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Is There Any Nexus between Electronic Based Payments in Banking and Inflation? Evidence from India

Kalluru Siva Reddy[1] & Durairaj Kumarasamy[2]

[1] Gokhale Institute of Politics and Economics, Pune, India

[2] ASEAN India Centre, Research and Information System for Developing Countries (RIS), New Delhi, India

Correspondence: Kalluru Siva Reddy, Gokhale Institute of Politics and Economics, Pune, 411004 India. Tel: 020-2565-0287. E-mail: sivareddykalluru@gmail.com

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Abstract

This paper throws a light on the nexus between electronic payments in banking and inflation. Payments for goods and services are made by using different electronic payment modes such as credit cards, debit cards, and electronic transfers. There is a perception that large use of electronic channels for payments has the potential to substitute cash for payments in retail transactions and increase velocity of money by both reducing the transaction costs and enhancing the liquidity of financial assets. An increase in the velocity of money would plausibly inflate general prices that have adverse effect on economic system in the country. In this context, we make an attempt to examine the relationship between electronic payments and inflation in India, using cointegration and error correction framework for the period August 2007 to March 2013. We find that both inflation rate and economic growth lead to electronic payments. Particularly, inflation rate contributed in both short-run and long-run relationship, whereas economic growth has long run association with electronic payments. Electronic payment system has potential to expand further and fulfill the need of the people as it is driven by both inflation and economic growth in India.

Keywords: electronic payments, inflation, cointegration, granger causality, India

1. Introduction

Financial innovations influence velocity of money by both reducing the transaction costs and enhancing the liquidity of financial assets. Large use of debit/credit cards allows flexibility to economise on non-interest bearing cash and unused credit limits in credit cards work as a substitute to cash. Majority of the new payment channels for utility bills such as electricity, water and gas and dividends use direct debit and direct credit modes, respectively. These are done through Electronic Clearing Service (ECS) which also economise on the use of cash and could affect money velocity (Pattanaik & Subhadhra, 2011). Many people make payments for goods and services through electronic cards, not in cash.

Several studies such as Zandi and Singh (2010), Abednego and Apriansah (2010), Schoellner (2002), Geanakoplos and Dubey (2010) and others argue that electronic payments increase volume of monetary transactions, which would lead to an increase in the velocity of money in the economy. The increase in the velocity of money will have a direct impact on general price levels and hence it would push the economy towards higher inflation. On the other hand, Yang and King (2011) argued that credit card banks do not create money and cannot affect either the aggregate money demand, or the money supply, thus having no effect on velocity on money. Parker and Parker (2008), Marimon et al. (1997) and others observed a decrease in velocity of money after the introduction of electronic money. However, Patrick (1999) observed mixed results.

In the light of the rather inconclusive empirical results and recent inflationary trends in India, the present study attempts to examine whether the increase in use of electronic based payments in banking causes higher inflation in India. To the best of our knowledge, not a single study has focused on this issue in India. To examine the relationship, we use time series models such as Johansen Cointegration, VECM and Variance decomposition technique for the period August 2007 to March 2013. The study is important from both macroeconomic and microeconomic points of view. From the macro view, the banks are the transmitters of monetary policy and facilitators of the nation's payment system. Any change in payment system affect the very basic objective of monetary policy and overall stability of financial markets. From the micro point of view, the use of information technology in banking is crucial, especially for emerging economies like India, whose principal objective is financial inclusion, which warrants serving the rural and unbanked areas more inclusively and efficiently. Further, higher economic growth also raises the incomes of people which increases their purchasing power and thus stimulates more transactions in the economy that in turn increase usage of different electronic payment instruments.

The remaining paper is organised as follows: Section 2 describes recent trends in electronic payments and inflation in India. Section 3 reviews the earlier studies related to the study area. Section 4 provides methodology and data for the study. Section 5 discusses the empirical results and discussions. Section 6 contains a summary and policy implications of our findings.

2. Trends of Electronic Payment Systems and Inflation in India

Globally, electronic payments grew at 8.8 percent in 2011 to reach 307 billion transactions. Particularly, mature markets like North America, European Union and selected Asia-Pacific countries accounted for 77 percent of the total global volume transactions. However, the growth rate of electronic payment transactions is higher in the developing markets including India and China at about 18.7 percent in 2011 to that of growth rate of 6.2 percent for the mature market (World Payment Report, 2012). According to the Committee on Payments and Settlement Systems (CPSS) as of 2012, in terms of volume of electronic transactions in payment instruments (non-cash), India (with credit transfers at 6.9 percent and direct debit transfers at 2.1 percent) is below average among the CPSS countries but above countries like Singapore and Saudi Arabia. Further, in terms of percentage of transactions in cheques and cards, India is far above the average of CPSS countries with 17.5 percent and 74.9 percent respectively. In terms of value of transactions (non-cash), India is below average among the CPSS countries but above some of the countries like China, Brazil and Italy (Bank for International Settlement, 2012).

