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What Explains the Adoption of Digital Payment Methods Among Individuals and Firms in India, and How Have Public Policy Interventions Streamlined and Shaped the Structure of this Transition?

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ABSTRACT

This research paper looks at how households and organizations in India use digital payment methods. It focuses on the Unified Payments Interface (UPI) and explores the government's role in promoting its use. The paper gathers data primarily through a survey. The findings show that the adoption of digital payments depends on the context, and payment patterns are usually non-linear. The trends in the choice process varied by income bracket, age group, occupational category, technology availability, and financial awareness. Transaction size was an additional factor affecting payment choice, particularly among people in higher income brackets. **Additional research is needed to verify these findings at the national scale.** By applying economic theory, the study identifies UPI adoption as generating a positive consumption externality, which leads to under-adoption. Hence, social welfare loss is due to the absence of intervention. Government actions, like the recent ₹1,500 crore incentive scheme, have been shown to increase digital adoption by reducing costs for businesses and households. However, this rise in digitalization may cause short-term issues due to more formalization and higher tax visibility, especially in informal sectors. Still, it has the potential to act as a long-term boost by improving financial intermediation and transaction efficiency. These findings are important for households, businesses, individual consumers, financial institutions, and policymakers who want to understand how digital payment systems affect behavior, welfare, and inclusion in growing economies.

Keywords: Aadhaar; BHIM-UPI; Cashless Economy; Circular Flow of Income; Consumer Payment Behavior; Credit-Linked UPI; Demonetization; Digital Divide; Digital Infrastructure; Digital Payments; Digital Transformation; Direct Debit Transfer; Economic Externalities; Financial Inclusion; Financial Literacy; Fintech Adoption; Government Intervention; Informal Sector; Jan Dhan Yojana (PMJDY); Low-Value Transactions; Market Failure; Merchant Adoption; Network Effects; Payment Reconciliation Efficiency; Post-COVID Digitalization; Public – Private Collaboration; Public Policy; Risk Perception; Social Welfare; Technology Acceptance Model (TAM); Transaction Costs; Unified Payments Interface

(UPI) in India; Zero Merchant Discount Rate (Zero MDR)

INTRODUCTION

The Influence of COVID-19

The COVID-19 pandemic acted as a primer for an unprecedented wave of digital transformation across the globe. It has fundamentally altered how individuals, businesses, and governments operate. Lockdowns, social distancing measures, and the sudden shift to remote work and learning created circumstances in which digital technologies became indispensable and embedded themselves in people's day-to-day lives.

The Introduction and Rise of Digital Payments

The 2019 pandemic highlighted the importance of financial inclusion, particularly with the advent of contactless digital payments. For example, research from the World Bank shows that the percentage of adults with bank accounts worldwide increased from about 68% in 2017 to 76% by 2021. This was important because of the short time frame. Much of this growth came from fintech payment solutions instead of traditional bank expansion. In 2024, about 40% of adults worldwide used a digital payment platform for the first time. They used cards, phones, or the internet to buy things or pay big bills. This trend was especially clear in India and China, the two largest emerging economies. More than 80 million adults in India made their first digital payment to a store. In China, that number exceeded 100 million. (World Bank, 2022).

This study focuses only on India, a country recognized for its quickly digitalizing economy. In this market, digital payment transactions increased from $4.57 billion in 2019 to $23.83 billion in 2025. A large part of this growth comes from the fast expansion of the Unified Payments Interface. Further, reports indicate that the fintech adoption rate in India grew to 87%, significantly higher than the global average of 64% (Ministry of Finance, Government of India, 2021).

On a broader scale, the fintech sector in India has maintained a strong trajectory, with an average compounded annual growth rate (CAGR) of around 30% in recent years. By 2024, UPI processed over 12 billion transactions each month (NPCI, 2023), a huge jump from under 1 billion per month just six years earlier, in 2018. Today, the UPI system has over 350 million users and about 50 million merchants. Nearly 75% of transactions are worth less than ₹500. UPI has proven effective for everyday, low-value payments, such as retail purchases and peer-to-peer transfers. Furthermore, rural areas now account for almost half of all UPI transactions. This is up from the 30% share seen before the pandemic (Reserve Bank of India, 2022). **This shows a trend of greater use beyond urban and high-income groups.**

The Significance of the Study

This study is significant to individual consumers, firms of various sizes, and the government. The differences in access to certain payment methods can affect consumers' spending patterns. It can alter the interactions between individuals and small, medium, and large-scale organizations in India. Furthermore, understanding and appreciating how economic theory underlies the transformation of UPI and its impact on the cross-interaction between consumers and firms. This can enable stakeholders to adjust their sales behaviors and patterns to maximize social equality and welfare. Organizations of different levels can readily adapt to changes in consumer preferences. This includes both products and payment methods. Additionally, the study allows firms in India to analyze market preferences. This would enable them to make potential changes and demonstrate flexibility in their current adopted systems.

The government plays a significant role in consumer-firm transactions. It can regulate usage when market externalities are created. Consequently, the government can harness UPI's potential to shape the country's future market economy. On another level, this paper analyses government initiatives and policies aimed at encouraging UPI adoption. Hence, this research enables stakeholders to understand how to enhance economic growth with UPI and which policies can be implemented in the near future.

Aims and Goals of the Paper

This paper aims to examine the recent surge in the adoption of the Unified Payments Interface (UPI) system in India. It analyses key government policies and legislative initiatives introduced to promote inclusive fintech adoption, alongside the underlying private and social motivations that truly drive the growth of India's digital economy. The study's goal is to bridge policy-level analysis and consumer-level behavior by examining how individuals interact with digital payment platforms in their daily transactions. Therefore, the study aims to explore the factors influencing consumers' payment choices and the role of UPI within the broader digital payments ecosystem and the economy as a whole.

CONCEPTUAL AND INSTITUTIONAL BACKGROUND

Unified Payment Interface and Functionality

The Unified Payments Interface is a real-time payment system created by the National Payments Corporation of India (NPCI) in 2016. It was designed to make interbank transactions easier on mobile devices and later became a government tool to promote financial inclusion. People and businesses can send and receive money right away with UPI. They can use a Virtual Payment Address (VPA), a smartphone app, or QR codes. You do not need to give your bank account information for every

transaction. UPI differs from other digital payment methods, such as debit and credit cards and electronic funds transfers, because it brings multiple banks and wallets together on a single platform.

Furthermore, it supports features such as peer-to-peer transfers, bill payments, and merchant collections. It's 24/7 availability and near-instant settlement. This means that payments are authorized and settled (i.e., funds are moved) in seconds, not days. Thus, UPI provides near instant finality. Its architecture leverages two-factor authentication and secure APIs to ensure compliance with regulatory and security standards. It makes UPI both convenient and safe for a wide range of users (RBI, 2018; NPCI, 2020).

