



Do Payment Technology Innovations Affect Currency Demand in Tunisia?

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ABSTRACT

This study investigates the impact of non-cash payment technologies on demand for currency in Tunisia using the autoregressive distributed lag (ARDL) cointegration approach from 2010M12 to 2018M7. In this context, our findings indicate a negative influence of EFT-POS terminals on currency demand. We have also shown that the demand for currency is positively influenced by the increase in the number of ATMs and the volume of transactions made by bank cards in circulation, reflecting the frequent use of cards to receive cash in Tunisia. Whereas, the impact of increase in check payments on demand for currency is negative and not significant. The empirical evidence shows that there is preference for cash in payment habits by Tunisian consumers. So, it should be noted that despite the development of payment systems, cash still attractive and an easier substitute for non-cash payments in Tunisia.

Keywords: Currency Demand, ATM, POS, ARDL, Tunisia

JEL Classifications: E41, E42, E44, G21, O33

1. INTRODUCTION

Recent developments in payment technologies have added new words to current literature about money demand and particularly about cash demand. In this context, new payment instruments, based on electronic transfer of funds, were broadly accepted by economic activists in different countries, caused more than ever the expansion of e-commerce in various forms.

The Central Bank of Tunisia involve strategies to promote the financial inclusion through the development of payment systems and means. The idea was to increase the use of non-cash payment instruments generated in the framework of the less cash society in order to encourage the creation of a secure payment system with the rapid use of non-cash payment instruments based cards.

In Tunisia, the payments' motives are not changing: notes and coins are still more and more diffused for everyday purchases, in

particular for low-value expenses, at the detriment of paper-based or card-based payments. In other words, cash is still the preferred and more used payment instrument by tunisian consumers.

Research studies on the demand for currency has found that the option of the payment systems, changes the demand for cash reflecting changes in the volume of cash transactions via changes in the consumer behaviors. There are several empirical studies started to model the demand for money against payment instruments development investigating the relationship between new payment instruments and cash usage. Amromin and Chakravorti (2007) estimated a study on the impact of the rise use of debit card to the circulation of cash. The findings showed that increasing debit cards may decrease low denomination currency, but high denomination currency is less affected. Yilmazkuday (2007) examines the effects of credit and debit cards on the demand for currency using GMM estimation. He found the usage both credit and debit cards had a negative effect on currency demand. Rinaldi (2001) estimated a

currency demand equation for Belgium to determine the impact of alternative means of payment on cash usage. The findings show that POS merchant acceptance and the number of ATMs had a negative impact on currency in circulation while there is a weak positive effect found for the number of credit and debit cards. Snellman et al. (2000) estimated a money demand equation using panel data for ten European countries and found that the number of debit and credit cards had an insignificant effect on demand for cash. Stix (2004) found that debit cards affect cash demand significantly. Also, Anderson-Reid (2008) found that demand for currency is positively affected by the volume of ATM transactions in the previous two periods and negatively affected by Electronic Funds Transfer Point of Sale systems (EFTPOS) transactions in the prior period in Jamaica. Moreover, Tehranchian et al. (2012) 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. They found a positive impact of the number of ATMs and credit cards on the demand for currency in both short and long runs and a negative impact of the number of POS on cash usage. Further, Reddy and Raj (2017) examines the impact of credit cards and debit cards on currency demand and seigniorage in India employing an auto-regressive distributed lag (ARDL) model for monthly data. He found that credit cards decrease currency demand. Also, he found that wider usage of electronic cards may not be a threat to the central bank's autonomy in the near future as seigniorage revenue is not affected by the use of cards. Adil and al (2020) estimate money demand for India from 1996:Q2 to 2016:Q3 with the linear ARDL approach. They found that financial innovation plays a very significant role in the money demand specification and its stability.

To the best of our knowledge, this paper represents the first attempt to examine the impact of non-cash payment developments on currency demand in Tunisia using the ARDL approach. The purpose of this study is to understand if the modern payment instruments have an influence on currency demand in Tunisia by a special focus on the more advanced means of payments as a main variable of interest. We particularly concentrate, for the first time, on the evolution of non-cash payment infrastructure that has increased in recent years in Tunisia, highlighting its impact on currency usage. In view of the fast-changing external factors in the payment systems, we focus on the most used means of payment in Tunisia like checks and POS and bank cards.