Indian banking sector has undergone substantial changes from a heavy regulated system to liberalized market system similar to those witnessed in the banking systems of developed and emerging economies from 1992. Prior to that almost all the payments in the country were being made through paper based systems like cash, cheques and drafts. Even though few committees recommended for the use of technology in banking operations in early 1990s, its pace accelerated only after 1992 onwards (Note 1). With the advancement of information technology and product innovations, new services such as Automatic Teller Machines (ATM), Credit Cards, Debit Cards, Tele Banking, Call Centres, Core Banking Solutions (CBS), Internet Banking, Mobile Banking, etc. have emerged in the banking sector. They provide faster, cost effective and secure payment mechanism to the customers in comparison to the paper based payment system. These services have resulted in a reduction in customer visits to banks for important routine bank services like depositing money, withdrawing money, balance enquiry, account statements, transfer of funds, cheque book request, etc. Further, the introduction of Electronic Clearing Service (ECS), National Electronic Funds Transfer (NEFT) and Real Time Gross Settlement (RTGS) has led to an unprecedented change in the payment and settlement systems. Thus, electronic payments have drastically reduced the time taken for doing a transaction by facilitating transfer of money without visiting bank branches.

As a result, the share of electronic based non-cash payments has increased significantly over the period. By October 2012, electronic non-cash payments accounted for about 53.88 percent in volume and 92.19 percent in value (see Figure 1). By the end of March 2013, the scheduled commercial banks issued about 19.5 million credit cards and 331.2 million debit cards; and placed about 55,760 on-site ATMs and 58,254 off-site ATMs. This shows a very significant surge in the usage of these products across various channels like debit and credit cards, ATMs, point of sale, e-commerce, m-commerce, Interactive Voice Response, etc.

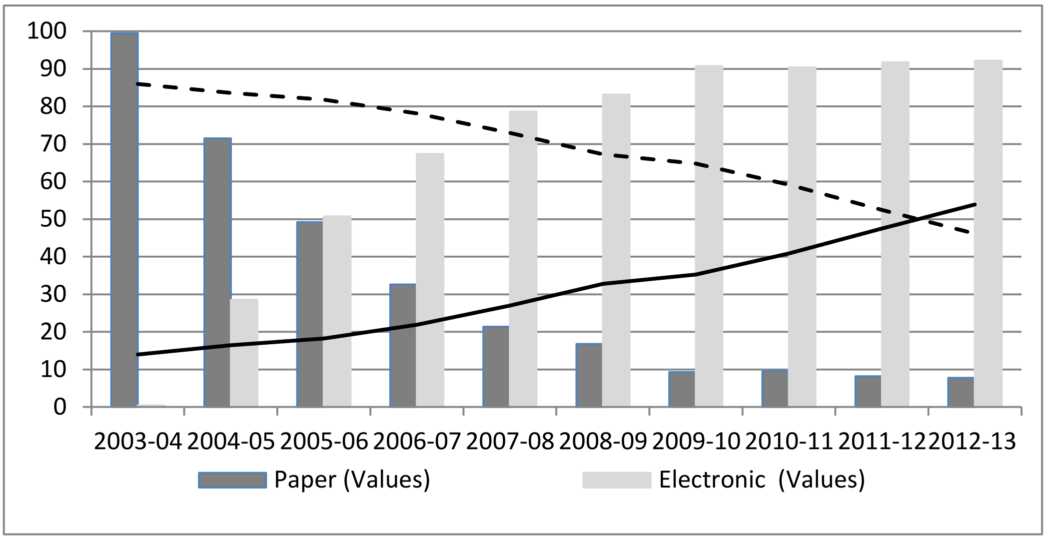

Figure 1. Share of paper and electronic money transactions in total transactions (both in volumes and values) in India (%)

Source: RBI.

On the other side, India is second fastest growing economy in the world next to China, with the annualised growth rate of about 7.54 percent over 2001-2012 and thus India's performance is impressive on growth front. Besides, India experienced high inflation rate of about 6.0 percent over 2001-2012 period and it was about 6.6 percent for the period 2006-2012. India's higher inflation rate scenario is not only higher among the advanced economies, but also in many developing countries in Asia, especially East Asia (GOI 2011). As India experienced higher economic growth along with high inflation rate in the late 2000s, the monetary policy in general and technological innovation in Indian banking system in particular facilitate the rapid real economic growth but by keeping general price level under control. Figure 2 evidences that wholesale price index (WPI) and electronic payments (both volumes and values) in banks seem to be correlated in India as their movement is similar along with the index of industrial production (IIP) over the period. However, one has to understand this relationship empirically.

