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Did demonetization have a bigger impact on PPIs (prepaid payment instruments) or Mobile Banking in India?

Ansh Vora

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Professor Andrew Finley

Ansh Vora

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Abstract

On November 8, 2016, Narendra Modi, prime minister of India, tele-advertised the entire nation and announced that India's highest value banknotes, the 500 and 1000 rupee "Rs" notes would be demonetized and taken out of circulation, effective midnight. Modi stated that this is an effort to reduce the large economy of black money, transition India into a digital economy, abolish funding of terrorist groups and illicit circulation of counterfeit notes. In this study, I choose to analyze the impact of demonetization on two digital payment methods - Prepaid Payment Instruments, "PPI" and Mobile Banking. The data used in this study is monthly data from the Reserve Bank of India's "RBI Bulletin" for a time period of 7 years from October 2013 - October 2021. I use an Interrupted Time Series "ITS" model to study and compare the stability and trends for 4 variables: volume of PPI transactions, value of PPI transactions, volume of Mobile Banking transactions and value of Mobile Banking transactions. I find that there has been an increasing trend in the 4 variables being analyzed over the time period. Additionally, I find that for the time-period being analyzed, between PPI and Mobile Banking, PPI observed higher volume trends in the non-event period after demonetization whereas Mobile Banking saw greater value trends compared to PPI in the non-event period after demonetization.

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Section 1: Introduction

Demonetization is defined as the act of devastating a currency unit of its level as legitimate tender (Bhuvana and Vasantha, 2017). On November 8, 2016, Narendra Modi, prime minister of India, tele-advertised the entire nation and announced that India's highest value banknotes, the 500 and 1000 rupee "Rs" notes would be demonetized and taken out of circulation, effective midnight. This was followed by two press releases from the Reserve Bank of India "RBI": 1) a formal announcement pertaining the withdrawal of legal tender (Figure 1) & 2) issuance of two new currency notes: 500 rupee and 2000 rupee note under the Mahatma Gandhi series of notes (Figures 2 & 3). Modi stated that this is an effort to reduce the large economy of black money, transition India into a digital economy, abolish funding of terrorist groups and illicit circulation of counterfeit notes (Jain, 2017).

The impact of demonetization can be analyzed through multiple lenses: the effect on the Indian economy, impact on different social classes of people, stock market returns, etc. In this study, I choose to analyze the impact of demonetization on one of Modi's goal's: the impact it had on transitioning India into a digital economy. More specifically, I would be analyzing two digital payment methods - Prepaid Payment Instruments, "PPI" and Mobile Banking. Thus, I address the question of whether demonetization has a bigger impact on PPIs or Mobile Banking? According to the RBI, 15 billion notes of 500 denomination (approx. Rs. 7853.75 billion) and 6 billion notes of 1000 denominations (approx. Rs. 6325.68 billion) existed at the time of the announcement (Reserve Bank of India, 2016). This is significant because the demonetization announcement meant that 86% of the Indian currency that was in circulation would be considered demonetized overnight (Fouillet, Cyril., et al, 2021). The 10, 20, 50 and 100 rupees note under the Mahatma Gandhi Series continued to exist in circulation and had no impositions.

However, considering that these small denomination notes can only support very limited transactions, it was expected that the Indian economy would plunge into chaos considering that it is an economy that is heavily dependent on cash transactions. (Lahiri, A., 2020).

The 2016 demonetization announcement was one of the best kept secrets of the Indian government. Therefore, I intend to use the "shock" effect of this event, to analyze the effect of demonetization on consumer usage trends between PPIs and Mobile Banking, considering that these were anticipated to be the popular methods the average Indian consumer would shift towards with the influx of sudden cash shortage in the economy (Gupta and Manrai, 2019). The RBI defines PPI as the instruments that facilitate purchase of goods and services, conduct of financial services, enable remittance facilities, etc., against the value stored therein. PPIs can be issued by banks and non-banks. Mobile banking is the use of a mobile device to facilitate transactions such that all transactions should originate from one bank account and terminate in another bank account (Reserve Bank of India, 2022).

In this study, I use an Interrupted Time Series "ITS" model to study the stability and trends for 4 variables: volume of PPI transactions, value of PPI transactions, volume of Mobile Banking transactions and value of Mobile Banking transactions. The time period being analyzed for this study is from October 2013 - October 2021. I categorize my time periods into the following: estimation period (October 2013 - October 2016), event period (November 2016 – May 2017) and non-event time period (June 2017 - October 2021). I would then compare the trends for my 4 variables in the estimation and non-event periods.