This article is organized as follows. Section 2 presents the payment technologies dynamic in Tunisia. In section 3, we focus on the data and the empirical methodology. We present the empirical findings and the interpretation in section 4. We offer some concluding remarks in section 5.

2. THE PAYMENT TECHNOLOGIES DYNAMIC IN TUNISIA

Developments in information technology and telecommunications increased the payment technologies infrastructure. In Tunisia, payment systems and the use of non-cash payment instruments

have undergone significant changes for over the last years. The Central Bank of Tunisia adopted strategies to promote the financial inclusion and to support the development of payment systems in Tunisia including the move toward the increasing reliance on the use of newly developed payment technologies to enable both e-commerce and e-payments. Despite that, Tunisian consumers required preference for cash.

2.1. The Cash Holdings In Tunisia

The question we ask is: Why do Tunisians use currency? Why is currency still an important means of transaction in Tunisia?

To answer these questions, we have to investigate the reasons for currency usage in Tunisia which are essential to understand and design the behavior of the Tunisian economic agents towards cash:

2.1.1. The motives for which currency is demanded:

The motives behind holding cash must have gained in importance against other means of payment:

The transaction motive: Cash is a medium of exchange function. Demanding currency arises from the fact that most transactions involve an exchange of cash. So, cash must be available as a mean of payment for consumption expenditures for both small and large transactions. Cash is the most preferred and the most dominant mean of payment for Tunisian consumers for the different nature of transactions particularly the extraordinary household expenses for the summer season, the month of Ramadan, the religious holidays and the end of year celebration, respectively.

In Tunisia, most retail purchases are normally made with cash because of its specific benefits:

1. Cash is completely anonymous which affords the most important characteristic relative to e-money and the other payment products. In this context, anonymity preserves a certain measure of privacy for users. Almost, the payer and payee may not prefer to reveal their identities or the type of the transactions
2. Cash is secure and provides confidence for the payer and the payee
3. Cash is preferred for its high degree of liquidity
4. Cash is the quickest mean of payment for transactions
5. Cash is mostly used for legal and illegal transactions
6. Cash can be used without the further involvement of any intermediate as a computer or a mobile or service providers
7. Cash is the cheapest mean of payment in Tunisia.

The precautionary motive: Cash is a store of value. Tunisian consumers reserve cash for precautionary reasons. They have a monetary habit which is to store an amount of currency in their houses or in their wallet. This form of cash hoarding has gained in importance against uncertainty and unforeseen expenses that may require the payment must be done with cash. This reflects the urgent needs for liquidity and a secure mean of payment.

2.1.2. The expansion of the informal economy in Tunisia

In Tunisia, the expansion of the informal sector can be a determinant factor for the higher demand for cash. Indeed, the

informal economy needs more cash than the modern means of payment. Moreover, Abid and Ben Salha (2013) found that the informal GDP is found to range between 14% and 29% of the formal GDP in Tunisia during the period between 1980 and 2009 and represent 54% of the formal GDP in 2018.

The informal economy plays an important role in Tunisia that explains the use of cash as the most preferred means of payment for Tunisian consumers. A higher share of currency issued by the monetary system is captured by the informal sector away from banks and does not serve the transparent financing of the economy.

2.1.3. Low digital and financial inclusion in Tunisia:

Despite the strategies involved by the Central Bank of Tunisia to promote the financial inclusion particularly with supporting the development of payment systems and means, the Tunisian consumers required preference for cash. According to annual report of the Central Bank of Tunisia, only 17% of Tunisians use payment means other than cash at least once per month and 3% of Tunisians have already used a financial service via mobile phone in 2018.

The Central Bank of Tunisia create a new professional body namely the payment institution, exclusively devoted to the payment service. The aim is to boost financial inclusion and make the payment market more competitive to help consumers have access to proximity payment services at affordable prices. However, there are only 5 149 872 Tunisians that have current accounts in 2018 relative to 4 153 000 people of the total labor force, indicating that about 124% of Tunisians have a more than an account relative to the labor force (The number of the current accounts and check accounts held by Tunisians in 2018 including banks and the National Post Office). Nevertheless, digital inclusion must be developed because it is not enough to have a client accounts. It must be used by means of card payment and, increasingly, by mobile phone.