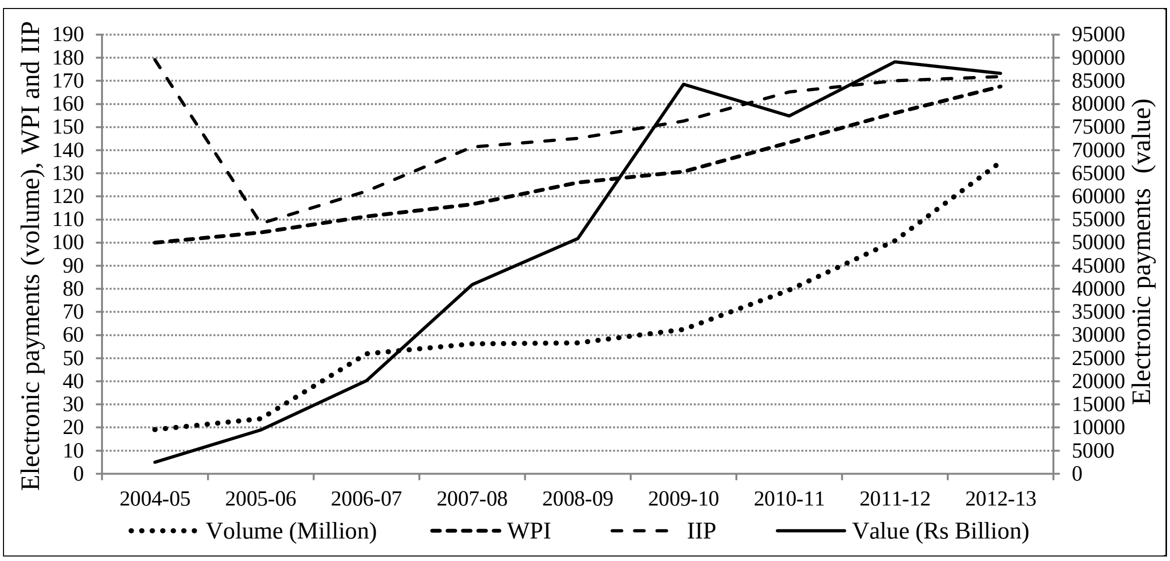

Figure 2. Movement of electronic payments (volume and value), wholesale price index (WPI) and index of industrial production (IIP)

Source: RBI.

3. Literature Review

The use of technology has broader implications for an economy. Technology is the result of higher growth of the global economy and has led to structural change at all levels (Chakrabarty, 2010). Jorgenson and Stiroh (1999) provides empirical evidence that information technology could be a substitute for other type of capital and labour inputs, and it has contributed to a significant extent to the growth of the total output of US. Similarly, on examining the impact of information technology on economic performance of US and Europe, Timmer et al. (2003) observed that the economy performed better in the period where investment in information technology was high. He further stated that the countries which invested relatively higher amount in information technology have done better in terms of higher economic growth and total factor productivity than the countries which did not. Further, Jorgenson and Khuong Vu (2007) examined the impact of investment in information technology on the recent resurgence of world economic growth in seven geographical regions and found that the investment in information technology for economic growth has increased in all the regions, but such growth was significant in industrialised economies and developing Asia.

However, empirical studies on the effects of electronic payment instruments on the economy observed rather mixed results. Studies in this context argued that technology in the form of electronic based payments increases volume of monetary transactions and has consequences on inflation and economic growth. Zandi and Singh (2010) studied the impact of electronic money in the form of credit cards in 51 countries and found that 1 percent increase in card usage increased consumption by 0.039 percent and GDP by 0.024 percent. The impact was little higher in developed countries by 0.041 percent and 0.025 percent respectively, while in the developing countries, including India, it was 0.031 percent and 0.01 percent respectively.

Further, Abednego and Apriansah (2010) observed that electronic money can change the money demand function and reduce the average amount of cash held with public which in turn would increase the circulation of money in the economy. Thus, increase in the velocity of money. Similarly, Schoellner (2002) also observed that higher credit card usage reduces the cash in hand with consumers and increases the balances in their checking and savings accounts. It also found that higher revolving credit and outstanding consumer credit was associated with more transitory monetary policy shocks.

Geanakoplos and Dubey (2010) observed that the use of credit cards not only increases trading efficiency, but also increases the velocity of money, which in turn causes inflation in the absence of monetary intervention. If there is any default on the part of credit card holder, there is even more inflation and less efficiency gains as monetary authority tries to correct the situation by reducing the money supply, whereby the volume of trade and utilities would fall.