My hypothesis is that demonetization would specifically change the relative trend line more for the volume of PPI transactions than for Mobile Banking. On comparing this trend to a counterfactual trend if demonetization was not announced, I hypothesize that the PPI volume

trend would be greater than Mobile banking volume transactions. The immediate effect of demonetization would be people finding alternate payment methods out of which we focus on PPI and Mobile Banking. I think that PPI payments would be greater than mobile banking because PPI payments are a more accessible, convenient, and secure option for making payments. This is especially true in the wake of demonetization when access to cash was severely limited, and people are used to being reliant on cash transactions to facilitate everyday activities. PPI payments allow users to make payments directly from wallet to wallet, and offer features such as instant notifications, which are not available through mobile banking (Reserve Bank of India, 2022). PPI is more convenient and user-friendly, as customers can make payment transactions that are usually faster than mobile banking through instant payments. Finally, PPI fees are usually lower than mobile banking fees, which makes it a more cost-effective option (Paytm, 2022). Most of the population in India falls under the middle- and lower-income categories, coupled with factors such as the increase in third party apps offering PPI services right after demonetization announcement (Gupta and Yadav, 2020) and abovementioned reasons, I believe that people would have easier access to PPIs compared to Mobile Banking. This is empirically tested by comparing the individual trends for my PPI vs. Mobile Banking variables and observing the stability trends across the estimation and non-event periods.

Based on the results in this study I find that demonetization had the greatest immediate impact (in the event period) on the volume of Mobile Banking transactions in the event period right after demonetization was announced. However, in the non-event period, this trend stabilizes to be lower than the counterfactual trend had demonetization not been announced. The volume for PPI transactions sees a more stable trend in the estimation period and event period. The regression figures show that this is the only variable in our analysis for which the non-event

period trend remains higher than the counterfactual trend. Thus, based off our results we can conclude that the volume for PPI transactions had a greater positive impact than the volume for Mobile Banking transactions over time (in the non-event period) after demonetization was announced. We also find that there was an immediate increase in the trendline in the event period for the value trends of both PPI and Mobile Banking. However, the non-event trendlines for both value variables were lower in comparison to their counterfactual trends. We conclude that for the time-period being analyzed, between PPI and Mobile Banking, PPI observed higher volume trends in the non-event period after demonetization confirming our hypothesis. On the other hand, Mobile Banking saw greater value trends compared to PPI in the non-event period after demonetization.

Post demonetization, the government and the RBI has been known to be promoting the use of digital payments. There are mainly five modes of transactions that are increasingly being promoted. These are Unified Payment Interface (UPI), Unstructured Supplementary Service Data (USSD), Aadhaar Enabled Payment System (AEPS), Mobile Banking and debit cards (Nithin, M., et al, 2018). UPI, AEPS (both fall under PPIs) and Mobile Banking out of these are variables of interest analyzed in the results of this study. The results in this study can be used by academics to analyze how demonetization impacted the trends of PPI and Mobile Banking between the event period and non-event period. The results can also be used towards a study of comparing effects of demonetization on other payment systems defined by the RBI such as debit card usage, credit card usage, RTGS etc. Academics could reference the findings in this study to predict consumer usage trends amongst these other payments methods. Lastly but not limited to, PPI and Mobile Banking fall under the category of digital payment methods in India and their

usage trends as seen in our results can be used as a component in studying the progress of digitization of the Indian economy through digital literacy.

Section 2: Background

In September 2013, the Bharatiya Janata Party, "BJP", announced that Narendra Modi would be their prime ministerial candidate for the upcoming elections. The 2014 elections are recorded as one of the biggest political shifts in India after the BJP defeated the Indian National Congress which had been the ruling party since 2004 (Sridharan, 2014). Narendra Modi was appointed as the prime minister of the world's largest democracy in May 2014 where he vowed to "increase efforts to eradicate poverty, create employment opportunities for the country's young workers and provide a safer environment for women" (Singh, 2014). In line with his goal to eradicate poverty, Modi launched the "Jan Dhan Yojana" in August 2014, a campaign with the end goal of removing financial untouchability by promoting access to bank accounts for all citizens. The Indian investors cheered the strong economic regimes with the benchmark BSE index up 6% since Modi's election as prime minister (Gauba, 2015). In this study, I choose to start my analyzation for my estimation period in October 2013 as this marks the beginning period of Modi's prime ministerial reign. I think this would help capture aspects leading up to demonetization from the series of financial reforms Modi introduced for progressing India's economy (Pai, 2021).

Modi's 2016 announcement to demonetize the currency is recorded as the biggest financial reform in the history of the Indian government (Mohd, M.S., 2016). One of the key issues that this announcement wanted to tackle was the existing black money economy in India. It is important to understand what is black money and why it calls for such a large-scale reform

in India. Black money can be defined as a societal ill and is the currency of a black or "underground" economy. In India, black money, majoritively cash, originated from illegal sources of income such as drug trafficking, illegal betting, etc. Black money is primarily used for purchasing goods of the following nature: goods in exceedingly high amounts above government caps, illegitimate goods that can be consumed and goods that are wished to be not disclosed to government authorities. Collectively, this helps facilitate the existence of illegal organizations in India because black money links back to the legitimate economy and uses its advantages but does not pay its costs, for e.g., taxes and adherence to government regulations. Thus, as mentioned earlier, the estimated size of the Indian black money economy called for widespread systemic regulation associated with demonetization (Deodhar, 2016). But how does changing the notes in circulation actually eradicate the problem of black money?

