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Evaluating Digital Payment Ecosystems and Cash Dependency: A Regional Perspective On India's Atm and Card Transaction Dynamics

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ABSTRACT

The transition from a cash-dependent economy to a digitally empowered payment ecosystem is a critical aspect of India's financial inclusion journey. This research explores the influence of ATM and card payment infrastructure on reducing cash dependency in India. It evaluates how the expansion of digital payment tools fosters a shift towards digital transactions. The study investigates the density of ATMs and card payment terminals as determinants of digital payment adoption, aiming to assess their collective impact on cash reliance. Quantitative methods including path coefficient analysis and bootstrapping techniques were used to verify the robustness of the model. This study reveals that the ATM infrastructure provides a useful service for reducing cash dependency, while the Cash Transaction Framework optimistically steers the virtual payment organization. However, the mediation evaluation shows that the digital payment system does not significantly interfere with the relationship between infrastructure and cash dependency. The results underline the importance of strong foundations to accelerate the adoption of digital payments. In addition, the study recommends that action and technological elements affecting virtual remittance acceptance be intensified to increase financial involvement and move towards a less cash-dependent economy.

Keywords: *Digital payment, ATM Infrastructure, Card payment infrastructure, digital payment system, cash dependency.*

1. INTRODUCTION

Reducing the dominance of cash is an important part of the remaining financial inclusion plan in India. The government and financial institutions have over time put several measures in place with the ultimate aim of encouraging use of digital transaction methods than the use of cash. Schemes like Pradhan Mantri Jan Dhan Yojana (PMJDY) UPI, the withdrawal of the 500 and 1000 Rs currency notes in 2016 among others have boosted the shift to the next level of payments. Nevertheless, for a country that boasts of its compliance to global standards in infrastructure and culture of other sectors, the predominant mode of payment still remains cash based. ATM and card payment facilities are central to making this transition possible. ATMS on one hand in areas where there are few restricted branch networks offer outlets for cash withdrawals while card payment system coupled with POS terminals that accompany retail and service-based stations ensure cashless mode of payment. These components combined provide the framework of the payment ecosystem in India, fulfilling the role of the missing middle between the clients who remain anchored in cash and the advanced digital payment platforms. Even as mobile wallets, UPI continues to be a core pillar of the shift, and cards areseen as a basic component of this journey. Debit and credit cards are easy to use and widely accepted by people and companies as a first attempt for transitioning to the digital payment space. In this respect, the density and availability of ATMs and card payment terminals remain significant parameters defining the use of the new forms of payments. The relationship of formal and informal payment systems—ATM/card versus cash reliance—is complex. ATM on the one hand, facilitate the accessibility of cash. On the flip side, a well-developed card payment network can make cashless transaction easier and safer for consumers as well as businesses and hence make people shift from using cash. Awareness of this process is crucial for formulating decision to financial providers and institutions.

In this study, we aim at assessing the role of ATM and the card payment system in reducing subordination to cash in India. It investigates how the provision and ease or difficulty of access to these infrastructures determines consumers' behaviour and use of digital payment systems. Moreover, it's possible to examine the connection between the density of such infrastructure as well as digital payment usage and the minimization of cash transactions. The study is important in various ways. First, it offers information on the physical payment rails that underpin digital change, and the role that they can play, which is the subject of increased interest due to the ongoing digitization of India. Secondly, it draws attention to the need on taps for cash and other forms of payments and digital payment to meet needs and provide options to consumers. Last but not the least, it presents recommendations for building the impact and coverage of digital payments infrastructure to deal with cash dominance. Thus, the research pursues the goal to help to drive the changes essential for India to become an efficient, effective, and cashless payment industry and contribute to the overall analysis of the subject.

1.1 Statement of Problem:

The country is still predominantly a cash economy notwithstanding enrolment in the Pradhan Mantri Jan Dhan Yojana, use of the UPI, and demonetization. This is so because any challenge that would hinder the growth of infrastructure, knowledge and acceptance of mobile money will still lead to high cash back dependence – especially in rural and semi urban areas. While ATM and card payments are central to creating a connection between cash dominant customers and digital payments acceptance. This work also assesses the role of this infrastructure in decreasing cash needs and evaluates how the extension of this infrastructure complements the transition to digital payments and contributes to financial inclusion.