Besides, Mbiti and Weil (2011) observed that M-Pesa, Kenya's dominant mobile money transfer service, has actually increased the individual number of transfers and velocity of money. The velocity of M-Pesa ranged between 11.0 and 14.6 transactions per month, much higher than the situation prior to the introduction of M-Pesa and even higher than other competitive products of transfer channels.

The above findings are further strongly supported by African Development Bank (2012) on inflation dynamics in selected East African Countries. The study observed that M-Pesa has fuelled inflation as it increased the speed of monetary transactions, while increasing cash in circulation, bringing more people into the formal financial system and leading to demand for goods and services exceeding supply, and finally influencing the implementation of monetary policy.

Additionally, Benjamin (2001) argued that increase in electronic money adds further difficulty to central banks in controlling monetary aggregates and thus prices. Similarly, Aleksander (1997), for US and Europe, found that digital money could eventually replace the entire stock of central bank currency and thus complicates the implementation of monetary policy. Electronic money reduces demand for transaction deposits, increases the pressure on central banks to reduce the number of reservable liabilities and to lower reserve ratios, which could increase volatility in the income velocity of base money. Misati et al. (2010) also observed that innovations in payment technology had dampened interest rate channel in monetary policy transmission and posed challenges to the central bank in conducting monetary policy.

On the other hand, Parker and Parker (2008) observed down trend in velocity of money, linked to the definition of money supply and pessimistic nature of people about future, after the introduction of technology in banking in Finland. Marimon et al. (1997) observed that electronic money competition can discipline a revenue maximising government and result in lower equilibrium inflation rates, even when there is imperfect commitment. However, Yang and King (2011) argued that unlike commercial bank, credit card banks do not create money and cannot affect either the aggregate demand for, or the supply of money, thereby having no effect on velocity on money.

On the other hand, Patrick (1999) found mixed effects of payment technologies on money supply and demand in US.

4. Data and Methodology

The required data is collected from Database on Indian Economy, RBI's data warehouse. We use three variables: (i) electronic based payments which is the sum of RTGS, retail electronic clearing (i.e. Electronic Clearing Service, National Electronic Funds Transfer and Interbank Mobile Payment Service), credit cards and debit cards. This variable represent in two forms: a) electronic payment transactions in volume (EPVOL); and b) electronic payment transaction in values (EPVAL). These variables are alternatively used in the analysis; ii) wholesale price index (WPI) is used as a proxy for inflation; and iii) index of industrial production (IIP) is used as a control variable for accounting for the growth of the economy. All the variables are in 2004–05 prices, thus are in real prices and then converted into natural logarithm. Both EPVOL and EPVAL data are available from March 2004 onwards; however, due to consolidation errors in the data, there is a peculiar shock in the data for the period from July 2006 to August 2007 for EPVOL (Note 2) (see Figure 3). Therefore, we could not utilise all available data and are constrained to the period from August 2007 to March 2013 for the analysis.

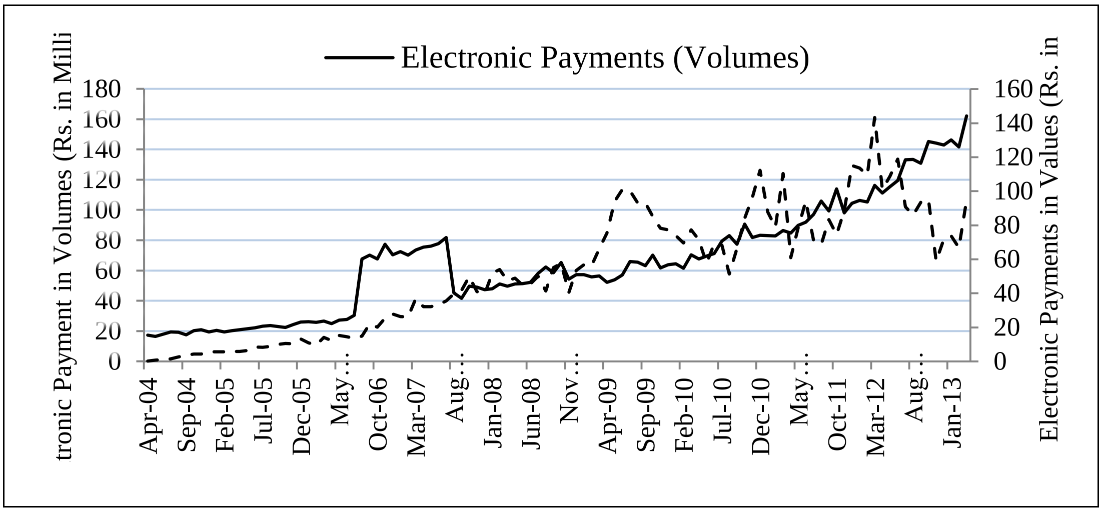

Figure 3. Electronic payments transactions (volumes and values)

Source: RBI.