In this context, the Central Bank was committed, over 2018, to implementing the Decashing plan which will serve as an example to acquire new habits in terms of payment, characterized by more transparency and security. However, Tunisian consumers have an “eternal” trust for cash, and even the retailers, the traders and the merchants are reluctant to adopt the bank cards since the number of EFTPOSs sill insufficient due in particular to high commissions. This observation is confirmed by the statistics concerning electronic banking where the number of affiliated merchants increased from 13 958in December 2013 to 19,228in December 2018, an increase of only 37.7%.

Cash is the currency in circulation stocks required for settlement of transactions. Thus, development in payment system have encouraged the use of many noncash instruments in transaction payments.

According to Table 1, the share of cash in M1 in Tunisia has revealed a trend increase to 40.1% of M1 balances in 2018 from 35.3% in 1998. The cash usage still persistent in spite of a small drop in the ratio of cash to M1 which has fallen from 35.4% in

2008 to 34.4% in 2015, showing that cash still the most important means of payment in this country. The second column of the table shows the indicator of cash use: currency in circulation to GDP between 1998 and 2018. The statistics shows that cash to GDP ratios have increased in Tunisia indicating that circulation of coins and banknotes grew faster than nominal GDP, which reflect an increase in cash holdings, and therefore, the frequent use of cash as a competitive means of payment. As illustrated in Table 1, cash holdings per person increases between 1998 and 2018 Which explain the importance of the currency demand in the settlement of the daily transactions in Tunisia in spite of various innovations in the payment technologies.

2.2. The Noncash Payments Infrastructure In Tunisia

The frequent use of cash by Tunisian households in daily financial transactions is overriding in all socio-demographic categories. For Tunisians, cash is the perfect mean of payment. Moreover, there is no strong influence of the payment technologies innovations on the demand for cash in Tunisia in spite of the development of payment media and the creation of various technical innovations for settling payments. The Tunisian consumers have a high preference for cash usage particularly in small retail payment.

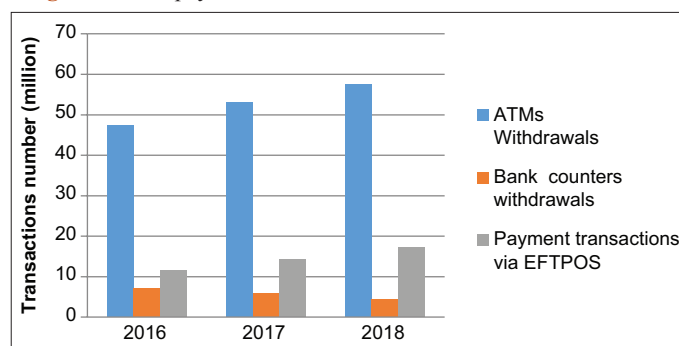
The increased use of ATM between 2016 and 2018 to withdraw cash may explain the higher demand for currency to settle payment transactions, particularly those of low-value transactions. Since cash is most often used for everyday small value retail purchases, bank cards are its closest substitute in modern payment systems. As shown in Figure 1, bank cards are used more frequently for withdrawals more than for payments in Tunisia. The number of cash withdrawals transactions from ATM machines increased from 47.4 million in 2016 to around 53 million operations in 2018. However, the number of cash withdrawal transactions at

Table 1: Indicators of cash use in Tunisia

Year	Cash to M1* ratio (%)	Cash to GDP** ratio (%)	Value of cash holding per capita
1998	35.3	7.9	190.7
2003	38	8.87	285.1
2008	35.4	8.39	446.6
2013	34.7	10.5	692.33
2015	34.4	9.94	779.4
2018	40.1	11.19	1073.1

Source: IFS. *M1 includes the currency in circulation (coins and banknotes) plus demand deposits other than those in central banks. **GDP at current prices

Figure 1: POS payments and cash withdrawals transaction in Tunisia



Source: Central Bank of Tunisia

bank counters decreased from 7.1 million in 2016 to 4.4 million in 2018.

Tunisian consumers withdraw cash more frequently from ATMs than from their bank counters that reflects their preferences of withdrawal options. It is quite common in Tunisia, to see people, especially those having salary from public or private sectors, line up in queue in front of ATM machines in order to withdraw money at the time right after the payday of each month. In this context, it's clear that the ATMs have a determinant role in cash withdrawals in Tunisia and are an important source of cash more than the bank counter. In accordance with this results, it's important to note that the bank counter withdrawals are substituted by ATM withdrawals in Tunisia in the last 3 years

Moreover, the number of payment transactions via EFTPOS increased from 11.5 million operations in 2016 to 17.2 million in 2018, its reflects the development in the noncash payment habits using bank cards in Tunisia which partially replaced cash. Although growth in EFTPOS payment transactions has recently increased, this noncash payment instrument is likely to become increasingly important as the POS terminals network increases. Overall, there is a link between the number of POS terminals and the number of payment transactions. This depends on the density of the EFTPOS network. At the same way, the expansion of ATMs could affect the withdrawal frequencies and therefore the currency circulation.