However, UPI systems have some problems that could make it harder for people to use them and keep using them. First, the system relies heavily on internet access and a smartphone. This can make it hard for people in rural areas or low-income groups to use it. Second, a lack of digital literacy and confidence in using computers is a big problem. Some people are hesitant to use UPI because they think it is too complicated or fear being scammed (Suri & Jack, 2016). Third, problems with the platform's operations, such as failed transactions, downtime during peak times, and interoperability issues, can make people less likely to trust it. Interoperability problems arise when banks or payment service providers cannot communicate easily. This may result in mistakes in transaction processing. For example, money may fail to transfer between banks, and there may be delays in updating balances across various UPI apps (NPCI, 2020).

Moreover, although UPI is a very handy tool for micro- and medium-sized transactions, it will probably not completely substitute for cash in the informal or unbanked segments of the population (Bansal et al., 2019). Merchants and consumers opt for cash because of privacy concerns, adherence to their own traditions, or simply a lack of banking facilities (Nature Humanities & Social Sciences Communications, 2025). These constraints indicate that, although there is a basic structure for digital transactions in the form of UPI, external factors such as demonetization can hinder its adoption (Crouzet et al., 2022).

This is particularly true for populations that already face structural and/or behavioral barriers (Bansal et al., 2019) that may limit system adoption. That is, exogenous shocks would force agents, such as consumers and firms, in emerging markets to quickly adapt to the economy’s new state, adopting UPI systems for Indians, especially after the demonetization of currency in 2016.

The Role of Government Initiatives

Targeted government incentives and schemes have rapidly streamlined the growth and scale of digital payment systems such as UPI. For instance, at the beginning of 2025, the Indian Union Cabinet passed a ₹1,500 crore incentive scheme. The aim was to enable low-value Bharat Interface for Money – UPI (BHIM-UPI) Person-to-Merchant (P2M) transactions during the year 2024-2025. The scheme focused on P2M transactions up to ₹2,000, and offered 0.15% of the transaction value. This policy measure has

greatly contributed to the growth of digital payment systems by encouraging the informal sector to adopt them.

Although transaction-based subsidies can certainly promote digitalization to a limited extent, this does not necessarily reflect the Indian government's strategy for developing digital payment systems, according to the Ministry of Finance, Government of India (2021). In this regard, it is important to note that a better understanding of the strategy is required to interpret the previously implemented structural interventions previously implemented. For instance, the Pradhan Mantri Jan Dhan Yojana (PMJDY) financial inclusion plan. It was initiated by the Department of Financial Services on August 28, 2014, to increase universal access to financial services, including savings accounts, remittance services, credit, insurance, and pensions, according to NITI Aayog (2021). Therefore, establishing the foundational infrastructure was necessary for digital payment ecosystems. A key feature of the program was the provision of zero-balance bank accounts, which significantly reduced barriers to entry into the formal banking system (World Bank, 2022; La Porta & Shleifer, 2014).

In addition, in collaboration with the RuPay payment network, PMJDY enabled people to receive free debit cards without annual maintenance fees (NPCI, 2023; RBI, 2021). Through this move, account holders could participate in electronic payment mechanisms even without funds in their accounts (International Monetary Fund, 2021). This initiative was executed so efficiently that it resulted in the opening of over 56 crore (560 million) bank accounts, of which about 67% were held by people residing in rural or semi-urban areas. Further, nearly 56% of these new accounts were held primarily by women (World Bank Global). The total deposits ranged from 2.6 lakh crore (USD$28 billion) to 2.8 lakh crore (USD$31 billion) (Ministry of Finance, 2025; RBI, 2023). PMJDY has shown the way forward by achieving broad demographic coverage while minimizing traditional access gaps.

Notably, a set of policies that were not formally aimed at increasing digital payment use have significantly contributed to the rapid spread of digital payment platforms like UPI. This is especially true in the case of the 2016 Indian banknote demonetization. It is frequently cited as a prominent example of an exogenous government-induced adoption shock (Chodorow-Reich et al., 2020; RBI, 2017). The policy was announced on 8 November 2016 and put into effect across the country until 30 December 2016. It also canceled all existing ₹500 and ₹1000 notes, which made up about 86% of the cash in circulation (RBI, 2017; Ministry of Finance, 2017. This decision aimed to reduce undisclosed cash holdings and limit informal economic activity, RBI, 2017; Ministry of Finance, 2017. However, this withdrawal of currency led to a severe cash shortage for people. This caused widespread economic disruption (Banerjee & Kala, 2018; Chodorow-Reich et al., 2020). To add to these difficulties, the government also set a limit on daily exchanges. Hence, people were allowed to exchange up to ₹4,000 per day at any bank or post office (RBI, 2017). This also contributed to a shortage of cash in hand, forcing people to explore alternatives (RBI, 2017). From a technology adoption perspective, this move also contributed to a coercive adoption

scenario, in which people were compelled to explore and use digital payment systems regardless of their ease of use (Muralidharan et al., 2019; RBI, 2018).

This move also modified the original Technology Acceptance Model (TAM) by making constraint-driven technology adoption a key initial driver, followed by learning-by-doing effects, thereby removing psychological barriers to technology use (Davis, 1989; Suri & Jack, 2016). Although almost 99.3% of the demonetized currency was returned to the banking system, the move also had a lasting impact on people, encouraging the use of technology-driven payment systems (RBI, 2017; BIS, 2019).

Despite the high private and social costs, including job losses and disruptions in the informal economy, demonetization can be seen as a strong policy that unintentionally increased digital payment volumes and pushed economic activity toward more formal and digital channels (Chodorow-Reich et al., 2020; Aggarwal et al., 2021).

METHODOLOGY

This paper focuses on research that uses both quantitative and qualitative methods. For research design, the data come mainly from a survey, which forms the basis of the analysis presented in the paper. The survey targets people from various backgrounds in urban and rural areas of India. In urban areas, the target group includes working professionals, business owners, retired individuals, and students. In rural and semi-urban areas, the target group includes people with limited access to digital infrastructure. In addition, the survey was sent to students at a co-educational school in Gurgaon, India. This is done to analyze the effect of the educational environment and socio-economic factors on the preferences for digital payments. To make the survey more relatable to the target group, the questions were tailored to the Indian context.

Inclusion Criteria

The respondents discussed in this section were chosen for their clarity and contrast, which, combined, provide insight into the context of payment method choices in India rather than any preference for them per se. The findings should be seen as examples rather than definitive. They are mainly used to examine behavioral patterns rather than to draw causal or nationally representative conclusions. The participants in the survey have provided insight into the behavioral mechanisms underlying the choice between digital and non-digital payment options across different transaction contexts, thereby offering more than mere statistics on UPI adoption.