Although various reports tried to best estimate, there is no precise percentage of the existing Indian black money economy in 2016. The discrete nature of this money supply made it impossible for the Indian government to solve the issue within the existing cash currency in circulation. Thus, the Modi government's decision to demonetize the currency and introduce new notes attacks the cash supply of the economy. Removal of the legality of tender forces people to disclose the sources of their black money to exchange it for the new notes or completely lose the monetary value of that black money. Additionally with the new notes, the government could now keep a distinct record of legitimate money in the economy. Considering that India is heavily a cash-based economy, this announcement induced panic across all social-classes of people. The rich were scared of losing their illegitimate income while the poor had to tackle issues of supporting families with a shortage of money.

However, Modi assured that citizens working hard and honestly would have their interests protected. According to the Reserve Bank of India, "RBI", citizens would have 50 days, till the end of the 2016 calendar year, to exchange old notes for the new 500 and 2000 rupee notes that were introduced. During this time, all forms of electronic, mobile, online banking would be allowed as they would continue to be. Thus, this did not create any worry for businesses and individuals adhering to the government rules. There were special rules for hospitals, emergency situations that allowed the old notes to be circulated for the next 72 hours after the announcement giving them a grace window (Dasgupta, 2017). According to the November 8th press release by RBI, banks would be closed the day after (November 9th) to prepare for this announcement and starting on November 10, 2016, anyone holding the 500 and 1000 rupee notes can tender them at any office of the Reserve Bank or any bank branch and obtain value thereof by credit into their respective bank accounts. Additionally, for the immediate needs, exchanges for new currency for 4,000 rupees per person were available for counter transactions and a bank account withdrawal limit of 10,000 rupees per day / 20,000 rupees per week were put into place. However, the black money aspect was tackled by the rule that placed a limit of 250,000 rupees that could be deposited without proof of income. Any amount that was higher than that would require proof of income and taxes paid, which if not provided made that amount eligible for a 100% penalty (Rajagopalan, 2020). This served as an effective deterrent because people would have to pay a penalty and retain some value of their black money or lose it entirely. Either way, it was an effective step of weeding out the illegitimate money in the economy.

There were a variety of problems that arose in the subsequent days after the Modi announcement. The RBI made announcements regarding the initial rules outlined in Modi's

announcement during the 50 day window for note exchanges. Although these rules were beneficial to the average Indian, there was much criticism against the government given the time constraint of the exchange scheme and the prevalent confusion among the general population. According to the RBI, there would be increases in limits for ATM withdrawals and cheque deposit withdrawals. There would also be an extended window till March 31, 2017, for only Non Resident Indians, "NRI" to exchange old currency at major RBI offices across India. It was during these announcements that the government announced that it encourages citizens to transition to electronic modes of transfer like NEFT, RTGS, IMPS, Mobile Banking, internet banking etc. from cash for the first time in the history of the Indian economy (Lok Sabha, 2017).

Modi's "Jan-Dhan-Yojana" followed by the subsequent demonetization of India can be one of the most elaborate government reforms to financially boost the Indian economy. Additionally, this was not the first time that the Indian government demonetized the India currency. In 1946, the currency notes of Rs.1,000 and Rs.10,000 were demonetized. The higher denomination notes were not accessible to common people at that time. So, the currency ban did not have much impact on the common people and the Indian economy. In 1978, the government demonetized Rs.1000, Rs.5000 and Rs. 10,000 notes. The impact of currency ban on common people were limited as the demonetized notes formed only a small portion of the total money supply. (Singh, 2018). On a comparative basis, the 2016 demonetization affected 87% of the currency in circulation, which represented close to 11% of the GDP at the time (Roy, 2019). I chose to analyze trends related to this event because of two reasons:- it is the largest demonetization in the history of the Indian government (Sarkar and Chatterjee, 2019) and India was a heavy-cash dependent economy at the time of this announcement (Lahiri, A., 2020). Many countries have demonetized their currency in the past, but nothing beats the extent and effect of

the Indian demonetization. Table (1) summarizes a list of countries around the world that have demonetized their currency in the past with an explanation of why they did so. Some notable countries include the United States, Soviet Union etc. (Puniya, 2021).

The announcement received a lot of criticism. One of the most notable critics was Raghuram Rajan, former governor of the RBI. According to Rajan, the short term economic costs associated with demonetization outweighed the long term benefits (Mahapatra,2017). Short term economic costs with respect to demonetization are: costs related to new notes, decrease in consumption of consumer durables, cash shortages especially in the agro sector, payment disruptions across multiple industries, etc. Further, Rajan and the International Monetary Fund "IMF", both predicted that demonetization would hurt India's GDP growth by 0.5-1% in the short term (Preethi and Sangeetha, 2017). Demonetization shaped the future of the Indian economy for the years to come but left a lasting effect on local populations, especially those who were the most deprived. Additionally, there were questions about the effectiveness of this policy. One of these claims is that there is no evidence to show that demonetization had direct impacts on reducing terrorism. For example, there were 301 terrorist attacks in the Indian state of Jammu & Kashmir in 2017 compared to 283 in 2016 (Mukhopadhyay, 2019). In this study, I will focus on the impact that demonetization had on 2 digital payment method systems in India.