First, we used Augmented Dickey-Fuller (ADF) and the Phillips Perron (PP) tests to test the stationery of the data series. The null hypothesis tested is that the variable under investigation has a unit root against the alternative that it does not. In each case, the lag-length is chosen using the Akaike Information Criteria (AIC) after testing for first and higher order serial correlation in the residuals. Individual time series may not be stationery, but there may be possibilities of linear combination among the variables, which means that non-stationery time series may result in stationery relationships if the variables are cointegrated (Enders, 2010).

Second, for the purpose of examining the existence of a long run relationship among the selected variables, Johansen and Juselius (1990) cointegration technique is employed. Johansen (1988) and Johansen and Juselius (1990) propose two test statistics for testing the number of cointegrating vectors. In this method, the null hypothesis of *r* cointegrating vectors is tested against the alternative of *r+1* cointegrating vectors. Thus, the null hypothesis $r = 0$ is tested against the alternative that $r = 1$, $r = 1$ against the alternative $r = 2$ and so forth.

Third, Granger (1988) points out that if there is a cointegrating vector among variables, there must be causality among these variables in at least one direction. Therefore, we estimate the following Vector Error Correction Model (VECM) to determine the causal relationship among variables. Specification of the model is as follows:

$$\Delta\begin{bmatrix} EPVOL \\ WPI \\ IIP \end{bmatrix}_t = \eta_0 + \alpha_i \Delta\begin{bmatrix} EPVOL \\ WPI \\ IIP \end{bmatrix}_{t-i} \ldots\ldots + \alpha_n \Delta\begin{bmatrix} EPVOL \\ WPI \\ IIP \end{bmatrix}_{t-n} + \lambda_n ECM_{t-1} + \xi_t \quad (1)$$

$$\Delta\begin{bmatrix} EPVAL \\ WPI \\ IIP \end{bmatrix}_t = \eta_0 + \alpha_i \Delta\begin{bmatrix} EPVAL \\ WPI \\ IIP \end{bmatrix}_{t-i} \ldots\ldots + \alpha_n \Delta\begin{bmatrix} EPVAL \\ WPI \\ IIP \end{bmatrix}_{t-n} + \lambda_n ECM_{t-1} + \xi_t \tag{2}$$

Where, $\eta_0$is the vector of constant terms, $\alpha_{i=1\ldots.s}$ are parameters and $\lambda_{n=1\ldots.j}$ is cointegration vector and ξ_t=*NI (0, 1)*. Akaike Information Criterion (AIC) is employed to determine the number of lagged terms in the model, as direction of relationship may depend on the number of lagged terms involved.

Engle and Granger (1987) and Toda and Phillips (1993) argued that if X_t and Y_t are cointegrated, the lagged ECM (Error Correction Mechanism) term needs to be included in the VECM. Because the failure to include lagged ECM will lead to misspecification of the model which may in turn lead to erroneous conclusions about the direction of causality. Therefore, if Y_t and X_t are I(1) and cointegrated, causality tests can be carried out using (1) and (2). The causality of Y_t by X_t can be tested in three ways: 1) by a simple *t*-test of the coefficient of the lagged ECM term provides the long run relationship through short run dynamics between X_t and Y_t; (2) by a joint Wald *F*-test of the significance of the sum of the lags of X_t to identify the short run causal relationships from X_t to Y_t; and (3) by a joint Wald *F*-test of the X_t and lagged ECM terms to obtain the source of causation for the long run relationships. Similar procedures are followed to test the causation of X_t by Y_t.

The Granger-causality tests indicate only the existence of causality, however, they do not provide any indication on how important is the causal impact, say the impact of LWPI and LIIP on LEPVOL and LEPVAL. For instance, if there is a shock to LWPI, it would also be interesting to know by how much this shock will affect the growth rates of LEPVOL and LEPVAL respectively. Further, it is very important to know how long the effect of such a shock will last. Therefore, to capture this, we decompose the variance of the forecast-error of all the variables into proportions attributable to innovations in the respective variable in the system including its own.

5. Empirical Results and Discussions

Prior to estimation, all the variables are tested for stationarity and the results are reported in Table 1. Both ADF and PP unit root tests results suggest that the variables are integrated of order one (i.e., I(1)). This implies the possibility of cointegrating relationships.

Table 1. Unit root tests

Variables	**ADF**		**PP**	
	Levels	**1ST Diff.**	**Levels**	**1ST Diff.**
LEPRVAL	-2.44	-4.13*	-2.83***	-11.58*
LEPVOL	-0.28	-9.82*	-0.10	-9.80*
LWPI	0.27	-5.51*	0.26	-5.72*
LIIP	-1.20	-4.63*	-2.26	-16.06*

Notes. * and *** indicate 1 % and 10 % level of significance.