Survey Design and Overview

The survey has three sections. The first section gathers demographic information, which includes gender, occupation, and income range. The second section examines consumer preferences through a series of hypothetical scenarios (see Appendix A). The final section asks respondents about their actual payment behavior by inquiring: "Which payment method do you use most frequently?"
This has enabled segmentation of the results by demographic and financial backgrounds. Thus, enhancing the depth of the analysis. Furthermore, for each question in sections 2 and 3 of the survey, respondents were asked to provide the reasoning for their answer. This allowed a deeper analysis to be carried out. Thus, connections could be drawn among the survey results.

104 respondents completed the survey, with an equal spread between male and female participants. The ages of the participants ranged from 16 (high school students) to over 60 (senior citizens). The participants came from various professions. On one side are businesspeople earning over ₹1 crore, while others, including homemakers and those in various other professions, earn even less than ₹5 lakh.

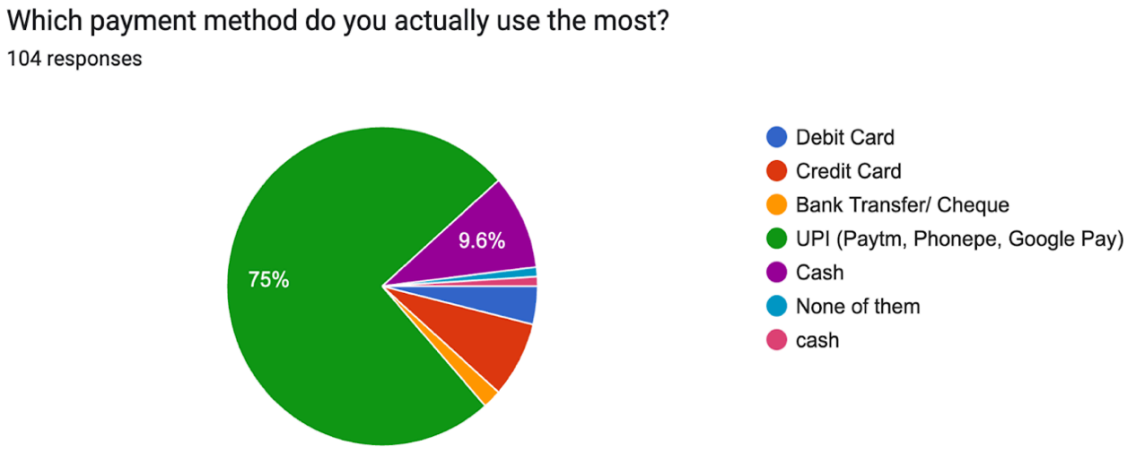


Figure 1. Payment Method Preferences: Pie Chart of Overall Survey Responses

This shows a combined visual summary of the payment methods respondents use most often.

Survey Result and Overview

The survey results among the sampled population indicate a clear preference for the Unified Payments Interface (UPI) as the preferred payment option in most situations. Of all survey participants, 78 people (75%) reported that UPI is their preferred payment option in any situation. The reasons for choosing UPI were convenience and ease of use. On the other hand, 26 participants (25%) reported that their preferred payment method is not UPI, with 11 preferring cash.

1. The survey results reveal that the choice of payment option for the survey participants depends on their income level. For instance, participants from higher income groups used different payment options, as highlighted in Section 2 of this report. However, for lower-income groups, UPI was preferred for all kinds of transactions.
2. The results also reveal that professional background affected the choice of payment options for survey participants. Individuals with business backgrounds were found to be more conservative, preferring UPI for smaller transactions.

3. Out of 26 participants who did not prefer UPI for making payments, 14 were males, and 12 were females. Of these 26 participants, 11 preferred cash for transactions, and the majority were female. The female participants who preferred cash reported that it was easily accessible, convenient, and comfortable to use compared with electronic payment options such as UPI. The other female participants preferred other options, such as debit cards due to UPI's inaccessibility and portability issues, and credit cards for their ease of use and convenience. Out of the 14 males who did not prefer UPI, 4 preferred cash, 4 preferred credit cards for keeping records of their expenses, tracking their expenses, and earning rewards, 2 preferred bank transfer/cheques for capital safety, and 2 preferred debit cards for keeping their expenses within their own funds and without incurring any credit debt.

FINDINGS & THEORETICAL ANALYSIS

The survey presents several responses that are particularly important for understanding UPI adoption.

1) Respondent 45 (male, employed in product management) identified credit cards as his most preferred payment method. Such a tendency suggests a certain degree of financial literacy, as it reflects knowledge of consumers' rights regarding credit and the advantages of using a credit card for transactions in certain scenarios, such as ordering food or arranging ride-sharing services. One thing to note is that the same individual reported observing people making more UPI payments than cash payments. In this regard, it refers to network effects described in the theoretical part, where the value of UPI rises with the number of its users. In fact, its acceptance among merchants and consumers enables it to scale nationally despite users' predilection for other payment methods.

2) **Respondent 57** (male, retired banker, annual income between ₹20–35 lakh) reported UPI as the payment method that he used the most and even chose this platform as his preferred method of payment in four out of the six hypothetical cases mentioned in the questionnaire. However, when the person had to transfer money to his friend, it became evident that the choice of payment method depended on the amount [23 November 2025]. This demonstrates that the amount of money plays an important role in deciding the mode of payment. This indicates variation in payment options under certain circumstances. It also highlights the influence of context, and in particular transaction size, on consumer payment behavior.

3) **Respondent 71** (male, business owner, annual income between ₹20–35 lakh) revealed payment behavior consistent with that of someone with relatively higher financial literacy for the income group in question. Notably, the respondent was one of the only male respondents who stated a general predilection

for cash-based transactions because he has "always done so, and plans accordingly." This is consistent with the general behavior of people engaged in business. However, the respondent's stated behavior was flexible: he opted for credit cards for tuition fee payments—where the transaction value is generally higher—because credit cards can be converted into equated monthly installments. This is consistent with the respondent's level of financial literacy, as it reveals that the respondent is aware of the financial benefits of different payment methods. Interestingly, the respondent has not opted for the UPI as a payment method in any of the six scenarios. This may indicate a degree of reluctance on the part of the respondent to use UPI as a payment method. This is consistent with the inference that people engaged in business may be reluctant to use UPI as a payment method because of issues related to transaction traceability.

4) Moreover, there is a possible gender-related factor involved in the choice of payment methods. For example, **Respondent 78** (female, retired, and with an annual income between ₹10–20 lakh**)** chose cash as her most favored payment method, as it "feels most comfortable." The factor of comfort is further emphasized in her answers to questions about online orders through platforms like Zomato or Blinkit, where cash is preferred because it is "more comfortable when an item is received." This is possibly an indicator that comfort, trust, and assurance are significant determinants of payment method choice, and that a lack of comfort with digital payment methods or trust in UPI transactions may be more pronounced in the female population, particularly among retired women.