Considering demonetization to be the event, I analyze the impact the event had on the value and volume of PPIs and Mobile Banking. The time period observed in this study is from October 2013 - October 2021, a unique time period that has not been analyzed before. I choose this particular time period as October 2013 marks the beginning of Modi's prime ministerial reign. Since his appointment, he has introduced multiple financial regimes other than demonetization which I believe would better help capture the trends being analyzed in this study.

October 2021 is the latest period of available data that would allow me to capture a complete calendar year since the beginning period in 2013. (Data for October 2022 will not be published till December 2022, thus I had to limit my study till October 2021). This allows me to study the trends for my 4 variables for a time period of 53 months after the event period using an Interrupted Time Series framework. Section 3 analyzes the initial impacts that demonetization had in the early days following the announcement followed by Section 4 which reviews the literature associated with the impact of demonetization on digitization of the economy. Section 5 covers the data description and methodology used in this study followed by Section 6 summarizing the results and conclusions from my findings.

Section 3: Initial Impact

The government's demonetization announcement was expected to affect multiple industries in the Indian economy. Some notable industries include the retail and agricultural industry. The retail industry was impacted due to the lack of cash liquidity in the economy. More specifically, this decision affected small traders and the unorganized retailing segment. Within the retail industry, some sectors like the luxury segment were impacted more than others (Sarawgi, 2016). Footfall traffic from shopping malls shifted to long queues outside ATMs where people waited for hours to exchange currency in minimal amounts as per the cap issued by RBI. Printing press constraints prevented the immediate replacement of the demonetized currency with new notes, with the result that cash that could be used in transactions declined sharply. Thus, poor government preparation often resulted in people waiting for hours before being told that new currency supply was exhausted (Chodorow-Reich, 2020). As for the agro sector, farmers and lower income labor class individuals were affected the most by the

demonetization announcement. Perishable food prices fell 5% in the November 9 - 21 (2016) period. The cash shortage halted transportation and severely limited the ability of middlemen to buy any significant stock, forcing farmers to sell perishable goods at lower prices to meet needs (Kapoor, 2016). Additionally, consumers shifted towards making targeted grocery purchases for essential items compared to non-essential items. Grocery stores offered alternative payment options for over the counter purchases. This is supported by the findings in Agrawal, et. al, 2019 study for how average cash usage drops and is made up for by increased debit-card usage when compared to pre-demonetization levels.

One of the initial impacts of the demonetization announcement was the impact it had on the prices of gold in India. According to the India Bullion & Jewelers Association (IBJA), jewelers sold 15 tons of gold ornaments and bars, worth around Rs 5,000 crore (USD 611 million), on the intervening night of November 8 and 9 (Sahgal, 2016). The figure of 15 tones is significant as it amounts to over a fifth of the monthly sales of gold in a normal. People were buying gold in old currency notes at almost twice the market value to dodge the demonetization implications year (Business Insider Bureau India, 2016). Thus, the immediate impact of the announcement was a very short-term splurge of spending on bullion and other high value articles as individuals seek to offload the soon-to-be obsolete notes.

The biggest winners of the demonetization were companies that offered immediate alternative methods of payment following the cash ban. Digital payment companies like Paytm went on to become one of the biggest beneficiaries of demonetization. Some notable immediate impacts:- The company's user base catapulted from 140 million in October of 2016 to 270 million in November of 2017. The user base doubled, and the company raised a USD 1.4 billion financing round in May of 2017 from Japan's Softbank, even as other consumer internet

companies floundered for money in a depressed economy (Sahay, 2017). Similarly, PhonePe saw a significant increase in transaction traffic to over a million transactions a day compared to 10,000 prior to demonetization (Nair, 2017)

Section 4: Literature Review & Hypotheses Development

There has been much critique of the Modi government's demonetization measures on the adverse consequences it has had on the local population. However, a more recent study shows that the demonetization played a key role in the advancement of digitizing payment methods in India. Fouillet, Guérin and Servet (2021) analyze ATM and point of sale (POS) transactions data from the Reserve Bank of India ("RBI") for the May 2014-March 2020 period. The data on payment systems are drawn from RBI's monthly reports on bank wise ATM and point of sale (POS) transactions. The study also draws on secondary data from M. Nithin, P. Jijin and P. Baiju (2018) study that uses Intervention Analysis in Time Series, which refers to how the mean level of a series changes after an intervention to examine the effect of financial digitization using monthly RBI data. Overall, C. Fouillet, I. Guérin and J. Servet (2021) study results show that the demonetization period brought a decline in ATM withdrawals and increased the mean POS transactions. Further, they conclude that "street vendors, shopkeepers and other micro and small businesses in urban and metropolitan areas show an increase in the adoption of mobile payments during the demonetization period" but the "access to money is already unequal and the cashless society that the government seems to be promoting will widen preexisting inequalities.". Fouillet et. al. study analyzes ATM transactions data as an indicator to analyze cash based transactions. Further, POS transactions refer to those that take place electronically at a retail outlet, where the customer pays for goods or services using a debit or credit card (Reserve Bank of India). Thus, it

differs from the two variables that are analyzed in this study (PPI and Mobile Banking), which are both purely under the category of digital payments., payments facilitated with the usage of a technology device such as a smartphone etc.

