is stationary with a deterministic trend. Moreover, Phillips-Perron (PP) and Kwiatkowski et al. (KPSS) test create a "bandwidth" for parameters' choice (as a part of covariance estimator of Newey-West) creating problems in an infinite sample proportional to the lag length of Augmented Dickey and Fuller (ADF) test.

5.2. ARDL Model Specification

ARDL bounds cointegration method was developed by Pesaran et al. (2001) for investigating the long run relationship between variables in a VAR model. In this paper, we adopt the ARDL method because in relation to other cointegration tests, this method has some advantages which are:

- It provides consistent results when the sample size is small
- This method is flexible as far as the integration order of variables is concerned
- ARDL method, in comparison to other cointegrating methods, can detect and wipe out the problems that may arise between dependent and independent variables like autocorrelation and endogeneity.

The ADRL $(p, q_1, q_2, \ldots, q_k)$ model specification is given as follows: (Pesaran et al. 2001):

$$\alpha\left(L, p\right) y_t = \mu + \sum_{i=1}^{k} \beta_i \left(L, p\right) x_{1t} + \lambda' w_t + \varepsilon_t \quad \forall t = 1, \ldots, n \tag{3}$$

where
$\alpha\left(L, p\right) = 1 - \alpha_1 L - \alpha_2 L^2 - \ldots - \alpha_p L^p$
$\beta_i\left(L, q_i\right) = \beta_{i0} + \beta_{i1} L + \beta_{i2} L^2 + \ldots + \beta_{iq_i} L^{q_i} \quad \forall i = 1, 2, \ldots, k$
$y_t =$ dependent variable.

μ = constant term.
L = lag operator.

w_t=$s\times 1$ vector of deterministic variables such as intercept term, time trends, or exogenous variables with fixed lags.

Long run elasticities of equation (3) can be calculated as follows:

$$\phi_i = \frac{\hat{\beta}_i(1,\hat{q})}{\alpha(1,\hat{p})} = \frac{\hat{\beta}_{i0}+\hat{\beta}_{i1}+\ldots+\hat{\beta}_{i\hat{q}}}{1-\hat{\alpha}_1-\hat{\alpha}_2-\ldots-\hat{\alpha}_p} \quad \forall i = 1,2,\ldots,k \tag{4}$$

where
$\hat{p}$ and $\hat{q}_i$ $i = 1, 2,\ldots, k$ are the estimated values of p and q_i.

Long run coefficients of equation (3) can be calculated as follows:

$$\varpi = \frac{\hat{\lambda}(\hat{p},\hat{q}_1,\hat{q}_2,\ldots,\hat{q}_k)}{1-\hat{\alpha}_1-\hat{\alpha}_2-\ldots-\hat{\alpha}_p} \tag{5}$$

where
$\hat{\lambda}(\hat{p},\hat{q}_1,\hat{q}_2,\ldots,\hat{q}_k)$ denotes the OLS estimates of λ in the equation (3).

To test for the existence of long run relationship among variables with ARDL method, we use as endogenous each variable of the model and exogenous the same variables as follows:

$$\Delta(m-p)_t = \beta_0+\gamma_T T+\delta_{(m-p)}(m-p)_{t-1}+\delta_g g_{t-1}+\delta_{R_1}R_{1t-1} +\delta_\pi \pi_{t-1}+\sum_{i=1}^{p}\alpha_{1i}\Delta(m-p)_{t-i}+\sum_{i=0}^{q_1}\alpha_{2i}\Delta g_{t-i}+ \sum_{i=0}^{q_2}\alpha_{3i}\Delta R_{1t-i}+\sum_{i=0}^{q_3}\alpha_{4i}\Delta\pi_{t-i}+\varepsilon_{1t} \tag{6}$$

$$\Delta g_t = \beta_0+\gamma_T T+\delta_g g_{t-1}+\delta_{(m-p)}(m-p)_{t-1}+\delta_{R_1}R_{1t-1}+ \delta_\pi \pi_{t-1}+\sum_{i=1}^{p}\alpha_{1i}\Delta g_{t-i}+\sum_{i=0}^{q_1}\alpha_{2i}\Delta(m-p)_{t-i}+ \sum_{i=0}^{q_2}\alpha_{3i}\Delta R_{1t-i}+\sum_{i=0}^{q_3}\alpha_{4i}\Delta\pi_{t-i}+\varepsilon_{2t} \tag{7}$$