5) Likewise, in the case of **Respondent 72** (Female, Housewife, Annual income less than ₹5 lakh), the preferred mode of payment was also cash. This may reflect a pattern within the sample, though it cannot be generalized to the broader population. To support this, in the provided scenario, where the respondent was asked to choose the payment method for online orders via on-demand delivery sites such as Zomato and Blinkit, the respondent chose cash. The reason provided was that the respondent had "no digital payment app" [27 November 2025] available at her disposal: a plausible indication of the fact that attitudinal factors do not necessarily drive the behavior in this segment, but are more likely driven by the lack of access to digital technologies or banking services like digital payment applications. This observation for the lack of access is also supported by larger organizations in India (World Bank, 2022; Reserve Bank of India, 2022; OECD, 2018).

In contrast to the responses of individuals in whom financial preferences had been developed by professional or financial involvement, another response also points to the influence of educational and socio-economic factors in the development of financial literacy, even in younger individuals.

6) Respondent 103 is a male high school student from a well-known co-educational high school in Gurgaon, India. He has very little income, but provided an interesting response to the question about his preferred payment method in a hypothetical situation where he would need to choose how to receive payments as a restaurant owner. Despite his lack of income, his answer showed a strong understanding of digital financial tools and how they operate, which is impressive for someone his age. Thus, this response also points to the influence of financial literacy on the choice of financial instruments, even in younger individuals, and thereby also reflects the earlier findings that consumer payments in India are

context-dependent and are mediated by financial knowledge, and not necessarily by their age or their earning capacity (Shree et al., 2021).

As a relatively recent institutional innovation in the Indian economy, the UPI system embodies the fundamental concept of opportunity cost. From the viewpoints of consumers, companies, and governments, UPI offers an interesting trade-off. It allows for quick, low-cost digital transactions but means forgoing investments in other payment systems, older financial systems, and strong cybersecurity measures. To fathom how the Indian economy has adopted digitalized payment methods and the government's role in streamlining the process, it is imperative to use microeconomic theory and, on the national scale, macroeconomic theory to analyze the true private and social benefits of adopting these systems over traditional methods. For example, cash or credit/debit. This would best be done by understanding the context of the three main stakeholders involved in this trade-off.

Benefits and Costs of the UPI System for Consumers and Firms

From a theoretical point of view, the adoption of the Unified Payments Interface (UPI) by consumers and firms can be explained using marginal cost-benefit and social welfare approaches. In this approach, social welfare is defined as the net benefits society derives from adopting digital payment systems. Social welfare is also expressed as the sum of consumer and producer surplus, with any external benefits and costs taken into account. The maximum level of social welfare is achieved when the marginal social benefits equal the marginal social costs, which is expressed as:

Maximum Social Welfare occurs when **Marginal Social Benefit (MSB) = Marginal Social Cost (MSC)**

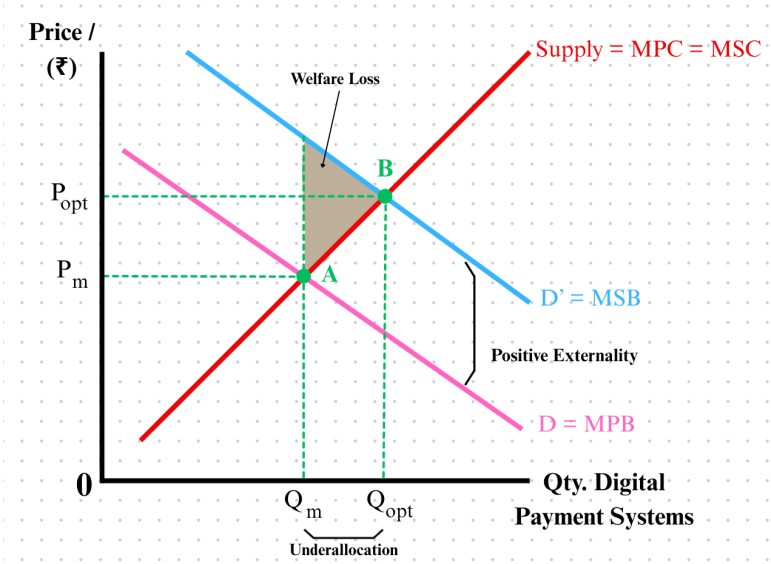


Figure 2. Positive Externality of UPI: Diagram Illustrating the Consumption Externality That is Generated by UPI

*For analysis, we assume that the positive externality tied to UPI adoption stays the same in relation to usage on the welfare curves. This assumption allows us to graph the marginal social benefit and marginal private benefit curves with a consistent gap between them. It makes it easier to compare the private and socially optimal outcomes. While the strength of network effects and external benefits may vary in practice, this assumption does not affect the main conclusions of the analysis.

To distinguish private decision-making from socially optimal outcomes, it is necessary to explicitly define the relevant marginal functions. Marginal Private Benefit (MPB) is the direct benefit an individual consumer or firm receives from adopting UPI. For consumers, MPB includes convenience, instant real-time transfers, 24/7 availability, low to even zero transaction charges, and transaction security. For firms, MPB consists of faster settlements, lower transaction costs relative to card-based payments, improved liquidity management, and reduced cash-handling risks; in all balancing the scale of benefits for both sides of the equation. In the broader view, Marginal Social Benefit (MSB) exceeds the private benefit because UPI adoption generates positive externalities that are not yet fully internalized by individual users. These include reduced economy-wide cash-handling costs, lower transactional inefficiencies, increased financial inclusion, improved tax transparency, and strengthened network effects that raise the system's value for all users. As a result:

MSB > MPB

The advantages of UPI enjoyed by the household level are not mere theoretical in nature but have been well captured in the results of this survey. In the group of 74 individuals using UPI as their main payment option, almost all respondents mentioned that the reason behind their preference for UPI is the convenience factor and quick transactions.

However, the Marginal Private Cost (MPC) is the cost that individuals and businesses encounter when using the UPI system. The cost that individuals incur through this technology is the effort they must put in to learn how to use digital payments, the need for Internet connection, and fears of cyber theft and security issues. Similarly, for businesses, this cost includes setting up the system, depending on the technology used, and tracing transactions.

The existence of Private Costs in question can be illustrated by the case of **Respondent 78.** The female retiree was found to normally shun the use of UPI. In only one out of the six given situations did she opt for UPI; in the other five, she preferred cash transactions. Ultimately, she also identified cash as her most common payment method, noting her greater comfort with it and its accessibility. This response highlights the non-monetary costs of UPI adoption: the perceived threat to financial security and low digital confidence.

This pattern is not unique. Many interviewees continued to rely on cash transactions and other forms of payment due to inadequate access to digital infrastructure, discomfort with technology, and concerns about traceability. Such elements reveal both the actual and the subjective costs that people incur when using UPI. Hence, despite the low marginal social cost of using digital payments, the high private cost

prevents their widespread adoption. This situation strengthens the divide between personal choices and the best outcomes for society.