Agarwal et al. (2019) examines consumer spending responses after the 2016 demonetization was induced in India. They use anonymized transaction-level data from a large Indian supermarket chain. The data comprise all purchases in 171 stores in twenty-one districts of five states from April 2016 to September 2017. The main payment methods that were observed in this study are cash, debit cards, credit cards, and mobile payments. The results from this study show that there was a subsequent increase in usage of non-cash payments and monthly spending after the announcement. The study provides evidence for how average cash usage drops and is made up for by increased debit-card usage when compared to pre-demonetization levels. Debit-card and Credit-card fall under the category of POS transactions as defined above by the RBI (Reserve Bank of India). I use this study to show initial impacts of demonetization and further support my hypothesis demonetization and the associated cash decline in economy led to reduced usage of cash based transactions.

Mukhopadhyay (2019) conducted a study to assess the long term effects of demonetization. Using the consumer confidence survey conducted by the RBI, the study assesses 97,102 responses to conclude that from a net optimistic outlook in 2016, sentiment has shifted towards a net pessimistic outlook. The study's logistic regression shows that there is a high uncertainty in the future and that there is uncertainty with respect to the future of India's economy. The study also suggests that the timing of demonetization was inappropriate in the sense that it came at a time when the economy was recovering. I use this study to provide appropriate critiques regarding the 2016 demonetization in India.

Rajagopalan (2019) suggests that the demonetization policy of 2016 in India anticipated that a large share of the old notes was held by tax evaders and criminals, who, in the interest of avoiding legal scrutiny, would not exchange their currency for the new notes in circulation. However, the study found that after the demonetization policy, entrepreneurs discovered ways to effectively and swiftly launder money and 99.3% of the revoked currency was returned within the sixty-day window. Another indicator of a country's economy is the stock market performance. An event study of the S&P BSE 100 companies by Kaushik and Chauhan (2017) shows that the shock effect of demonetization on the market was only for a shorter duration, but it recovered soon. It concludes that the demonetization announcement did not have any significant impact on stock market prices.

A study by Verma (2018) analyzes that although there were expectations that people would return to old habits as cash flushed back into the economy after the exchange period, the value of electronic transactions still remained elevated and demonetization was a progressive shift to a cashless economy with a greater focus on digital payments. This is supported by another case study, Thirupathi (2019), that concludes there is a 440% increase in digital payments after demonetization in 2016. As per Reserve Bank of India (RBI) and National Payments Corporation of India (NPCI), the cashless transactions had been more intensive in familiar channels such as NEFT and mobile wallets.

Chavali, Prasad and Rao (2019) conducted a pre-post analysis of the impact of demonetization on digital transactions comparing PPI transactions and POS transactions (digital vs electronic). Based on the time period they analyzed, March 2015 - July 2018, they concluded that there is a significant increase in the usage of payment methods like PPIs as well as Debit cards usage (POS) in the post demonetization period. Agarwal, Poddar, and Karnavat (2020)

analyze how the mobile banking sector has an upward trend in countries like India as one-fifth (19.1%) of the total population is composed of the younger generation, which is further projected to grow up to 34.33% share by 2023. The time period being analyzed in this study was from July 2016 - July 2018. Compared to Chavali et. al. study and Agarwal et. al. study, this study analyzes two different variables against each other over a unique time period from October 2013 – October 2021.

In my study I look to analyze data from RBI from October 2013 - October 2021, a unique time period and more specifically analyze transactions for a period of 5 years after the demonetization event was announced. Although there are studies that analyze different payment system indicators over time periods, no study analyzes the volume and value of PPIs vs Mobile Banking from October 2013-October 2021. The reason I choose such a long time period is because although the event period is relatively short (November 2016-May 2017), the more observations you have on either side of the event in an Interrupted Time Series framework, the more robust your model would be (McDowall, et.al, 2019). Unlike other studies, this would capture the most recent available data to get a comprehensive understanding of consumer spending using digital payments, more specifically through mobile banking and prepaid payment instruments. The purpose of using a longer time period is so that it captures a more accurate representation of the underlying trend or phenomenon. For example, a stock price may experience a short-term increase in price due to speculation, but when looking at the stock over a longer time period, the price may be more reflective of the stock's intrinsic value. Similarly, a short-term trend in usage of PPI and Mobile Banking data may not be reflective of the longer-term effect that demonetization had on it.