2. LITERATURE REVIEW:

Impact of ATM Infrastructure on Cash Dependency

Effects of ATM Network on Cash-Intensive Nature The analysis of the role ATMs have found that ATMs act in India simultaneously as providers of cash access and agents of financial inclusion. ATMs are consider useful in growth sector where the normal banking facilities are hard to find while they provide more reliability in terms of cash withdrawals as pointed by Gupta and Sharma (2020). However, Ramesh et al. (2019) published research that claims that the abovementioned high availability of ATMs serves as a strong reason for enhancing people's dependency on cash, especially among rural citizens who possess low levels of digital literacy. On the other hand, Singhal (2021) has pointed out that ATMs are gradually changing the role of connecting cash and digital applications where they would allow things like cardless withdrawals and direct digital mobile money transfers. The author notes that the role of ATMs to enhance the uptake of digital services depends on user knowledge and preparedness of users for these services that is still different across the regions.

Role of Card Payment Systems in Promoting Digital Payments

In this paper, the following discussion aims to establish the role of card payment system in advancing the kind of digital payments as earlier discussed. Debit and credit cards have become valuable means to weaken the use of cash and card payment systems. According to Jain and Thomas (2018), POS terminals have promoted the proficiency of utilizing cards especially in large cities. According to the authors, card payments create a pathway through which consumers will readily embrace other forms of e-payments like the mobile wallets and commercial UPI. But Kumar et al. (2020) also know that there are factors that prevent effective card payments such as absence of proper POS facilities especially in the rural regions and high fees charged by merchants. They also note the increased influence of various government measures, for example, the recent decisions to eliminate MDR (Merchant Discount Rate) as the means that make the small merchants to accept the card payments systems. In contrast, Singh and Patel (2021) opine that a restriction of cards is the ability to curb the usage of cash and its associated problems in high-value transactions, while low-value transactions are still extensively dominated by cash.

Relationship Between Payment Infrastructure Density and Digital Payment Adoption.

Several works set a positive correlation between the density of payment infrastructure and digital payments. Mishra and Kapoor (2019) sampled ATM density and POS terminals and discovered that centers with high ATM density and POS terminals were less reliant on cash, followed by the convenience that proximity to payment tools renders. However, Das, and Choudaray (2020) explained that infrastructure gaps by region, especially the difference between the urban and rural areas, explain the levels of digital payments. In relation to this Arora et al. (2022) have noted that tangible network augmentation should be complemented with digital education interventions to enhance outcomes. The authors say that physical access to ATMs and POS terminals is not enough when consumers are inaptness and inadequate to use electronic payment systems proficiently. This is in line with the results obtained by Bhatia (2021), in his proposed model where perceived behavioral control which include factors like trust and perceived ease of use positively influences digital payment adoption.

2.1 Research Gap:

Despite the ever-growing literature in the context of transformation from cash to non-cash transactions in India, research gaps which remain unaddressed include the efficiency of ATM and card payment systems. Previous studies focus on exploring various technological factors such as UPI, mobile wallet and fails to consider how the physical structure affects cash usage and other electronic payment systems.

2.2 Primary Research Question:

In what way does ATM and card payment infrastructure help in decoupling of cash payments system in India?

The Role of Card Payment Infrastructure in the Transition from Cash to Electronic Payment System

Is there a material correlation between the ATM & card payment terminal density, the adaptation of electronic payments and