As illustrated in the graph above (Figure 2), it is important to evaluate the MPC against the Marginal Social Cost (MSC). The MSC includes MPC and the external social cost. For UPI, the MSC tends to be close to the MPC, since there are minimal negative externalities from digital payment processes. The externalities include cybersecurity threats, privacy concerns, and potential disruption to traditional cash-based sectors. As such, it can be argued that:

MSC ≥ MPC

In the absence of government intervention, consumers and firms base their adoption decisions on MPB and MPC, leading the market to settle at an equilibrium level of UPI adoption where the **MPB = MPC.** This is not beneficial for the market because the quantity produced at Marginal Social Benefit > Marginal Private Benefit. That is, the positive consumption externality results in underconsumption of UPI relative to the socially optimal level, where MSB equals MSC. This divergence provides a strong theoretical justification for government intervention to internalize positive externalities and align private incentives with social welfare.

Network Effect

At the consumer level, UPI adoption is strongly influenced by direct network effects, whereby the utility derived from using the payment system increases as the number of other users grows (Katz & Shapiro, 1985). As more people use UPI, consumers have a better chance that their friends, shops, and service providers will accept it. This reduces the time and effort needed to use other options, such as cash or credit. The wide acceptance of UPI makes it easier and more reliable for all consumers, businesses, and the government alike. It encourages regular use and reduces the perceived cost of making digital payments. Over time, these consumer network effects contribute to path dependence, in which UPI becomes the default payment option for everyday transactions, even when other methods may offer comparable functionality.

UPI exhibits strong network effects that significantly enhance firm-level adoption and value creation. Additionally, as the number of consumers using UPI increases, the incentive for firms to accept UPI as a payment method also rises, indicating a two-sided network effect between consumers and firms (Katz & Shapiro, 1985). This is because the two-sided network effect reduces customer acquisition costs for firms and increases scale through UPI interoperability. The standardized nature of UPI, through common APIs and QR codes, further strengthens these effects by reducing integration costs and enabling rapid diffusion across sectors and geographies.

In addition, rising transaction volumes on UPI generate data network effects that firms can leverage to improve fraud detection, credit assessment, and the provision of complementary financial services, such as working-capital loans and embedded finance. As the scale increases, the average transaction costs

decrease, which in turn fuels the cost network effects. This is also due to low and even zero merchant discount rates, which sustain merchants in the long term.

The survey responses highlight the importance of network effects in the adoption of digital payments. For instance, **Respondent 79**, a woman with an annual income of ₹5-10 lakh, identified UPI as her primary payment method. She noted that "most of the places are interlinked together" [27 November 2025]. Her comment supports the idea that when one person starts using UPI, it benefits the broader community as more places connect through a single system. This also shows how broad acceptance can strengthen consumer trust and regular use within the Indian economy.

Government Intervention for the UPI Market

During periods of structural market change, such as the rapid adoption of digital payment systems, governments, including India's, may intervene to reduce deadweight loss arising from externalities. While a range of policy responses is possible, this paper focuses on two interventions implemented in parallel with the Indian government's policy actions to better evaluate their effectiveness in addressing real-world market outcomes.

1. Subsidy & Cashback Provision

Various types of subsidies have been implemented by the Indian government for promoting UPI usage. This part of the paper will analyze the policy measures theoretically. The efficiency of the policy measures in tackling the externality problem will be assessed using welfare analysis graphs.

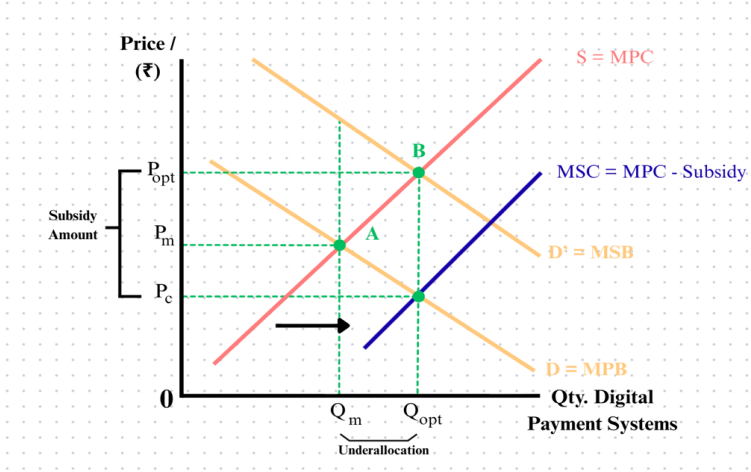


Figure 3. Government Subsidy for UPI: Diagram Showing Post-Intervention Effects on the Consumption Externality

*For analysis, we assume that the positive externality tied to UPI adoption stays the same in relation to usage on the welfare curves. This assumption allows us to graph the marginal social benefit and marginal private benefit curves with a consistent gap between them. It makes it easier to compare the private and

socially optimal outcomes. While the strength of network effects and external benefits may vary in practice, this assumption does not affect the main conclusions of the analysis.
Once the subsidy takes effect, the graph indicates that the economy begins to shift toward the socially optimal level of output (Qopt), minimizing the welfare loss from the original level of under-consumption. This is because the subsidy lowers the price that buyers pay from Pm to Pc, making digital transactions not only attractive but also accessible to a wider number of people. This causes consumption to rise from the original equilibrium to the socially optimal level. Although the price is still below the optimal price (Popt), consumption is now closer to the socially optimal level.

However, the subsidy is not entirely effective because the long-run costs of maintaining it are high for the government. It can also lead to dependence on the subsidy by the buyers and suppliers. This is because suppliers will have no incentive to seek ways to reduce their costs once UPI adoption takes root. In the long run, the subsidy's allocative efficiency will be negative because it will cause consumption to exceed the socially optimal level.

Aside from that, there are efforts to promote credit-linked consumption support through formal financial channels. This strategy seeks to ensure that the adoption of UPI is not hampered by liquidity challenges, rather than to reduce the cost of transactions. At present, the majority of transactions conducted via the UPI system are debit-oriented, meaning the payment is made directly from the bank account. These systems let users make daily transactions using credit rather than their current deposits. They provide access to credit facilities offered by banks or licensed NBFCs, available through UPI.

One of these systems is offered by HDFC Bank as '*UPI Now Pay Later'*. Users of this facility are provided with a pre-approved credit limit that may be used to make UPI payments up to a predetermined limit, such as Rs 50,000, which may be paid later. In macroeconomic terms, credit-linked UPI payments serve as an injection into the circular flow of income, offsetting short-run leakages caused by increased formal savings and taxation associated with digital payment adoption.

Even though credit-based UPI transactions may increase spending and thus boost the circular flow of income due to savings, the absence of money or taxation, such a trend may not be sustainable over time. In the short run, depending heavily on credit backed by bank finances will lead to money being withdrawn from investments and savings, as there will be cases of failure to repay or reductions in bank loans. As a result, this mechanism can temporarily boost economic activity. However, it may also create financial risks that need careful regulatory oversight and a detailed assessment of costs and benefits.