My hypothesis is that demonetization coupled with the RBI's efforts to promote digital payment systems would have a positive effect on the trends for PPI and Mobile Banking in the non-event period. More specifically, I believe that demonetization would change the relative trend line more for the volume of PPI transactions than for Mobile Banking in the non-event period after the announcement. On a broader basis, there is evidence to suggest that digital forms of money and payments are attractive to poor populations for reasons such as reduced transaction costs, speedy process and safety of money (Donovan, 2012). PPI payments allow users to make payments directly from wallet to wallet, and offer features such as instant notifications, which are not available through mobile banking (Reserve Bank of India, 2022). PPI is more convenient and user-friendly, as customers can make payment transactions that are usually faster than mobile banking. PPI also allows customers to access their funds more quickly when using as they do not have to wait for their bank to approve a transaction before funds are available which is the case with some mobile banking transactions. Finally, PPI fees are usually lower than mobile banking fees, which makes it a more cost-effective option for Indian users(Paytm, 2022). All the reasons mentioned above in addition to the demographic market that PPI would attract in terms of users, I believe are ground reasons to influence my hypothesis.

Modi's 2014 financial inclusion campaign would serve as a platform to enable technology friendly financial literacy in India. The average Indian would now have access to a bank account which enables them to utilize digital payment systems like PPIs and Mobile Banking to facilitate their daily transactions compared to traditional cash usage. I would like to conclude this section with some relevant present day information. As seen in Table 2, according to the 2020 report by National Payments Corporation of India, the total percentage of Indian households using third party apps like Paytm, PhonePe (which is categorized under PPIs per RBI

guidelines) is much higher than the percentage of Indian households using a mobile for banking related purposes or having a mobile app for a bank (which is categorized under Mobile Banking per RBI guidelines). Further, Table 2 shows that PPIs are more popular compared to Mobile Banking in lower income households and small businesses, because with the growing popularity of apps such as Paytm and PhonePe, people are now empowered with a wide variety of payment solutions under one platform (Kumar and Singh, 2021).

Section 5

5. 1: Data Description

The data used in this study is monthly data from the Reserve Bank of India's "RBI Bulletin". The time period that I have used is data from October 2013 - October 2021. These data points can be found in the "Payment System Indicators" under the "Payment and Settlement Systems" sections of the monthly bulletin. The two payment methods that I am studying are Prepaid Payment Instruments, "PPI" and "Mobile Banking". The RBI defines PPI as the instruments that facilitate purchase of goods and services, conduct of financial services, enable remittance facilities, etc., against the value stored therein. PPIs can be issued by banks and non-banks. Banks can issue PPIs after obtaining approval from RBI. The non-bank PPI issuers are companies incorporated in India and registered under the Companies Act, 1956 / 2013. Examples of PPIs in India include prepaid cards, electronic purses, online wallets, QR-code vouchers, paper vouchers, etc. All types of these payments are digital except for paper vouchers which make up a minimal representation of total PPI transactions. As of 2019, less than 0.05% of PPI transactions were paper vouchers with the majority being mobile wallets and PPI cards (Statista, 2022). Third party companies such as Paytm and Amazon Pay offer PPI service platforms that link app wallets to bank accounts that can be pre-loaded and thus facilitate efficient purchases for

everyday consumer purposes. Mobile banking is quite self-explanatory and is defined as the use

of a smartphone mobile device to facilitate transactions such that all transactions should originate

from one bank account and terminate in another bank account. According to the 2014 RBI report

guidelines, Mobile Banking can be used to facilitate funds transfer from one bank account to

another bank account, both for personal remittances, corporate payments and purchase of goods

and services (Reserve Bank of India, 2014).

Under these two, I look at the volume (# number of transactions) and value (rupee value

of the transaction) for each of the payment system indicators. The bulletin breaks out PPIs into

three categories:- m-wallet, PPI cards and Paper Vouchers. I sum the individual value and

volume of each of these three categories for each month. This sum value is my final volume and

value data for that pertaining month period. Mobile banking data is given as an individual line

item. In total, I have four variables:- volume of PPI transactions , value of PPI transactions,

volume of Mobile Banking transactions and value of Mobile Banking transactions. The time

period being analyzed for this study is from October 2013 - October 2021 and I have 97 monthly

observations for each of these variables. Lastly, the volume variables are expressed in millions of

transaction units and the value variables are expressed in billions of rupees.

In this study, the monthly data is divided into three periods to facilitate an Interrupted

Time Series model:- estimation period, event period and non-event period. The estimation period

is from October 2013 - October 2016. The event period consists of data from November 2016 -

May 2017. I end the event period in May because that marked the end of the period of exchange

notes for everyone. This longer extension period was for some people like nonresident Indian

citizens etc. The non-event period consists of data from June 2017 - October 2021. The summary

statistics for the 4 variables are in Table (3) below.