$$\Delta R_{1t} = \beta_0+\gamma_T T+\delta_{R_1}R_{1t-1}+\delta_g g_{t-1}+\delta_{(m-p)}(m-p)_{t-1}+ \delta_\pi \pi_{t-1}+\sum_{i=1}^{p}\alpha_{1i}\Delta R_{1t-i}+\sum_{i=0}^{q_1}\alpha_{2i}\Delta g_{t-i}+ \sum_{i=0}^{q_2}\alpha_{3i}\Delta(m-p)_{t-i}+\sum_{i=0}^{q_3}\alpha_{4i}\Delta\pi_{t-i}+\varepsilon_{3t} \tag{8}$$

$$\Delta\pi_t = \beta_0+\gamma_T T+\delta_{(m-p)}(m-p)_{t-1}+\delta_g g_{t-1}+\delta_{R_1}R_{1t-1}+ \delta_\pi \pi_{t-1}+\sum_{i=1}^{p}\alpha_{1i}\Delta\pi_{t-i}+\sum_{i=0}^{q_1}\alpha_{2i}\Delta g_{t-i}+\sum_{i=0}^{q_2}\alpha_{3i}\Delta R_{1t-i}+ \sum_{i=0}^{q_3}\alpha_{4i}\Delta(m-p)_{t-i}+\varepsilon_{4t} \tag{9}$$

Where Δ denotes the first differences, β_0 is the constant (drift), γ_T is trend coefficient $\delta_{(m-p)}$, δ_g, δ_{R_1}, and δ_π, are the long run coefficients and ε_{1t}, ε_{2t}, ε_{3t}, and ε_{4t} are white noise errors (disturbance terms).

Before estimating equations (6), (7), (8), and (9) we should select the optimal lag length. The wrong choice of lag length can lead to biased results on equations' estimation. Moreover, the suitable lag length for each variable of ARDL model is important because we try to avoid non-normality, autocorrelation and heteroscedasticity of errors terms in an ARDL model. For optimal lag length, we use the Akaike information criterion (AIC), Schwarz Bayesian Criterion or Hannan-Quinn Criterion.

Afterwards, the existence of long -run relationship between variables of ARDL model is tested using F statistic, an asymptotic distribution, and we compare it with critical bounds stated in the paper of Pesaran et al. (2001) to ascertain if there exists a cointegrated relationship or not.

The null hypothesis of no cointegration among variables on equations (6), (7), (8), and (9) is:

$H_0: \delta_{(m-p)} = \delta_g = \delta_{R_1} = \delta_\pi = 0$ (there is no cointegration – long run relationship).

$H_1: \delta_{(m-p)} \neq \delta_g \neq \delta_{R_1} \neq \delta_\pi \neq 0$ (there is cointegration – long run relationship).

Many scientists are interested mainly in long run relationship between variables. Thus, the concept of cointegration and error correction model (ECM) was developed connecting both the short and long run relationship among variables. The ECM can be formed as follows:

$$\Delta(m-p)_t = \beta_0+\gamma_T T+\sum_{i=1}^{p}\alpha_{1i}\Delta(m-p)_{t-i}+\sum_{i=0}^{q_1}\alpha_{2i}\Delta g_{t-i}+ \sum_{i=0}^{q_2}\alpha_{3i}\Delta R_{1t-i}+\sum_{i=0}^{q_3}\alpha_{4i}\Delta\pi_{t-i}+\lambda_1 ECM_{t-1}+e_{1t} \tag{10}$$

$$\Delta g_t = \beta_0+\gamma_T T+\sum_{i=1}^{p}\alpha_{1i}\Delta g_{t-i}+\sum_{i=0}^{q_1}\alpha_{2i}\Delta(m-p)_{t-i}+ \sum_{i=0}^{q_2}\alpha_{3i}\Delta R_{1t-i}+\sum_{i=0}^{q_3}\alpha_{4i}\Delta\pi_{t-i}+\lambda_2 ECM_{t-1}+e_{2t} \tag{11}$$