As illustrated in Table 2, the use of bank cards has been strongly supported by the diffusion of EFT-POS terminals and ATM machines. The number of ATMs and EFT-POS terminals grew at a slower pace. Indeed, ATMs are usually available 24 h a day even in the weekend and are widely dispersed in different regions in Tunisia. The number of ATMs increased at a slowly rate from 2070 to 2694 during the years 2014-2018, representing the fluctuation growth between 8.6% in 2015 and 3.5% in 2018. In a similar way, the number of point-of-sales (POS) increased from 12655 to 21622. This points to the increase of around 2 times during the same period.

Noticeably, the expansion of payment cards in Tunisia has been reinforced by the rapid increase in the number of EFTPOS terminals reflecting the new technology strategy adopted by the commercial banks. For bank cards, its growth reached the highest value in 2018 at 27%. During 2014 and 2018, bank cards growth fluctuated between 12.7% and 27% reaching the lowest value in 2016 at 3.8%. A closer look to the number of bank cards and the number of bank current accounts provides many interesting things.

First, it indicates that the expansion of bank cards in Tunisia has been reinforced by the rapid increase in the number of bank current accounts over the years 2014-2018. In terms of number noncash payment instruments, the number of bank cards (such as the payment cards and the withdrawals cards) progressed from around 3.1 million in 2014 to around 4.6 million in 2018. Second, the number of bank current accounts grew at a slower pace over the period under review. However, it's logical to find that the number of the bank cards is higher than the number of bank current accounts since every customer's bank can hold both types of cards including withdrawal and payment functions.

As seen in Table 3, Check payments have a major share of the total volume of transactions between 2008 and 2018 in Tunisia. The share of check payments has fallen only a little from 68.7% to 54.5% during the same period. These statistics show that check is a competitive payment product and is mainly used for small and large value retail payments.

Moreover, the share of bank cards payments increased significantly from around 0.5% in December 2008 to around 7% in December 2018. This suggests that card payments have partially replaced checks in low value retail payments in Tunisia that have historically strongly used checks. According to this, the diminishing share of checks in noncash transactions has mainly benefited bank cards and transfers payments, while the share of debits transactions in the total volume of payment transactions has been relatively stable. The share of commercial papers payments is decreased at a slower pace from around 14.2% in December 2008 to around 13% in December 2018. Whereas, the share of the electronic payments is negligible. Technological innovation has largely influenced the volume of electronic transactions, the volume of these transactions remain to be modest increasing from 0.03% to 0.08% during the period between 2008 and 2018.

3. DATA, MODEL SPECIFICATION AND ESTIMATION METHOD

3.1. Data And Model Specification

In this section, we analyze the degree to which some forms of noncash payment instruments would substitute cash usage in Tunisia. To this end, to more clearly identify the various effects on the demand for cash, we specify and estimate the following money demand equation using monthly data over the period 2010M12-2018M7 in Tunisia considering the model of Tehranchian et al. (2012):

$$MC_{it} = \rho_i + \alpha1_{it} Y_{it} + \alpha2_{it} R_{it} + \alpha3_{it} ATM_{it} + \alpha4_{it} EFTPOS_{it} + \alpha5_{it} checks_{it} + \alpha6_{it} cards_{it} + \epsilon_{it} \tag{1}$$

Table 2: The number and growth of payment instrument in Tunisia

Year	Number of ATM	Annual change %	Number of EFTPOS	Annual change %	Number of Bank cards*	Annual change%	Number of bank current account**	Annual change%
2014	2070	*	12 655	*	2721166	*	2614705	*
2015	2249	8.6	12 991	2.65	3066792	12.7	2857676	9,29
2016	2385	6.04	13 510	3.99	3185 935	3.8	2974429	4,08
2017	2602	9.09	18 919	4	3655 026	14.7	3108370	4.5
2018	2694	3.53	21622	14.28	4640 237	26.9	3279143	5.4