5.1 Co-Integration Tests

Table 2 provides the results for Johansen and Juselius (1990) cointegration tests based on ECM using an optimum lag length. To choose appropriate lag length and to ensure the errors are approximately white noise, we employed Akaike's Final Prediction Error criterion which supported optimum lag length of 6 lags for EPVOL model and 7 lags for EPVAL model respectively. Further, we also tested for normality and absence of serial correlation in the residuals in Vector Auto Regression (VAR) to ascertain that none of these factors violates the standard assumptions of the model. Results from both the trace and max tests indicate that the variables in the system are cointegrated. For instance, we found two possible cointegration relationships among EPVOL, WPI and IIP and one possible cointegration relationship among EPVAL, WPI and IIP. However, it does not point out the direction of long run and short run causality among the variables. Therefore, to determine the direction of causality, we employ VECM.

Table 2. Johansen co-integration test

Models for EPVOL				
Cointegrating rank (r)	*Eigen Value*	*Optimal Lag*	*Trace Statistic*	*Max-Eigen Statistic*
r = 0	*0.73*	6	*122.62****	*87.80****
r < 1	*0.38*		34.81***	*32.84****
r < 2	*0.03*		*1.97*	*1.97*
Models for EPVAL				
r = 0	0.26	7	31.53***	20.81**
r < 1	0.13		10.72	9.4
r < 2	0.02		1.28	1.3

Notes. *** and ** indicate 1 and 5% level of significance respectively.

5.2 Results of Granger-Causality

Before testing for Granger causality, we conducted the following six diagnostic tests on the VECM, namely, Lagrange Multiplier (LM) test for serial correlation, Ramsey RESET test for suitable functional specification, Jarque-Bera normality test for normalisation of errors, White's test for heteroscedasticity, D-W test for presence of auto correlation and the R^2 test for testing overall goodness of fit of the model. Table 3 reports the results of diagnostic tests on the residuals from each equation. As it can be seen, the residuals from all equations pass the tests at 95% significance levels and hence, there is no significant departure from the standard assumptions.

Table 3. Diagnostic tests of the estimated VECM model

	Models for EPVOL			Models for EPVAL		
	EPVOL	WPI	IIP	EPVAL	WPI	IIP
R^2	0.52	0.27	0.47	0.44	0.31	0.63
Durbin Watson test	2.59	2.13	2.04	1.9	1.9	2.02
Serial Correlation	18.73	18.27	15.1	17.51	18.1	12.03
Functional Form	1.67	0.9	1.72	1.2	0.18	3.21
Normality Test	0.33	1.26	2.35	4.79	1.92	1.49
Heteroscedasticity	0	0.41	6.69**	0.009	0.11	2.3

Note. The figures in the table are Lagrange multiplier statistics for respective test. ** indicates significant at 5 percent.

Table 4 reports the results of the Granger-causality tests. The table presents Joint Wald F-statistic of the lagged explanatory variables of the VECM to explain the short run causality. The t-statistics for the coefficients of the VECM show long-run causal effects. Further, we also provide joint Wald F-statistics for the interactive terms (i.e., the VECMs and the explanatory variables) which gives an indication that which variable is the source of short-run adjustment to re-establish long-run equilibrium, given a shock to the system.

Table 4. Granger-causality test for VECM model

	Short run causality (Wald F-Statistic)				Source of causation (Wald F-statistic)				
	$\Delta lwpi$	$\Delta liip$	$\Delta lepvol$	$\Delta lepval$	*Coefficients of ECMt-1*	$\Delta lwpi$, *ECM*	$\Delta liip$, *ECM*	$\Delta lepvol$, *ECM*	$\Delta lepval$, *ECM*
Models for Electronic Payments in Volumes (EPVOL)									
$\Delta lepvol$	2.18*	1.03	-	-	-0.87***	6.61***	5.08***	-	-
$\Delta lwpi$		1.16	1.08	-	0.56*		1.55	1.97	-
$\Delta liip$	2.30**	-	0.31	-	0.099	2.20**		5.79***	-
Models for Electronic Payments in Values (EPVAL)									
$\Delta lepval$	1.5	0.94	-	-	-0.52**	2.75***	1.21	-	-
$\Delta lwpi$	-	1.11	-	0.96	0.49*	-	1.24	-	2.15
$\Delta liip$	5.45***	-	-	2.87***	0.87***	5.10***	-	-	2.67***

Note. ***, ** and * indicates the significance at 1, 5 and 10 % level respectively.

EPVOL = Electronic payments in volume; EPVAL = electronic payments in value.