$$\Delta R_{1t} = \beta_0+\gamma_T T+\sum_{i=1}^{p}\alpha_{1i}\Delta R_{1t-i}+\sum_{i=0}^{q_1}\alpha_{2i}\Delta g_{t-i}+ \sum_{i=0}^{q_2}\alpha_{3i}\Delta(m-p)_{t-i}+\sum_{i=0}^{q_3}\alpha_{4i}\Delta\pi_{t-i}+\varepsilon_{3t}+\lambda_3 ECM_{t-1}+e_{3t} \tag{12}$$

$$\Delta\pi_t = \beta_0+\gamma_T T+\sum_{i=1}^{p}\alpha_{1i}\Delta\pi_{t-i}+\sum_{i=0}^{q_1}\alpha_{2i}\Delta g_{t-i}+ \sum_{i=0}^{q_2}\alpha_{3i}\Delta R_{1t-i}+\sum_{i=0}^{q_3}\alpha_{4i}\Delta(m-p)_{t-i}+\lambda_4 ECM_{t-1}+e_{4t} \tag{13}$$

The ECM test derives from cointegration models and represents the estimated equilibrium errors. The λ coefficient of ECM is called short run adjustment coefficient and present the speed adjustment from equilibrium point or the correction of instability in every period. The sign of λ coefficient must be negative and its value should be between 0 and 1. Finally, it should be noted that ARDL and ECM models are estimated with least squares method (LS).

5.3. Stability and Diagnostic Test

To assure that our estimated model is correctly specified and can be used for forecasting, we should conduct not only the diagnostic test but also the coefficients' stability test. Diagnostic tests examine the model for functional form, non-normality serial correlation and heteroscedasticity. The stability test is conducted by employing the cumulative sum of recursive residuals (CUSUM) and the cumulative sum of squares of recursive residuals (CUSUMSQ) suggested by Brown et al. (1975). Furthermore, as a final step for the analysis of stability on estimated ARDL model, we test all the inverse roots in relation to the unit circle.

6. EMPIRICAL RESULTS

Our empirical analysis for money demand of Italy is based on equation (2). As a proxy for money demand we use M1 which contains the monetary circulation. For the estimation and stability of money demand, we use as explanatory variables the gross domestic product, CPI, long run interest rate and inflation rate by implementing an ARDL technique. The choice of this technique was made, because it can be applied in small samples and circumvent the problems arising from the stationarity of series. Moreover, this choice is based on the fact that cointegration and ECM can be applied jointly to determine money demand in Italy in the long run period as well as in the short run.

6.1. Data

Time series of the above model is annual covering the period from 1960 to 2017. Data derive from World Bank. All variables, except for long-run interest rate and annual rate of inflation were converted to natural logarithms.

Price index: CPI (Base 2010=100) is the price level.
Money level: M1 is the nominal money variable.
Income: Gross domestic product – GDP (constant 2010 US$).
Long-term interest rate: Average government bond yield (interest rate on government bonds %).
Short-term interest rate: Average deposit rate (interest rate %).
Annual inflation rate: Inflation consumer prices (annual %).

6.2. Unit Root Tests

Before continuing to ARDL bounds test, we examine the stationarity of all variables to determine their order of integration. Pesaran et al. (2001) mention that for the integration of time series in an ARDL procedure, time series can be integrated null order I(0) or first order I(1). To determine the integration order of time series in this paper, we use the Dickey and Fuller (1979, 1981), Phillips and Peron (1988) and Kwiatkowski et al. (1992) - KPSS test. The results of the unit root test are presented on Table 1.

6.3. Bounds Tests for Cointegration

It was referred that before estimating equations (6), (7), (8), and (9), we should choose the optimal lag length. On the following Figure 1, the lag length of variables is presented using the Akaike criteria (AIC criteria).

Then, on Table 2 the results of F statistic are given for the existence of long run relationship among variables on ARDL model as well as the diagnostic tests for each equation.

According to Narayan (2005), the existing critical values reported in Pesaran et al. (2001) cannot be used for small sample sizes because they are based on large sample sizes. Narayan (2005) provides a set of critical values for sample sizes ranging from 54 observations. They are 2.01-3.10 at 90%, 2.45-3.63 at 95%, and 3.42-4.84 at 99%.