Source: Central Bank of Tunisia. *Number of payment cards and the withdrawals cards. **Number of the current accounts and the checking accounts at the banks

Table 3: Percentage shares of the total volume of the payment transactions in Tunisia (% of the volume of transactions)

Payment instruments	December 2008 (%)	December 2018 (%)
Check payments	68.7	54.5
Commercial papers	14.2	13
Transfers	12.2	19.6
Debits	4	5.7
Bank cards payments	0.5	7
Electronic payments	0.03	0.08

Source: Central bank of Tunisia

Where MC is the real money holdings defined by currency (banknotes and coins) in circulation outside the banking sector, Y is the real income represented by the index of industrial production as a proxy for performance of the economy since monthly data on GDP is not available, R is the nominal short-term rate of interest which is presented by 3 months money market rate, ATM is the the number of automatic teller machines, EFTPOS is the number of electronic funds transfer per point of sale, checks is the volume of transactions made by checks, cards is the volume of transactions made by national bank cards in circulation (payment cards and ATM cards), ϵ_{it} is the error term and α_1 is the estimated constant. The consumer price index is used as the price variable. While the other variables typically enter in logarithms, the interest rate variable is used in levels.

The demand for currency is expected to be positively influenced by the real income and negatively influenced by the opportunity cost variable, the monetary market rate. The demand for cash is expected to decline as transaction technology improves thereby reducing the need for cash. In this regard, the number EFTPOS terminals is expected to be negatively related to currency demand while the number of ATMs may be positively or negatively related to the demand for currency. The relationship between cash usage and ATMs is theoretically ambiguous: Greater number of ATMs strongly increases the demand for cash since it can be easily accessed. On the other hand, more ATMs could reduce the currency demand since individuals can minimize the opportunity cost of transfers between currency and other bank deposits as reported in Drehmann et al. (2002). The volume of transactions made by checks and bank cards in circulation are expected to be negative.

All the data used in this study are collected from the International Financial Statistics (IFS) database, the Tunisian Central Bank, the national institute of statistics and the Tunisia’s Professional Association of Banks. The choice of sample countries is based on data availability covering the period of study.

3.2. Estimation Method

To examine short- and long-run effects of payment technology innovations on the demand for cash, method of auto regressive distributed lag (ARDL) is employed. The ARDL cointegration approach developed by Pesaran and Pesaran (1997) and Pesaran et al., (2001) has several advantages has several advantages over the well-known residual-based approach proposed by Engle and Granger (1987) and the maximum likelihood-based approach proposed by Johansen and Julius (1990) and Johansen (1992).

The ARDL approach provides unbiased estimates of long-run model and valid t-statistics, even when some of the regressors are endogenous. In addition, a dynamic error correction model can be derived through a simple linear transformation in the ARDL model. Moreover, it does not depend on pre-testing the order of integration of the variables, hence it is free from unit-root pre-testing and can be applied regardless of whether variables are I(0) or I(1) or mutually cointegrated. ARDL method simultaneously estimates the short-run and long-run patterns in model, and eliminates the problems of endogeneity and autocorrelation that why the estimations using ARDL approach are unbiased and efficient (Siddiki, 2000).

The short-and long-run parameters with appropriate asymptotic inferences can be obtained by applying OLS to ARDL with an appropriate lag length. For example, equation (1) can be re-written as an ARDL model depicted below in equation (2):

$$\Delta(MC)_t = \alpha_0 + \sum_{i=1}^n \alpha_{1i} \Delta MC_{t-i} + \sum_{i=1}^n \alpha_{2i} \Delta Y_{t-i} + \sum_{i=1}^n \alpha_{3i} \Delta R_{t-i} + \sum_{i=1}^n \alpha_{4i} \Delta ATM_{t-i} + \sum_{i=1}^n \alpha_{5i} \Delta EFTPOS_{t-i} + \sum_{i=1}^n \alpha_{6i} \Delta checks_{t-i} + \sum_{i=1}^n \alpha_{7i} \Delta cards_{t-i} + \beta_1 MC_{t-1} + \beta_2 Y_{t-1} + \beta_3 R_{t-1} + \beta_4 ATM_{t-1} + \beta_5 EFTPOS_{t-1} + \beta_6 checks_{t-1} + \beta_7 cards_{t-1} + \mu_t \tag{2}$$

Where, Δ is the first difference operator, β is the drift component, and μ the error term. The coefficients ($\beta_1 - \beta_7$) represent the long-run relationship whereas the remaining expressions with summation sign ($\alpha_1 - \alpha_7$) represent the short-run dynamics of the model.