5.2: Methodology

In this study, I plan to use an Interrupted Time Series ("ITS") to analyze how demonetization affected the value and volume of PPIs and Mobile banking In India. McDowall, David, McCleary, and Bartos (2019) describe an ITS can be described as a methodology for studies that have a large number of observations, $N > 15$, and the data being analyzed is available for a period before and after the intervention. An ITS helps you analyze an outcome that has changed after an intervention and the more observations that you have on either end of the intervention, the more robust your model will be (McDowall et. al, 2019). I choose to use this model because it is the strongest quasi-experimental design to assess the impact of an intervention. A key factor in picking this model was to analyze the PPI and Mobile Banking trends had the government not announced the demonetization of currency. An ITS model for this study would help us extrapolate data trends before demonetization and predict trends for our variables had demonetization not occurred (Jandoc, 2019). This method was first used in health services research in 1981 to study the effects of regionalized perinatal care. Subsequently, it has been used to evaluate the effects of interventions in healthcare, vaccines, new policies etc. For example, this model was used to study the impact of healthcare interventions on the utilization of drugs (Jandoc, 2019). In most cases, there is an underlying trend that is interrupted by an intervention at a specific point in time. In this study we observe trends for each of our four variables mentioned above and the intervention is the demonetization announcement that took place in November, 2016. In a similar framework, Taneja (2020) uses an ITS model to analyze the effect of demonetization on ATM and POS transactions in India. In this study we analyze the

PPI and Mobile Banking transactions using the same model as Taneja (2020) for a time period of 97 months.

      The estimation (pre-intervention) period in this model is from October 2013 - October 2016, a period of 36 months. Using this period and the 4 variables that are being I analyzed, I create trend lines for the 4 regression equations: -

- PPI_Val $= \beta0 + \beta1t + u$
- PPI_Vol $= \beta0 + \beta1t + u$
- MB_Val $= \beta0 + \beta1t + u$
- MB_Vol $= \beta0 + \beta1t + u$

In these equations, t ε time period for months within our sample. The data is constructed such that each month is its unique observation i.e., October 2013 = 1 as our first observation and October 2021 as our last, 97th observation. The purpose of these (estimation period) regressions is to observe trends prior to demonetization and support creating a counterfactual trend had the intervention not been announced. These are also used in the subsequent regressions to test my hypothesis.

      The post-event period in this model is from June 2017 - October 2021. I would be using the following regressions to study the stability of the trends after the intervention: -

- PPI_Val $= \beta0 + \beta1t + \partial0\{t \leq T^* -12\} + \partial1\{t \leq T^* -12\}t + \alpha0\{t \geq T^* + 6\} + \alpha1\{t \geq T^* + 6\}t + u$
- PPI_Vol $= \beta0 + \beta1t + \partial0\{t \leq T^* -12\} + \partial1\{t \leq T^* -12\}t + \alpha0\{t \geq T^* + 6\} + \alpha1\{t \geq T^* + 6\}t + u$
- MB_Val $= \beta0 + \beta1t + \partial0\{t \leq T^* -12\} + \partial1\{t \leq T^* -12\}t + \alpha0\{t \geq T^* + 6\} + \alpha1\{t \geq T^* + 6\}t + u$
- MB_Vol $= \beta0 + \beta1t + \partial0\{t \leq T^* -12\} + \partial1\{t \leq T^* -12\}t + \alpha0\{t \geq T^* + 6\} + \alpha1\{t \geq T^* + 6\}t + u$

      $\beta0$ and $\beta1t$ capture the intercept and trend for the event period (November 2016 – May 2017), $\partial0$ and $\partial1$ capture the intercept and trend for the estimation period (October 2013 –

October 2016), and α0 and α1 capture the intercept and trend for the non-event period (June

2017 – October 2021) and how it differs from the estimation window. The intercept being

captured is an indicator variable which equals to 1 if the month falls into the respective period

being analyzed. For example, intercept for October 2013 would be 1 for the estimation period

and 0 for the event and non-event period.

Next, we analyze the stability of our model to confirm our hypothesis of whether

demonetization had an impact on PPI or Mobile Banking transactions. This is observed by

creating a counterfactual trend had demonetization not been announced and comparing the

distance between the original trend to the counterfactual trend to see the observed stability. If the

trend changes during the event window, relative to the pre-event window, it means that there is

an immediate impact for that variable because of the demonetization announcement. I test this by

evaluating the following:

$$Ho: \partial 0 = \alpha 0$$

$$And$$

$$\partial 1 = \alpha 1$$

Table 4 shows the regression results: coefficients and standard errors for $\beta 1t$, $\partial 0$, $\partial 1$, $\alpha 0$

and α1. Tables (5-8) show the full regression results for the 4 variables.

Section 6

6.1: Results

Figures 4, 5, 6 & 7 show the trends for the 4 variables: - PPI_Val, PPI_Vol, MB_Val and

MB_Vol respectively. Figures 8, 9, 10 & 11 show the logarithmic trends for our 4 variables in

relation to the counterfactual trends had demonetization not been announced. The main reason

for using log values in regressions is to reduce the impact of outliers and to make the data more

normally distributed. Log values also tend to reduce the effect of extreme values and reduce the

effect of multicollinearity, which can lead to inaccurate results when using linear regression.

Table 4 shows that the coefficients are positive, and the results are statistically significant for all

4 variables in the non-event period ($\alpha 0$ and $\alpha 1$) suggesting that there has been an overall

increasing trend for all 4 variables in the non-event period. For PPI Volume, the non-event

period coefficients (1.933 & 0.0304) are greater than the estimation period coefficients (-0.419 &

0.0287). MB Vol non-event coefficients are (0.454 & 0.00471) are lower than estimation period

coefficients (0.706 & 0.0286). These results confirm our hypothesis that demonetization would

have a bigger positive impact on PPI than Mobile Banking in the non-event period. This suggests

that for an increase in one month in the non-event period, PPI volume transactions increased by

1.93 % compared to MB volume transactions which increased 0.45% ($\alpha 0$).