For the model using EPVOL (electronic payments in volume), the results of short run causality is observed that Joint Wald F-statistic of *lwpi* is statistically significant at 10 and 5 percent level respectively for both *lepvol* and *liip* models. However, none of the variables in the other two specifications (*liip* and *lepvol*) are statistically significant. These results imply that there is unidirectional short run Granger causality from *lwpi* to *lepvol* and also from *lwpi* to *liip*, whereas there is no short run Granger causal relationship between *liip* and *lepvol*. Further, the coefficient of ECM term is negative and statistically significant at 1 percent level in the *lepvol* model; besides, both *lwpi* and *liip* perform as the source of causation for the long run causal relationship from *liip* and *lwpi* to *lepvol*. This implies that both economic growth and inflation rate leads to electronic payments in volumes significantly. Particularly, growth in inflation rate contributed in both short-run and long-run relationships, whereas economic growth has long run association with electronic payments in volumes.

For the models using EPVAL (electronic payments in values), only for *liip* models, joint Wald F-statistic of *lwpi* and *lepval* is statistically significant at 1 percent, which indicates that there is a unidirectional short-run causal relationship from *lwpi* and *lepval* to *liip*. The ECM term is negative and statistically significant at 5 percent level for lepval models and *lwpi* is the main source of causation for the long run relation from *lwpi* and *liip* to *lepval*. The ECM term is positive and statistically significant for *lwpi* and *liip* models, which implies that there is long run interaction relationship among *lepval*, *lwpi* and *liip* variables. The result suggests that both inflation rate and economic growth drive electronic payments in values in the long run, where inflation rate is the source of long-run causation. Besides, the result also reveals interaction among the variables in the long run.

5.3 Variance Decomposition Test Results

To see how LEPVOL, LEPVAL, LWPI and LIIP respond to various shocks to the system, we perform the variance decomposition analysis characterising the dynamic behaviour of the VECM involving first differences (i.e., growth rates) of LWPI, LEPVOL, LEPVAL and LIIP with the lagged ECM or error correction term included as an exogenous variable. Table 5 shows the results of the variance decomposition function.

Table 5. Forecast variance decomposition function

	Models for LEPVOL				Models for LEPVAL			
Time horizon (months)	***S.E.***	***LEPVOL***	***LWPI***	***LIIP***	***S.E.***	***LEPVAL***	***LWPI***	***LIIP***
LEPVOL					***LEPVAL***			
1	0.034	100.00	0.00	0.00	0.128	100.00	0.00	0.00
6	0.051	46.78	50.67	2.54	0.216	64.67	28.93	6.38
12	0.069	26.65	69.27	4.07	0.384	39.17	53.81	7.017
18	0.079	20.85	74.46	4.69	0.443	38.41	49.91	11.67
24	0.086	17.66	78.07	4.26	0.519	30.39	48.52	21.08
LWPI					***LWPI***			
1	0.004	5.66	94.33	0.00	0.004	0.35	99.64	0.00
6	0.016	4.23	84.45	11.30	0.018	3.88	93.35	2.75
12	0.024	2.49	51.48	46.02	0.028	14.19	69.75	16.04
18	0.026	2.09	43.22	54.68	0.032	19.68	59.52	20.78
24	0.027	2.02	42.55	55.42	0.036	19.50	63.27	17.22
LIIP					***LIIP***			
1	0.018	1.26	0.19	98.53	0.017	8.84	0.19	90.95
6	0.027	2.13	4.41	93.44	0.029	10.81	17.82	71.36
12	0.049	1.14	21.76	77.09	0.039	11.82	14.55	73.61
18	0.055	1.12	29.54	69.32	0.040	11.87	15.39	72.73
24	0.058	1.21	28.87	69.90	0.040	12.26	16.63	71.10

For LEPVOL models, the table shows that at forecast horizon of 24 months, innovations in LWPI explain over 78.07 percent, LIIP explains only about 4.26 percent and LEPVOL explains over 17.66 percent of its own shock of the forecast error variance of LEPVOL; while LEPVOL and LIIP explain 2.02 percent and 55.42 percent of the forecast error variance of LWPI. This implies that shocks to the growth of LWPI significantly influenced LEPVOL growth, which corroborates the findings from the causality analysis that LWPI caused LEPVOL. With regard to the growth of IIP, LEVOL explains only 1.21 percent of forecast error variance of LIIP; on the other hand, LIIP explains only 4.26 percent of forecast error variance of LEPVOL.