The results of the above table show that there are four cointegrating vectors. Thus, we can say that there is a long run relationship among examined variables of the model.

Table 1: Unit root tests

Variable	ADF		P-P		KPSS	
	Levels					
	C	C,T	C	C,T	C	C,T
m	0.513(0)	−1.988(0)	0.534[6]	−1.970[3]	0.882[6]	0.191[6]**
m-p	−1.675(1)	−0.198(0)	−1.788[4]	−0.433[3]	0.526[6]**	0.222[6]
g	−7.448(0)*	−1.459(0)	−7.104[1]*	−1.571[5]	0.865[6]	0.237[6]
R	−1.632(1)	−2.040(1)	−0.830[0]	−1.558[2]	0.297[6]	0.199[6]**
π	−1.491(0)	−2.091(0)	−1.667[3]	−2.169[2]	0.353[6]**	0.153[5]**
	First differences					
	C	C,T	C	C,T	C	C,T
Δm	−7.034(0)*	−7.060(0)*	−7.028[5]*	−7.050[6]*	0.202[5]*	0.064[6]*
Δ(m-p)	−5.279(0)*	−5.801(0)*	−5.256[1]*	−5.801[0]*	0.511[4]**	0.123[3]**
Δg	−4.512(0)*	−6.901(0)*	−4.533[4]*	−7.017[6]*	0.926[5]	0.073[6]*
ΔR	−4.786(0)*	−5.216(1)*	−4.538[8]*	−4.480[10]*	0.265[1]*	0.068[3]*
Δπ	−6.397(0)*	−6.420(0)*	−6.360[2]*	−6.433[1]*	0.149[2]*	0.072[1]*

1. *, ** and *** show significant at 1%, 5% and 10% levels respectively. 2. The numbers within parentheses followed by ADF statistics represent the lag length of the dependent variable used to obtain white noise residuals. 3. The lag lengths for ADF equation were selected using Schwarz information criterion. 4. Mackinnon (1996) critical value for rejection of hypothesis of unit root applied. 5. The numbers within brackets followed by PP statistics represent the bandwidth selected based on Newey and West (1994) method using Bartlett Kernel. 6. C=Constant, T=Trend, Δ=First differences. m=Logarithm of the nominal M1 level, p=The logarithm of the CPI. g=Logarithm of real GDP. R=Long-term interest rate. π=Annual inflation rate. The results on Table 1 show that some variables are integrated null order I(0) and others are integrated order one I(1). Furthermore, because of the small sample, the most proper procedure for cointegration of the series is that of ARDL-Auto ARDL suggested by Pesaran et al (2001)

Figure 1: (a-d) Optimal lag length in equations (6), (7), (8), and (9) respectively