Digital Payment Adoption on the Circular Flow of Income

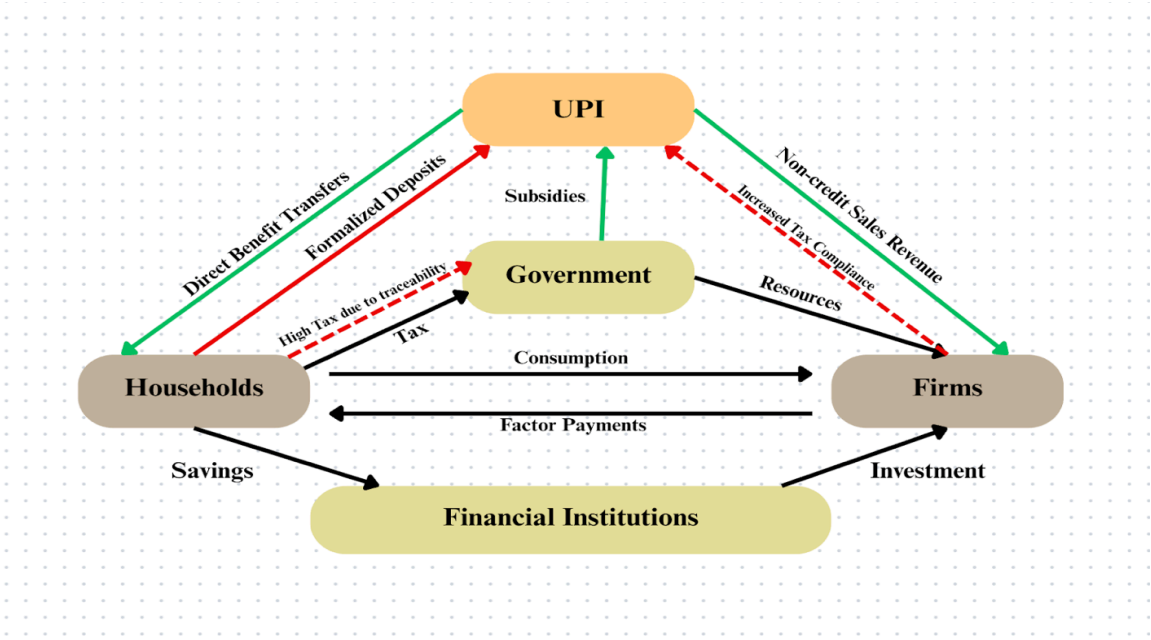


Figure 4. Circular Flow of an Economy with UPI: Diagram Illustrating Market Flows After UPI Introduction and Subsidy Imposition

In the circular flow diagram, rolling out UPI nudges the economy toward formal bookkeeping, which will hurt the informal sector the most. Informal-sector households and businesses have always relied on cash because this income is highly liquid and stays off the tax rolls. However, as UPI use becomes more widespread, the traceability of every transaction will force the informal sector to pay taxes on income that was previously unreported. Traceability will increase the tax burden because more money will flow from the sector to the government, hence creating a leakage in the circular flow model. To the participants in the informal sector, this will reduce the amount of disposable income they can consume in the short run.

Further, from a theoretical perspective, UPI adoption may channel income into formal bank-linked savings accounts. This causes a decrease in the amount of money people have available, which is something that usually happens in the informal economy. While this makes it easier for people to access money in the future, it means that people lose their savings instantly. This is particularly important when considering poor households in informal economies. As a result, informal markets might see decreased demand and liquidity during this transition, which lowers their overall consumption. Overall, UPI-led digitalization may cause a short-term downturn in the informal sector, even with efficiency improvements.

Although UPI leads to greater leakage in the informal sector, it also enhances injections that tend to favor the formal economy. Enhanced tax collection results in a greater inflow of money into the government's coffers. With such funds, the government is able to spend more and make more subsidies and DBTs, which flow back into the economy. This means that formal-sector participants benefit more immediately.

Similarly, firms operating within the formal sector experience higher non-credit sales revenue, improved liquidity,y and greater access to institutional finance. Therefore, it reinforces their advantage over informal competitors.

In the long run, economic digitalization as an injection results in meaningful structural change rather than just welfare loss. As informal agents become increasingly integrated into the formal economy, they gain access to credit, social security, and government transfers, thereby converting short-run leakages into long-run injections. To some extent, this has a similar function to the Capital/Consumer good trade-off, in that investing in capital (digitalization) comes at a present cost but yields future gains. The circular flow (Refer Figure 4) also indicates a notable transitional disequilibrium, wherein digitalization, fueled by UPI, results in a loss of informal-sector consumption due to taxation and savings leakages, while positively affecting income flows in the formal sector. Hence, proving the role of the balance function in the case of UPI's broader effect on the circular flow model.

DISCUSSION

This part presents results derived from the theories of network effects, information asymmetry, and positive externalities. There is a one-to-one relationship between each observed behavior pattern and the corresponding economic concept. Thus, we can see how our predictions match reality.

From the survey analysis, it is clear that payment method selection depends heavily on the situation. From the result, one can observe that UPI payments are preferred by customers. This indicates that the trend of using UPI payments is rising in India. This preference stems from personal benefits and factors such as network effects and merchant acceptance, which influence consumer behavior in digital payment systems. This connects to the earlier discussion of network effects, in which more people using UPI raise the marginal private benefit (MPB) for individual users.

One of the prominent observations in the survey results is the divergence between preference and actual usage of digital payment instruments. Although few participants preferred options such as credit cards or cash, they also used digital payment tools like UPI for transactions. This preference comes from UPI's wide acceptance and ease of use. This shows that two-sided network effects significantly influence the use of digital payments. As explained in the theory section, the value of UPI increases as more users adopt it. This incentive of inclusivity encourages people to pick UPI, even if their personal preferences differ. The presence of tools like UPI encourages consumers to use them, even if other methods might be more advantageous in particular scenarios. Therefore, UPI's strong position in India's digital payment landscape seems to stem from its role as a standard payment method, where two-sided network effects shape consumer choices in digital transactions.

The results show that the adoption of the UPI is conditional and not unconditional. Respondents changed their payment method based on the transaction value. This confirms the previous theory which proposes that decisions regarding adoption hinge on marginal private benefit (MPB) and marginal private cost (MPC). MPB and MPC vary in different transaction scenarios. This proves that confidence in digital

payment systems is relative rather than absolute. Safeguards and overall supervision in the financial system play key roles in determining MPB in various situations. Specifically, higher transaction values may increase perceived MPC. This explains why there are deviations from UPI usage, even though it is usually the preferred option. The findings support the idea that UPI under-consumption will continue even with strong network effects.