The bounds test used to determine the presence of cointegration among the variables is based on the wald test or the F-statistic test and follows a non-standard distribution (Pesaran et al., 2001). Under this, the null hypothesis of no cointegration is tested against the alternative of cointegration regardless of whether the regressors are I(1) or I(0) as follows:

$$H0: \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = \beta_7 = 0$$

$$H1: \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq \beta_5 \neq \beta_6 \neq \beta_7 \neq 0$$

Pesaran et al. (2001) provide the two sets of critical values in which lower critical bound assumes that all the variables in the ARDL model are I(0), and the upper critical bound assumes I(1). For this purpose, we first carried out the unit root tests to see the degree of integration of the selected variables. If the calculated F-statistics is greater than the appropriate upper bound critical values, the null hypothesis is rejected implying the existence of cointegration between the variables. If such statistics is below the lower bound, the null cannot be rejected, indicating the lack of cointegration. After establishing the evidence of the existence of the cointegration between variables, the lag orders of the variables are chosen by using the appropriate Akaike Information Criteria (AIC) or Schwarz Bayesian Criteria (SBC).

If cointegration is established, then long run results and short run results can be generated. The short run results include the error correction term that shows how much disequilibrium is eliminated

in each short run period. For cointegration to exist, the error correction term is expected to be negative and significant. Thus, the error correction version of the ARDL model pertaining to the equation (2) can be expressed as:

$$\Delta(MC)_t = \alpha_0 + \sum_{i=1}^n \alpha_{1i} \Delta MC_{t-i} + \sum_{i=1}^n \alpha_{2i} \Delta Y_{t-i} + \sum_{i=1}^n \alpha_{3i} \Delta R_{t-i} + \sum_{i=1}^n \alpha_{4i} \Delta ATM_{t-i} + \sum_{i=1}^n \alpha_{5i} \Delta EFTPOS_{t-i} + \sum_{i=1}^n \alpha_{6i} \Delta checks_{t-i} + \sum_{i=1}^n \alpha_{7i} \Delta cards_{t-i} + \lambda EC_{t-1} + \mu_t \tag{3}$$

Where λ measures the speed of adjustment parameter and EC is the residuals that are obtained from the estimated cointegration model of equation (2).

4. EMPIRICAL RESULTS AND DISCUSSION

We initially tested the order of integration of the variables using the unit root tests: the augmented Dickey–Fuller (ADF) by Dickey and Fuller (1981) and the Phillips–Perron (PP) by Phillips and Perron (1988).

In all cases, the two unit root tests have been applied for both levels and their first differences. The computed test statistics for the levels and first differences of the variables are illustrated in Table 4. All variables were found to have a unit root at the levels but not in their first differences, i.e. (I(1)). The ARDL approach to cointegration, therefore, may be the most appropriate method for this analysis since the variables are I (1).

After testing for the order of the integration of the variables, the next step is to perform the ARDL bounds test to test the existence of only one long run relationship between the dependent variable and the exogenous variables (Pesaran et al., 2001). In this context, two conditions must be fulfilled. First, there should be a long-run relationship among the variables, which is assumed by the *F*-statistics. Second, the Error Correction Model ECM should be significant.

The first step and before the estimation of cointegration, the appropriate lag length is required. To this end, we use the Schwartz-Bayesian criterion to justify lag order of each variable in the system. The maximum lag order is set to 4. After setting up the appropriate lag length, the ARDL method is estimated. Table 5 presents the results of cointegration of estimating money

demand function in Tunisia using ARDL approach for equation (2) where the dependant variable is the real money holdings defined by currency (banknotes and coins) in circulation outside the banking sector $\ln MC$.

Panel A shows the diagnostics tests of the short run model. Most short run coefficients of the variables under study have significant and reasonable impact on the demand for cash. The coefficient of real income is positive and significant, it has the expected sign as per economic theory. The coefficient of the interest rate being negative and significant shows the currency substitution effect in Tunisia in the short run under the study period. Importantly, focussing on the issue of new payment instruments in the short run, the coefficients of the number of automatic teller machines and bank cards are positive and increase the demand for cash. However, the coefficient of point-of-sale terminals and cheks, as expected, are negative and reduces the demand for currency.