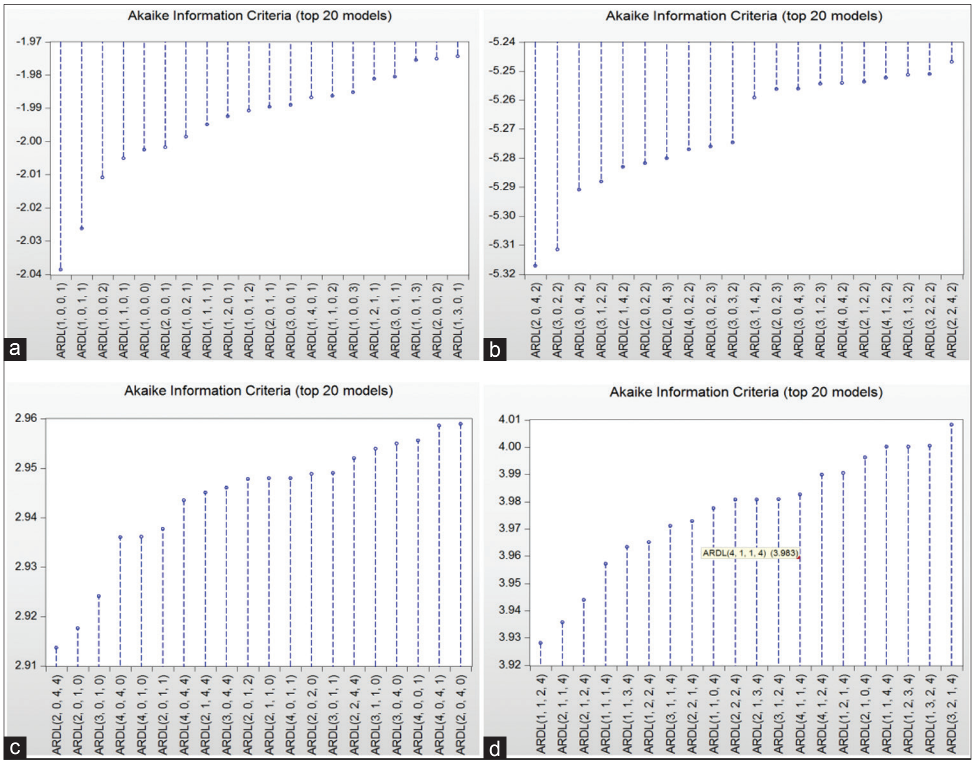


Table 2: The ARDL bounds testing cointegration approach analysis

Bounds testing to cointegration			Diagnostic tests			
Estimated models	**Optimal lag length**	**F-statistics**	**Jarque-Bera**	**LM (1)**	**ARCH(1)**	**RESET**
$F_{m\text{-}p}(m\text{-}p/g,R_1,\pi)$	(1,0,0,1)	8.258*	0.572	0.025	6.972*	0.527
$F_g(g/m\text{-}p,R_1,\pi)$	(2,0,4,2)	5.894*	2.783	0.438	1.239	9.945*
$F_{R1}(R_1/m\text{-}p,g,\pi)$	(2,0,4,4)	4.606**	0.157	1.076	0.673	0.836
$F_\pi(\pi/m\text{-}p,g,R_1)$	(1,1,2,4)	5.193*	6.665**	0.734	1.144	0.002

*, **, *** represent significance at 1, 5, 10% levels respectively. Appropriate lag length of the variables is selected following AIC

6.4. Estimated Long Run and Short-run Coefficients using the ARDL Approach

After the confirmation of long-run relationship among variables and the optimal number of time lags, the next step is to determine the short and long run elasticity of cointegrating vectors. The results of equations on long and short run dynamic appear on Table 3.

The results on Table 3 show that real GDP has a positive long run effect on nominal M1. On the other hand, variables representing the opportunity cost namely nominal interest rate and inflation rate, have a negative impact on nominal M1. The results of this paper agree with economic theory which is referring on long run relationship of money demand. Due to the fact that real GDP is also statistical significant in 1% level of significance, we can conclude that an increase of GDP by 1%, will increase money demand by 0.14% approximately.

The short run results on Table 4 denote that the short run coefficient on error correction term is negative in all equations and statistical significant in 1% level of significance. This implies that there is a long run relationship among variables for Italy. Also, this result denotes that short-run variations from the long-run equilibrium are corrected by 4% each year on first equation.

Table 3: ARDL long-run results

Variables	Coefficients	Std. error	t-statistic
Dependent variable: m-p			
g	0.139	0.030	4.500*
R_1	−0.097	0.108	−0.898
π	−0.211	0.189	−1.115
Dependent variable: g			
m-p	11.543	1.371	8.416*
R_1	0.944	0.510	1.849**
π	0.283	0.590	0.479
Dependent variable: R_1			
m-p	−2.796	1.146	−2.439*
g	0.297	0.093	3.169*
π	0.754	0.130	5.783*
Dependent variable: π			
m-p	−6.262	5.551	−1.128
g	0.736	0.608	0.232
R_1	−0.702	0.971	−0.722

*, **, *** represent significance at 1, 5, 10% levels respectively

In addition, the results of first equation show a positive relationship between GDP, the long run interest rate and money demand and negative relationship between money demand and inflation. Because only inflation rate is statistical significant in 1% level of significance, we can claim that an increase on inflation by 1%, will cause a reduction on money demand in Italy by 0.02% approximately in the short run.