Firm behavior becomes more complex with the adoption of the UPI. The results show that individuals who are more focused on business often limit their use of the UPI, even though it is convenient. This aligns with theoretical expectations regarding informal sector behavior and UPI use. The UPI requires firms to give up some flexibility in how they use their funds. This results in higher private costs for some agents, as explained in the theory section. These costs stem from issues such as traceability and compliance. Thus, even if the social benefits outweigh the social costs, individual agents may still limit adoption due to private costs.

Results on gender and income categories indicate that non-use of UPI is usually due to structural rather than ideological problems. This implies that neither market nor state intervention may be effective in reducing disparities in usage rates. This is despite the availability and affordability of digital payment platforms. The conclusion follows the earlier observation made concerning information asymmetry, whereby ignorance or inaccessibility leads to reduced perceived benefits and increased perceived cost of adoption.

Overall, the findings show that financial literacy is important in shaping how people adopt digital payments. People who are financially literate make decisions about payments which are considered smart and strategic. On the other hand, people who lack financial knowledge choose a certain number of payment methods that they have been familiar with. Factors such as income levels, age, education, and general socio-economic exposure affect financial literacy. This suggests influences that pass between generations and institutions. This supports the earlier point that differences in perceived money-management behaviors and payment choices among individuals can lead to variations in adoption outcomes.

IMPLICATIONS

A key implication of this study is the suggested relationship between socio-economic status, age, and behavioral psychology in determining digital payment preferences. According to the findings of this research, being financially literate is not merely an attribute of one's personality but also a hereditary feature. Families from privileged backgrounds tend to teach their kids digital financial literacy and financial management. As a result, wealthy individuals are more flexible in their digital payment habits. In contrast, those with less wealth have fewer payment options. However, it is critical to understand that this is more due to a lack of access to and understanding of digital tools than to resistance to digitalization.

These adoption trends in digital payment systems among consumers and firms are yet another piece of evidence supporting the role of information asymmetry in the inefficiency of UPI adoption. Consumers and small firms tend to be less informed and misinformed about the actual benefits and costs of digital payments, and to overestimate the perceived costs of fraud and data misuse while underestimating the benefits in terms of convenience, cost efficiency, and financial inclusion (Rochet & Tirole, 2003). This creates a wedge between the MSB and the MPB because the latter is less than the former. This leads to under-adoption of digital payments, despite the positive welfare benefits. This leads us to conclude that the availability of technology alone is insufficient for the optimal adoption of digital payments.

Government intervention is therefore necessary to internalize the positive externalities of adopting and using the digital payment system. The government can use regulation and the standardization of digital payment systems via UPI to mitigate uncertainty and build confidence in the digital payment process. Furthermore, financial education enhances consumers' ability to understand the advantages and disadvantages of digital payment systems. This increases the MPB and decreases the MPC so that the MSB equals the MSC in the socially optimal situation. Without such intervention in India's digital payment systems, they are likely to be constrained by informational asymmetry rather than by the underlying technology and economics.

CONCLUSION

The paper seeks to scrutinize the rapid adoption of India’s Unified Payments Interface (UPI) from an economic and behavioral perspective, thereby exploring its implications for consumers, businesses, and the state. Contrary to existing literature that attributes UPI adoption to its convenience, the absence of transaction costs, or the effects of COVID-19, this paper provides indicative evidence that UPI adoption may be influenced by policy actions, network effects, and behavior shaped by the socio-economic environment in which it began. By combining basic economic concepts with primary survey data, this paper shows that digital payment systems are not just tools for making transactions. They also act as structural tools that affect economic outcomes in India and beyond.

In conclusion, the study shows that there are no guarantees of adopting the UPI system, as adoption depends on contextual factors such as earnings, profession, age, gender, and digital access. The intermediary factor identified in this case is financial literacy, since the amount of financial exposure determines payment behavior. However, the degree of access constraints or the preference for cash is not related to the level of digital payment aversion among lower-income groups or older people. This supports, within the scope of this study, the argument that the success of UPI is as much related to network effects and policy support as to informed choice.

From a policy perspective, the study highlights the significance of government intervention to internalize positive externalities through subsidies and zero-cost mandates. Although the adoption of UPI creates leakage in the circular flow of income due to reduced informal cash flows, government intervention is critical to maintaining the stability of aggregate demand and welfare. Therefore, the study conceptualizes

UPI as a structural reform that realigns income flows with transparent, accountable, and inclusive economic activity.

Despite the findings, this current study may have certain limitations. First, the survey sample is far too limited to draw solid generalizations about the Indian digitalizing economy. Additionally, the survey's reliance on self-reported behavioral outcomes introduces bias, and its cross-sectional design limits its ability to assess behavioral outcomes over time. Finally, the analysis does not provide a true quantitative assessment of macroeconomic outcomes, including but not limited to the effects of digital payment system adoption on India's tax revenue, money velocities, and firm productivity: possible areas of further research.

Future studies can improve upon the limitations of the current study by using more representative datasets and survey designs to assess the welfare outcomes of digital payment system adoption in India with greater accuracy. Possible future research includes studying gender-based digital exclusion and the long-term impacts of credit-linked digital payment systems in India to understand better how digital payment adoption affects various populations. Overall, the current study adds to the growing body of literature on digital finance in India and demonstrates the importance of behavioral outcomes in the effectiveness of digital payment systems like UPI, alongside technological and policy interventions aimed at promoting economic efficiency and inclusiveness in India.

APPENDIX

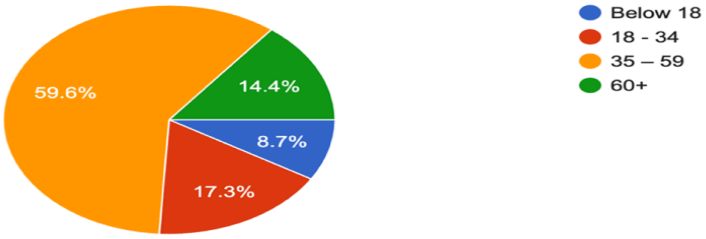
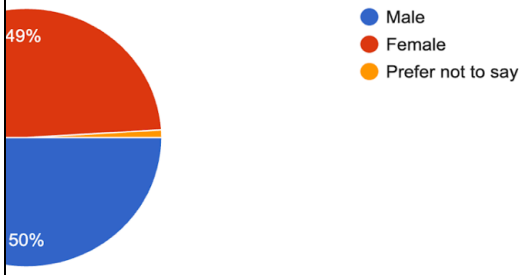
Appendix A: The Survey Structure and Responses

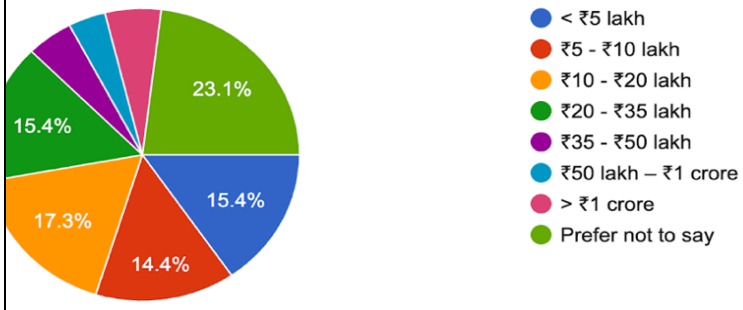
This appendix presents the primary survey instrument used to collect data on household and firm-level payment preferences in India. The survey was designed to capture demographic characteristics and contextual payment choices, reveal payment behavior, and analyze adoption patterns of digital payment systems, particularly the Unified Payments Interface (UPI).