3. RESEARCH METHODOLOGY:

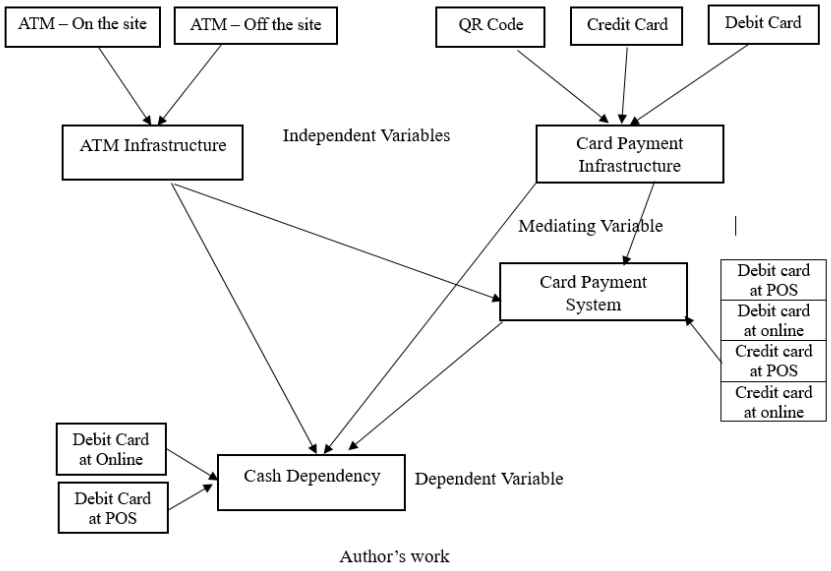
This research is explanatory research employed to find relationship between dependent and independent variables and their influence on each other. To answer the first research question and test the proposed hypothesis of this research, this is a quantitative research study investigating the effects of ATM and card payment infrastructure on reducing the usage of cash in India. This research design focuses on the descriptive and analytical research in order to particularly assess interconnection between ATM and card payment infrastructure and its usage, digital payments, and cash intensity. Secondary data on ATM Infrastructure, Payment Infrastructure, Card Statistics and Cash Dependency for the year 2024 is collected from public sector banks, private sector banks, payments banks, foreign banks and small fiancé banks (total 1,28,886 branches across the India) from the National Payments Corporation of India (NPCI). Both the descriptive and statistical tools were used to analyze the collected data. The descriptive part describes the existing state of payment infrastructure and its use in India, as well as the presence and correlation of variables, which are investigated using Structural Equation Modeling (SEM) and SmartPLS to assess and validate the formulated hypotheses efficiently.

3.1 Objectives

To assess the effects of implementations made such as, ATM Infrastructure and card payment infrastructure in the reduction of dependency of individuals on cash.

To determine the correlation between Digital payment system as a variable of Digital Infrastructure and the variable cash-based system.

3.2 Proposed Conceptual Model:



Author's work

3.3 Hypotheses:

H1: There is significant relationship between ATM infrastructure and cash payment infrastructure on cash dependency.

H2: There is significant correlation between ATM infrastructure and cash payment infrastructure towards cash payment system.

H3: There is significant relationship between cash payment system with digital infrastructure and cash dependency.

4. RESULT ANALYSIS AND DISCUSSION:

In this study, path coefficient analysis, R-square testing, and bootstrapping tools were utilized to analyze and interpret the collected data, aiming to understand how various elements of digital infrastructure contribute to the transition from cash-based systems to digital payment methods.

4.1 Reliability and Validity Testing:

Table 4.1: Reliability and Validity Test

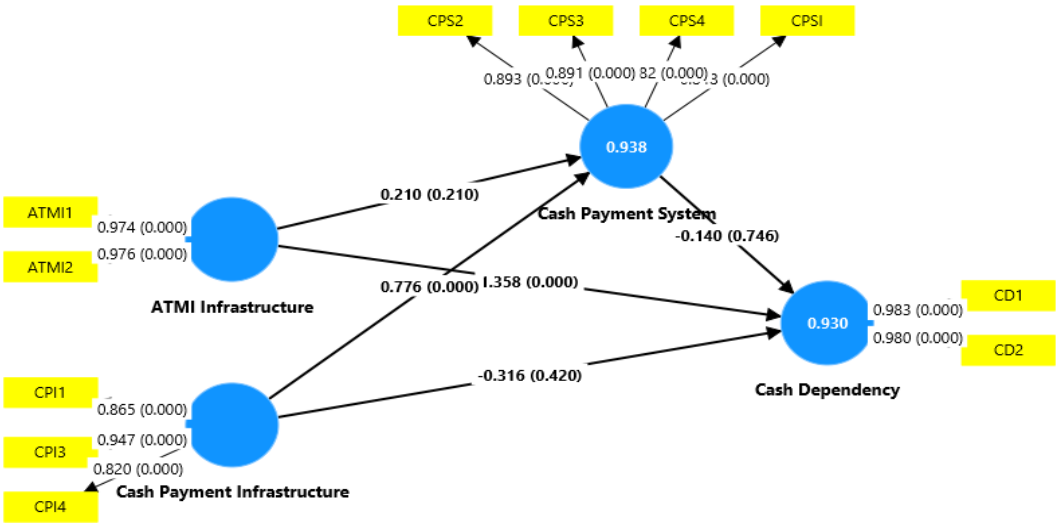
	Original sample (O)	Sample mean (M)	P values
ATM Infrastructure	0.974	0.976	< 0.05
Cash Dependency	0.982	0.932	< 0.05
Cash Payment Infrastructure	0.910	0.904	< 0.05
Cash Payment System	0.947	0.954	< 0.05