Figure 2: (a and b) Plot of CUSUM and CUSMQ for the coefficient stability of ECM model

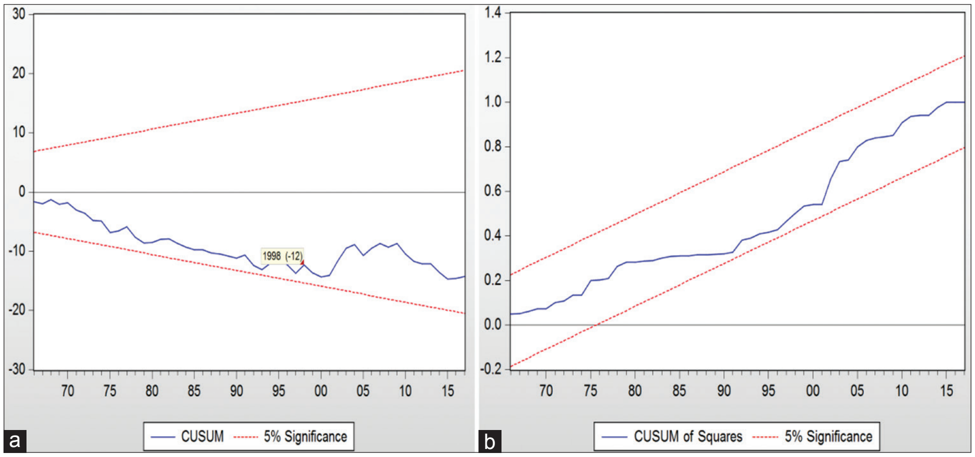
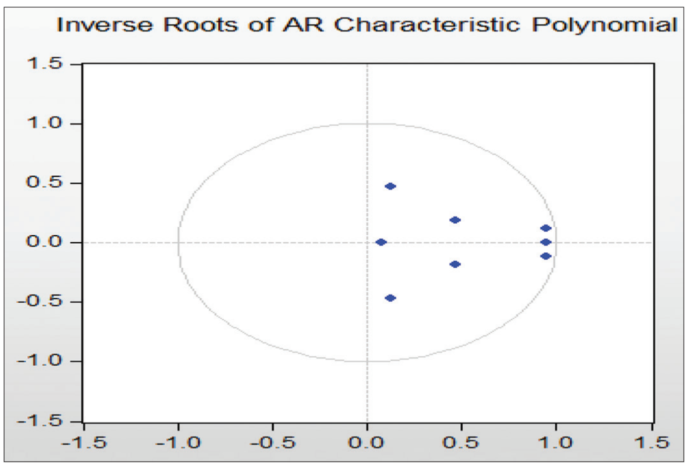


Figure 3: Inverse roots for equations presented in Table 4



Finally, all diagnostic tests (Table 2) satisfy all the assumptions of the linear regression model with autocorrelation and heteroscedasticity being absent while residuals are normally distributed.

6.5. Stability Test

The stability of long run coefficients is tested from short run dynamic of the model. On ECM s presented on Table 4, the cumulative sum of recursive residuals (CUSUM) and the CUSUM of square (CUSUMSQ) are applied to evaluate parameters' stability. On Figure 2, the results on CUSUM and CUSUMSQ on first equation are presented.

From Figure 2, we can see that the plots of CUSUM and CUSUMSQ statistics are within the critical bounds at 5% level of significance, showing the regression model is stable.

On Figure 3 the results on stability test of the estimated money demand function are presented, checking for all inverse roots of the model.

The results on Figure 3 show that all inverse roots of the model are inside the unit circle.

So, the results both on Figures 2 and 3 show that the stability condition is satisfied as the plots of CUSUM and CUSUMSQ are within the critical bounds and also that all inverse roots are all strictly inside the unit circle.