The results of the long-run normalized coefficients are presented in Panel B. As shown in Table 5, we found that there is a positive and a significant effect of the demand of currency on the income variable in Tunisia (1.025). This may reflects the importance of economic activities in influencing the currency demand. The demand for cash is significantly, and positively affected by interest rate. The estimated coefficient on interest rate is around 0,488. This may reflect that a predominant share of cash in circulation is held for transaction rather than a store of value purpose. Also, the coefficient of ATMs is positive and statistically significant (0.15), increasing weakly the needs for currency. This confirms the direction towards the ATMs to withdraw cash which led to a growing demand for currency to settle payment transactions, particularly those of low-value, or for unexpected defenses. This evidence appears to remain a fairly positive interaction between the number of ATMs and the demand for cash in Tunisia. In this context, findings of such, positive impact of ATM terminals on cash demand explained by the increased ease of receiving cash have been further reported in Hataiseree and Banchuen (2010) and Tehranchian et al. (2012).

In Tunisia, the ATM transactions have generally increased in step with ATM expansion strategies that encourage benefits of holding bank cards which enhances their use reflecting the attractiveness of cash as a mean of payment.

Interestingly, we also find a significant and negative influence of EFT-POS terminals on currency demand (-0,04). It should be noted, that a rise in the density of EFT-POS terminals decreases the cash usage in Tunisia reflecting the substitution wave of credit and debit cards payments for cash. This results show that tunisian consumers consider cash usage as an inexpensive instrument to pay, compared to paying with banking cards. This finding partly explains the low usage of electronic payment cards in point-of-sale (POS) because the no availability of these machines everywhere in many areas in Tunisia and also for the strong preference for cash payment in the retail stores and other outlets. Thus, in long run too, our findings support the results of Snellman et al. (2000), Drehmann et al. (2002), Rinaldi (2011) and Tehranchian et al. (2012). The coefficient of bank cards is positive and statistically significant

Table 4: Unit root test results

Variables	ADF test statistics		PP test statistics	
	Levels	First difference	Levels	First difference
MC	-1.426	-4.700***	-1.45122	-4.87052***
Y	-1.507	-4.648***	-1.21939	-5.12834***
i	-1.176	-6.398***	-1.33075	-7.70353***
ATM	-1.883	-4.073***	-2.18240	-4.56724***
EFTPOS	-1.558	-4.833***	-1.56587	-6.47155***
Checks	-0.219	-5.111***	-3.27215	-4.97547***
Bank Cards	-1,456	-6.975***	-1.444674	-7.75639***

Source: Calculated by author. H_0 is that the variable has a unit root. *** ** and * denote rejection of the null hypothesis at the 1%, 5% and 10% significance level

Table 5: The impact of noncash payment on currency demand in Tunisia using linear ARDL method (dependant variable MC)

Panel A: Short-run coefficient estimates							
Lag order	$\Delta \ln M$	$\Delta \ln Y$	Δi	$\Delta \ln ATM$	$\Delta \ln EFTPOS$	$\Delta \ln Checks$	$\Delta \ln Cards$
0	-	0.03275 (0.07293)	-0.04285 (0.02111)	0.09124 (0.1131)	-0.38352 (0.0830)	-0.12527 (0.06608)	0.29134 (0.1158)
1	0.05408 (0.0834)	0.10331 (0.06258)	-0.00208 (0.02166)	0.01853 (0.0064)	0.18792 (0.0972)		
2	-0.0295 (0.0845)	0.09925 (0.06425)	-0.03882 (0.02109)	0.07602 (0.1267)			
3	0.00547 (0.0953)	0.06717 (0.06308)	-0.29134 (0.11587)				
4	0.19983 (0.0750)						
Panel B: Long-run coefficient estimates							
$\ln Y$	$\ln i$	$\ln ATM$	$\ln EFTPOS$	$\ln Checks$	$\ln Cards$	c	
1.0252 (0.00)	0.48830 (0.1249)	0.15226 (0.0989)	-0.04584 (0.0507)	-0.49617 (0.4009)	0.10831 (0.0084)	15.9858 (0.000)	
Panel C: Diagnostic statistics							
F	ECM	R2	BG LM	BPG	RESET	JB test	
4.441	-0.176 (0.06)	0.99	3.774 (0.15)	17.696 (0.65)	1.383 (0.33)	2.399 (0.12)	