Source: Secondary Data

Table 4.1 features validity and reliability statistics for the research objects used in this analysis. All analysis variables demonstrate a strong research quality because their statistical values lie below 0.05. Testing validates that Bank Infrastructure (0.974) measures both reliability (0.976) and validity (p<0.05) and other variables such as Cash Dependency (0.982), Paying by Cash Infrastructure (0.910), and Payment System (0.954) achieved similar results (p<0.05). The results exhibit statistical significance because the table matches original sample outcomes to their sample means.

4.2 Bootstrapping Result Analysis:

Figure 4.2: Path diagram of structural equation model (SEM):



Source: *Secondary data*

The path diagram illustrates a structural equation model examining the relationships between ATM Infrastructure, Cash Payment Infrastructure, Cash Payment System, and Cash Dependency. The model shows several key pathways and standardized coefficients: ATM Infrastructure is measured by two indicators (ATM1 and ATM2) with strong factor loadings of 0.974 and 0.976 respectively ($p < .001$). Cash Payment Infrastructure is measured by four indicators (CPI1-CPI4) with loadings ranging from 0.820 to 0.947 ($p < .001$). The structural paths reveal a positive relationship from ATMI Infrastructure to Cash Payment System ($\beta = 0.210$, $p < .001$), a positive path from ATMI Infrastructure to Cash Dependency ($\beta = 0.776$, $p < .001$), a negative relationship from Cash Payment Infrastructure to Cash Dependency ($\beta = -0.316$, $p < .001$), a negative path from Cash Payment System to Cash Dependency ($\beta = -0.140$, $p < .001$). Cash Payment System is measured by four indicators (CPS1-CPS4) with high loadings between 0.893 and 0.961 ($p < .001$). Cash Dependency has two indicators (CD1 and CD2) with strong loadings of 0.983 and 0.980 respectively ($p < .001$). The model demonstrates good fit based on the standardized coefficients and significance levels (all $p < .001$), suggesting meaningful relationships between the infrastructure components and cash dependency outcomes.

4.3 Path Coefficient Analysis with Confidence Intervals:

Table 4.3: Path Coefficient Analysis with Confidence Intervals.

	Original sample	Sample mean	Standard deviation	T Statistics	P values	Bias	2.50%	97.50%
ATM Infrastructure -> Cash Dependency	1.358	1.256	0.288	4.708	< 0.05	-0.102	0.827	2.031
ATM Infrastructure -> Cash Payment System	0.21	0.234	0.167	1.254	> 0.05	0.024	-0.116	0.542
Cash Payment Infrastructure -> Cash Dependency	-0.316	-0.387	0.391	0.807	> 0.05	-0.071	-1.227	0.231
Cash Payment Infrastructure -> Cash Payment System	0.776	0.751	0.168	4.61	< 0.05	-0.025	0.432	1.097
Cash Payment System -> Cash Dependency	-0.14	0.013	0.434	0.324	> 0.05	0.153	-1.26	0.617

Sources: *Secondary Sources*

Table 4.3 displays path coefficient analysis data including the raw sample values (O), sample averages (M), standard deviations (STDEV), test statistics (T), significance levels (P), measurement errors (BIAS), and statistical range (CI 2.5% - 97.5%). With the information in table, it is understood that, each element of ATM Infrastructure, Cash Dependency, Cash Payment System, and Cash Payment Infrastructure impacts with each another. Our tests show significant relationships with p-values under .05 to demonstrate the active relationships between variables. ATM Infrastructure directly influences cash dependency with an effect of 1.358 and a statistical significance of $p<0.05$. The relationship between cash payment infrastructure and its system exhibits another strong positive connection with an odds ratio of 0.776 and $p<0.05$. Cash Dependency and Cash Payment System do not show significant connections because the p value is higher than 0.05 ($O = -0.14$, $p > .05$).