The survey questions were intended to illustrate the Indian payment system. Hypothetical transaction examples based on day-to-day transactions, such as UPI merchant transactions, local P2P transactions, and widely used Internet services in India, were considered. The payment methods offered to respondents were consistent with those Indian consumers actually use, namely UPI, cash, credit cards, and debit cards. This approach aimed to improve response accuracy. It ensured that the observed payment choices matched actual behavior rather than abstract or unfamiliar options.

Section A: Demographic Information

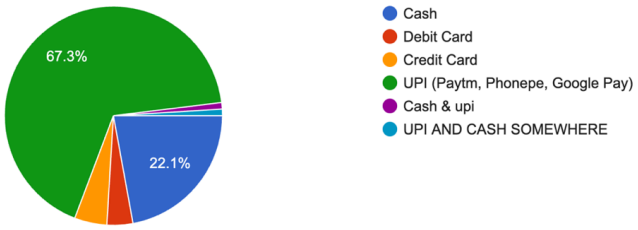
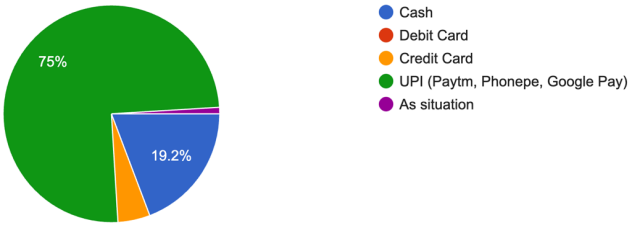
This section collected background variables necessary for segmentation and analysis, including:

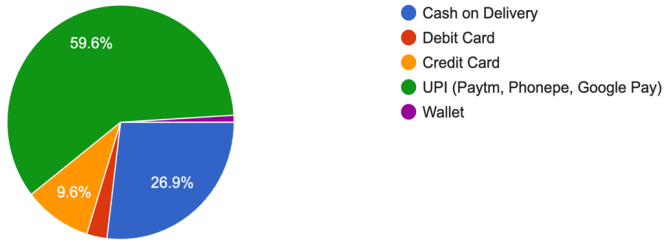
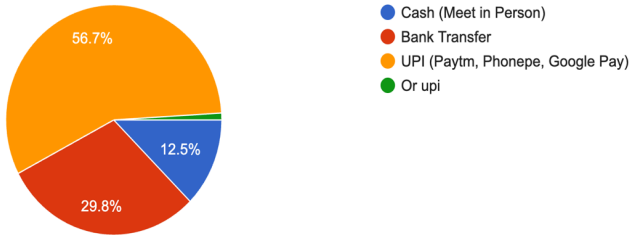
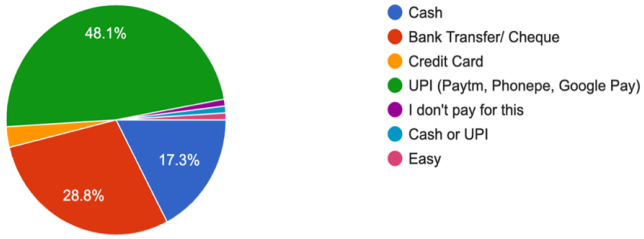
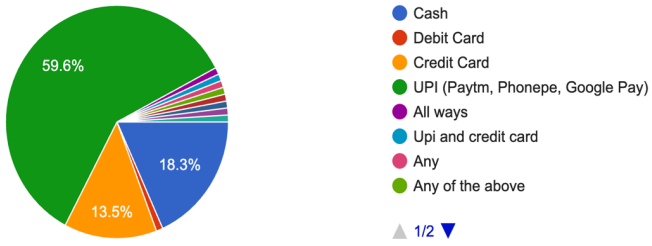
#) Question	Response Data
1) Age Distribution of Participants	
2) Gender Distribution of Participants	
3) Occupation Distribution of Participants	Service Student Business Business Service House wife Housewife Engineer Home maker

4) Income Range Distribution of Participants	

Section B: Hypothetical Transaction Scenarios

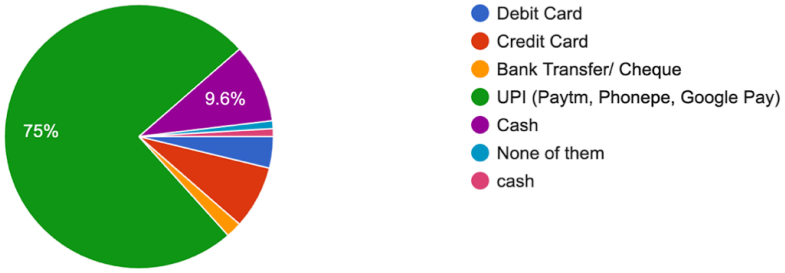
Respondents were presented with a set of hypothetical but realistic transaction scenarios to capture *context-dependent* payment preferences and perceived risk. For each scenario, respondents selected their preferred payment method and briefly explained their reasoning. Scenarios included are shown in the table below:

#) Question	Response Data
5) Hypothetical Scenario on Grocery Store Spending	
6) Hypothetical Scenario on Transportation Spending	

7) Hypothetical Scenario on Food Delivery Spending	
8) Hypothetical Scenario on Money Transfer Spending	
9) Hypothetical Scenario on Recurring Tuition Spending	
10) Hypothetical Scenario on Business Ownership Preference	

Section C: Revealed Payment Behaviour

The final section asked respondents to identify the payment method they use most frequently in daily life. This question was used to distinguish between stated preferences in hypothetical settings and actual usage patterns.

#) Question	Response Data
11) Final Payment Method Preference Distribution	

Appendix B: Limitations in Methodology

The methodology included a very small sample size consisting of 104 individuals among a population of 1.45 billion. However, the survey is based on individuals residing in the NCR-Delhi region and may therefore exhibit sampling bias or incomplete generalizations. Moreover, the responses are self-reported and could be influenced by recall or social desirability bias. Also, the survey reflects behavior at a single point in time and does not account for changes in payment preferences. Despite these limitations, the survey provides valuable qualitative and contextual insights into payment behavior that complement the theoretical analysis.

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