Table 4: ARDL short-run results

Variables	Coefficients	S. error	t-statistic
Dependent variable: Δ(m-p)			
Δg	0.076	0.362	0.210
ΔR_1	0.006	0.009	0.661
$\Delta \pi$	−0.018	0.006	−3.089*
ECM_{t-1}	−0.037	0.007	−5.011*
Dependent variable: Δg			
$\Delta g(-1)$	0.239	0.140	1.702***
Δ(m-p)	0.006	0.028	0.231
ΔR_1	0.001	0.002	0.820
$\Delta R_1(-1)$	−0.010	0.002	−4.653*
$\Delta R_1(-2)$	0.002	0.002	0.881
$\Delta R_1(-3)$	−0.003	0.002	−1.825**
$\Delta\pi$	0.002	0.001	1.640***
ECM_{t-1}	−0.001	0.0004	−4.126*
Dependent variable: ΔR_1			
$\Delta R_1(-1)$	0.379	0.116	0.002
Δ(m-p)	0.331	1.443	0.229
Δg	12.612	7.594	1.660***
$\Delta g(-1)$	2.475	6.797	0.364
$\Delta g(-2)$	−3.503	7.003	−0.500
$\Delta g(-3)$	9.396	6.192	1.517
$\Delta\pi$	0.247	0.069	3.564*
ECM_{t-1}	−0.242	0.056	−4.312*
Dependent variable: $\Delta\pi$			
Δ(m-p)	−8.921	2.387	−3.736*
Δg	15.251	11.213	1.360
$\Delta g(-1)$	21.863	11.411	1.915**
ΔR_1	0.779	0.173	4.494*
$\Delta R_1(-1)$	−0.069	0.232	−0.299
$\Delta R_1(-2)$	−0.040	0.214	−0.189
$\Delta R_1(-3)$	0.541	0.175	3.086*
ECM_{t-1}	−0.173	0.036	−4.800*

*, **, *** represent significance at 1, 5, 10% levels respectively

7. CONCLUSIONS AND POLICY IMPLICATIONS

The current paper examined the stability of money demand for Italy for the period 1960-2017. For this purpose, recently developed econometric cointegrating technique ARDL and the the error correction model (ECM) for long- run and short- run equilibrium relationship on time series of the model, were used. The results of ARDL technique and ECM confirm the existence of both a long- run and short-run relationship among variables used with the real income, long- run interest rate and inflation to be in accordance with the expectations of monetary theory. Furthermore, the results of stability tests CUSUM and CUSUMSQ and unit circle confirm the long- run relationship among variables showing that the stability condition is satisfied when money demand in Italy is estimated for the examined period.

Furthermore, the introduction of euro was undoubtedly an important change, a revolution in the monetary system of Italy. Even if theory denotes that the adoption of a new currency should not affect the distribution of real resources, the empirical data and in real terms show different results. The results of this paper are quite clear showing an important stability of the coefficients both in the short- and long- run. The results agree with the paper of Napolitano (2011). However, what is valid for Italy many not apply in other economies.

In a macroeconomics policy-making context, if money demand is stable, then a monetary policy aiming to increase the rate some monetary sizes, can contribute in the stabilization of the economy of a country. Thus, if money demand doesn't change unpredictably, then money supply will be a trustworthy way where stability in inflation rate can be achieved. Furthermore, real production will increase in the long -run on a steady pace, and will be equal to the sum of increasing rate of population, know-how and technology. Given the long- run increasing rate of production, the only determinative factor of inflation will be the increasing rate of money supply. In this case, inflation will be a monetary phenomenon in the long-run.

On the other hand, if money demand is unstable, then shocks on money demand will convert to changes of real and nominal interest rates in the framework of supply, leading to economic fluctuations. In this case, an alternative policy on interest rates is important and not on money supply, as this policy can improve the result. The money supply will adjust on shocks on money demand keeping interest rates stable as well as the economic activity. In conclusion, we can claim that the volatility of money demand plays a fundamental role in a country's monetary policy.

During the last decades, many economists and bankers are concerned about the notion that quantity of money in an economy can be measured and analysed in detail and that changes on quantity can be related to changes on inflation rate, interest rate and output. However, nowadays many economists (Benati et al., 2017) support the view that monetary aggregates don't play an important role in macroeconomic models. Benati et al. (2017) support the view that instability exists in the relationship among series.

Consequently, we can state that in the examined period real GDP has a positive long - run effect on nominal M1 for Italy while variables representing the opportunity costs namely nominal interest rate and inflation rate show a negative effect on nominal M1. The results agree with economic theory which is referring to long - run relationship of money demand. Also, the results on short -run period show a positive relationship among GDP, interest rate and money demand and a negative one between money demand and inflation.

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