4.4 Mediation Effects and Confidence Intervals in Path Coefficient Analysis:

Table 4.4: Mediation Effects and Confidence Intervals in Path Coefficient Analysis.

	Original sample	Sample mean	Standard Deviation	T Statistics	P values	Bias	2.5%	97.5%
ATM Infrastructure -> Cash Payment System -> Cash Dependency	-0.029	-0.007	0.136	0.216	> 0.05	0.023	-0.589	0.142
Cash Payment Infrastructure -> Cash Payment System -> Cash Dependency	-0.109	0.020	0.328	0.331	> 0.05	0.128	-0.968	0.431

Sources: *Secondary Data*

Table 4.4 summarizes the mediation effects in the path coefficient analysis. The indirect effect of ATM Infrastructure → Cash Payment System → Cash Dependency ($O = -0.029$, $p > .05$) and Cash Payment Infrastructure → Cash Payment System → Cash Dependency ($O = -0.109$, $p > .05$) are both negligible and statistically insignificant. The confidence intervals for both paths include zero, and their T statistics (0.216 and 0.331, respectively) further confirm the lack of mediation effects. These results indicate that the Cash Payment System does not mediate the relationships between the analyzed variables.

4.5 R – Square value testing confidence intervals:

Table 4.5: R-Square value testing with confidence intervals.

	Original sample	Sample mean	Standard deviation	T Statistics	P values	Bias	2.5%	97.5%

Cash Dependency	0.930	0.879	0.111	8.373	0.000	-0.051	0.607	0.984
Cash Payment System	0.938	0.941	0.036	26.064	0.000	0.003	0.798	0.983

Source: *Secondary data*

The R-square results in Table 4.5 confirm that the predictors strongly explain Cash Dependency and Cash Payment System behavior. Cash Dependency shows strong explanatory power as measured by the high R-square value of 0.930 with a significant T statistic result of 8.373 (p = 0.000). The data shows Cash Payment System's R-square measure of 0.938 matches a 26.064 T statistic result (p value zero) with a confidence range between 0.798 and 0.983. The model's explanations of Cash Dependency and Cash Payment System show strong results that carry statistical significance at p below 0.05. These results show that our predicting factors accurately describe how the dependent variables behave which proves our model's usefulness and reliability.

5. FINDINGS, CONCLUSIONS AND RECOMMENDATIONS:

5.1 Findings:

The study reveals that ATM Infrastructure significantly reduces cash dependency, as indicated by the positive and statistically significant path coefficient (1.358 $p < .05$). Cash Payment Infrastructure supports digital payment adoption at a significant level ($O = 0.776$, $p < .05$) because it helps build payment systems. The mediation examination shows that the Cash Payment System fails to link infrastructure with cash dependence because its indirect effects are not significant at the $p > .05$ level. Our tests showed that the measurement tools worked well since all values produced results lower than 0.05. The predictors successfully explain 93% of Cash Dependency behavior and 94% of Cash Payment System usage.

5.2 Conclusions:

The study demonstrates that ATM Infrastructure and Cash Payment Infrastructure play a significant role in reducing cash dependency, aligning with the first hypothesis (H1). However, the mediating role of the Cash Payment System in these relationships was not supported, refuting the mediation assumptions in H2. The results emphasize the importance of direct investments in infrastructure to achieve greater financial inclusion and digital adoption. Future research should explore other potential mediating factors and examine the impact of demographic variables on cash dependency and digital payment adoption.

5.3 Recommendations:

Our analysis shows that governments should enhance ATM and cash machinery to help people use digital payments less and more easily adopt digital funds transfers. The next research step should test if user security concerns drive digital payment adoption and if users trust these payment systems across their technical knowledge. Future research should assess how digital payment system growth will affect traditional cash transactions across different population sectors. By examining new research paths these studies will help us understand financial systems better and how users interact with technology. These avenues of research could provide deeper insights into improving financial ecosystems and understanding user behavior

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