Source: Calculated by author. Selected model: ARDL (4,3,3,2,1,0,0). Values in parentheses are probability values; \ln stands for natural logarithm; Δ stands for the first difference operator. F is the bounds test, the lower and upper critical bounds values of the F statistic at the 5% level of significance are 2.431 and 3.518, respectively. Critical values are obtained from Narayan (2005) (Unrestricted intercept and no trend). BG-LM is the Breusch Godfrey Serial Correlation Lagrange Multiplier test; RESET is Ramsey's regression specification error test; JB is the Jarque-Berra test; and BPG is the Breusch-Pagan-Godfrey test for heteroscedasticity

(0.108) reflecting the frequent use of ATM cards to receive cash in Tunisia. These results may be explained by the dominance of the ATM cards usage than the use of the cards payments in Tunisia. In this regards, the electronic transfer of funds is made more by ATMs, which have been installed more for receiving cash in the banks, than the EFT-POS terminals usage. However, the checks payment has a negative sign, although it is not statistically significant.

As presented in Panel C, the results indicates that the value of the F -statistic, is equal to 4.441, for joint significance of lagged level variables is higher than its critical upperbound at 5% significance level. This implies the existence of cointegration among the currency demand and its determinants. Besides, the speed of adjustment is 17.6% per month. The error correction coefficient is negative and significant showing that short-run fluctuations are attributed to the long-run equilibrium values and improve the hypothesis of presence of cointegration. The various diagnostic tests presented in the table shows the robustness of the model since there is no diagnostic problem with the model. The BG-LM test indicates that there is no serial correlation problem. Also, there is no heteroscedasticity, no functional form misspecification and the residuals are normally distributed.

5. CONCLUSION AND POLICY IMPLICATIONS

This study has examined the relationship between cash use and the development of electronic payment methods in Tunisia. Evidences so far tend to suggest that technological more advanced means of payments has shown a promising development in Tunisia, although the pace of the new payment instruments usage have yet to quicken since cash still the more used instrument retail 's payment.

In this study, the ARDL approach was used to estimate the short-run and long-run impact of currency demand on non cash

payment instrument in Tunisia over the period 2010M12-2018M7. Apart from standard macroeconomic variables like real income and interest rates, some proxy variables related to methods of electronic transfer, such as ATMs (automated teller machines), EFTPOS terminals (electronic funds transfer at the point of sale), electronic bank cards and check, which are also incorporated into the model to analyse this sort of possible interaction of cash-noncash instruments substitution in Tunisia.

On our evidence, we found that modern payment technologies have little impact on currency usage in Tunisia. The results showed that the number of ATMs and the volume of bank cards transactions tend to increase the demand for currency while both the number of EFTPOS and the volume of check transactions negatively influence the demand for cash, though neither effect is highly significant. In this context, the electronic transfer of funds are increasing as the number of ATMs and POS terminals rises. However, checks still a popular cashless method of transfer for tunisians in volume terms despite it is not statistically significant. Furthermore, according to the findings of this study, the demand for cash as a means of payment has been strong in Tunisia. Therefore, it should be noted in this regards that despite the development of payment systems, cash remains an important means of carrying out transactions. Subsequently, as thus confirmed by Drehmann et al. (2002), our results confirm that new payment technologies do not pose a threat to the use of cash in Tunisia.

Although the new electronic payment technologies have many advantages, several elements hinder their development in Tunisia. Indeed, electronic payments raise issues of security and privacy protection and freedoms, as well as hackers who try to penetrate the bank accounts of electronic payment systems and to carry out thefts there by transfers to other accounts from electronic traces to find personal data. In this context, the Tunisian government's Digital project held in 2020 aims to develop more the digital finance to enable users to pay for services electronically and to insure the

security of the payment systems. The strongest advantages of cash over other means of payment, cashless or electronic, is that it is safe as a medium of exchange, cheaper, safer and more anonymous.

Our findings suggest that currency will not be completely replaced by more advanced electronic transfers and e-moneys of assorted varieties in Tunisia due to infrastructure of Tunisian's economy and the payment consumers's choices which prefers frequently cash usage. This finding may be explained by the expansion of the size and the forms of informal economy (grey or parallel economy) that are ever-growing in Tunisia, it needs the anonymity for the holder or the user who is engaged in activities in this type of markets to satisfy the ordinary consumption expenditure transaction needs. So cash still the most anonymous means of payment demanded in this type of markets which tunisian's consumer can never won't give up on him.

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