For the model with LEPVAL, the results show that the growth of LWPI significantly explains the growth of LEPVAL at forecast horizon of 24 months. While 30.39 percent of the forecast error variance of LEPVAL is explained by itself, around 48.52 percent is explained by the growth of LWPI. At the same time, for the growth of LWPI, around 19.50 percent of the variance is explained by LEPVAL, LIIP explains about of 17.22 percent and LWPI explains 63.27 percent of its own shocks. These results suggest causality from LWPI to LEPVAL and again corroborate the results of the causality tests (see Table 3). For the growth of LIIP, LEVAL explains 12.26 percent of forecast error variance of LIIP, while on the other hand, for the growth of LEVAL, LIIP explains about 21.08 percent of forecast error variance of LEPVAL.

To sum up, the study reveals that both inflation rate and economic growth lead to electronic payments in volumes and values respectively. Inflation contributed in both short-run and long-run relationships, whereas economic growth has long-run association with electronic payments in volumes and values. The results can be interpreted as follows.

Raise in general price level would caution the people on their spending pattern and look for possible option to reduce transaction costs. Hence, they prefer to deposit the money in a bank rather than carrying in hand as the deposit would earn some interest from the bank since banks currently pay interest on minimum daily balances in the deposit accounts. People also prefer to make payments electronically. Hence, electronic payments turn out to be proper substitute for paper currency, as there are no barriers on bank interest rate for the usage of credit or debit cards. Further, in an increasing inflation scenario, people who do not have sufficient cash in hand to afford for goods and services at higher prices can also get motivated to use credit cards which provide interest free period for 15 to 48 days for the customers on purchases and thus encourage use of electronic payments (Lacker, 2003).

Besides, economic growth provides various opportunities in the economy. It will raise income and purchasing power of the people which would lead to more economic activities and transactions that would in turn lead to increase in the velocity of money. The increase in monetary transactions induces the banks to explore to new methods of payments to provide hassle-free payment services. This would lead to competition among banks in providing various modes of electronic payments effectively and efficiently to their customers. All these efforts will lead to increase in usage of these electronic payments. Besides, due to the advancement of electronic payments technologies and the widespread availability of alternative instruments for hand-to-hand transactions during the recent decade provides competition among cash versus non-cash means of payment. Particularly, the emergence of different combinations of channels such as credit card networks and the internet, lower telecommunication and computing costs, and greater security and reliability of electronic transactions makes assets holding and currency transaction much more possible for a larger number of individuals and businesses than was the case a decade ago, there by use of payments in electronic form would go up (Kroszner, 2003). Thus, inflation and growth supports usage of electronic payments.

6. Conclusions

Indian banks are being encouraged to use technology in banking operations, Because of which, banks in India provide various electronic payment modes to their customers. The other side, higher inflation has been persistent in Indian economy for the last several years. Earlier literature on the impact of electronic payments on inflation found rather inconclusive results. Therefore, we made an attempt to examine any possible nexus between electronic based payments in banking and inflation in India as a clear understanding or at least basic knowledge about the relationship between electronic based payment system and inflation is very important, particularly to policy makers, in framing effective stabilisation policies, including monetary policy.

We found that both inflation and economic growth lead to electronic payments in volumes and values respectively. Particularly, inflation contributed in both short-run and long-run relationships, whereas economic growth has long-run association with electronic payments in volumes and values. This indicates that when performance of the economy is good, incomes are rising and thereby demand, people do more economic activities and transactions. These transactions are preferably done by using electronic payment modes since they are cost effective, speeder and hassle-free.

The study observes that electronic payment system has potential to expand further and fulfill the need of the people as it is driven by both inflation rate and economic growth in India. Electronic channels should continue to be encouraged because of its cost and time advantage in its usage while keeping general price inflation rate at harmless level. However, promoting inflation to get benefit of usage of electronic payments is something that needs to be comprehensively examined. Besides, replacement of central bank currency with electronic money would affect central bank seigniorage revenue and may pose challenges to central bank in the implementation of monetary policy as it would affect monetary aggregates and the monetary policy transmission mechanism. This paper has possible scope for future research to look into the role and impact of electronic payments on effectiveness of RBI's monetary policy and vice versa, in order to better understand the relationship between the electronic payments and inflation rate.

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Notes

Note 1. Different committees recommended automation/computerisation of operations in banks in both pre and post reform period such as Y. B. Damle (1982) on introducing MICR/OCR technology for cheque processing, C. Rangarajan (1984) on mechanisation in the banking industry, T. N. A. Iyer (1987) on communication network (BANKNET) for banks and SWIFT implementation, C. Rangarajan (1988) on computerisation in banks, W. S. Surf (1994) on technology issues relating to payment systems, cheque clearing and securities settlement in the banking industry, and Burman (2003) on cheque truncation and e-cheques.

Note 2. We communicated this problem to the RBI officials. However, the problem remains unsolved, as we were told that it was due to data consolidation issues.

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