Comparing Figure 5 & 7, we analyze the trends specifically for PPI_Vol and MB_Vol

respectively. As suggested by the maximum Y-axis intercepts, the volume for PPI transactions is

significantly higher than the volume for Mobile Banking transactions. Figures 9 & 11 show the

log value for the volume variables across the time period in addition to the observed and

counterfactual trends to check for stability. In Figure 9, the results show that the "Trend" line is

slightly higher than the counterfactual for PPI_Vol after demonetization was announced through

the non-event period. In Figure 11, the results show that the "Trend" line is in fact higher than

the counterfactual for MB_Vol in the event period. This is also supported by the higher

coefficient (0.0513) for MB_Vol compared to PPI_Vol (0.0192) during the event period as seen

in Table 4. Thus, although the immediate impact of demonetization was greater for MB_Vol, the

trend stabilizes, and the counterfactual is higher through the non-event period. As mentioned

above, our hypothesis is confirmed based on the results in Table 4 (PPI volume exceeds MB

volume in the long run).

Next, we compare Figure 4 & 6, which analyze the trends specifically for PPI_Val and

MB_Val respectively. As suggested by the maximum Y-axis intercepts, the value for PPI

transactions is significantly lower than the value for Mobile Banking transactions. Figures 8 &

10 show the log value for the volume variables across the time period in addition to the observed

and counterfactual trends to check for stability. In Figure 8, the results show that the "Trend" line

is consistently lower than the counterfactual for PPI_Val after demonetization was announced

through the non-event period. In Figure 11, the results show that the "Trend" line is also lower

than the counterfactual for MB_Val after demonetization was announced. However, the trend for

MB_Val is more stable (closer to counterfactual) than the trend for PPI_Val as supported by the

figures below. Lastly, the greater coefficients for MB_Val compared to PPI_Val for the non-

event period in Table 4 show that value of Mobile Banking transactions was greater than PPI

after demonetization.

6.2: Conclusion

The 2016 demonetization is a crucial economic regime in the history of Indian fiscal

policies. This event affected industries and the Indian population across all industries and

sectors. Demonetization and its effects have been studied through multiple scopes to examine the

quantum effect of this policy. In this study, we focus on the effects that demonetization has on

the digital payment infrastructure in India. More specifically, we analyze two methods of digital

payments: - Prepaid Payment Instruments "PPI" and Mobile Banking from October 2013 -

October 2021 to conclude that demonetization did indeed have an impact on the value and volume of these payment methods.

In the results we can see that for the time period being analyzed, the volume of PPI transactions was significantly higher than the volume of Mobile Banking transactions after demonetization was announced compared to the period before the announcement. This supports my hypothesis that the trend line for PPI would be greater than the trend line for Mobile Banking in the non-event period. Although it was interesting to note that the value of Mobile Banking transactions as a whole was significantly higher than value for PPI transactions. This can be attributed to the Indian demographic characteristics and how PPIs are primarily used for smaller transactions such as personal remittances and purchases of minimal value goods. In addition, there is growing popularity of third party apps such as Paytm, PhonePe etc. that offer payment platform services which fall under PPI recognition under RBI. On the other hand, RBI characterizes Mobile Banking transactions as individual payments and corporate payments initiated, processed, and authorized using mobile devices. It is intuitive that corporate payments would be much higher in value compared to the nature of transactions that RBI characterizes as PPI transactions, thus supporting the above mentioned results.

This study offers an insight into the digital payment trends in India over a 7 year period. India has been adopting a multitude of technology enabled payment methods in the years to come. Demonetization followed by the COVID-19 pandemic has seen India emerge as a global leader in adoption of FinTech services, but particularly for money transfer and payment services. 99.5% of Indian consumers have financial literacy and FinTech services available to transfer money and make payments (Ernst & Young, 2019). For a country that was a heavily cash

dependent economy at the time of the demonetization announcement in 2016, India has shown promising growth towards a digital economy in the last decade.

It is important to note that this study is limited to the analysis of two payment methods: - PPIs and Mobile Banking transactions. It does not account for other forms of non-cash payments such as debit cards, credit cards, Real time gross settlement "RTGS", Retail electronic clearing transactions etc. and is thus limited in its scope. Further this study can also be used to draw inferences on how policy changes with respect to the leading payment system in a country could potentially affect consumer trends in that country. For India, I conclude that overall demonetization has had a net positive impact on the shift to a digitized economy especially for PPI enabled services but there is still a long way for India to achieve its goal of a 100% digital payment system based economy.

Section 7: Figures & Tables

प्रेस प्रकाशनी **PRESS RELEASE**

भारतीय रिज़र्व बैंक
RESERVE BANK OF INDIA
वेबसाइट : www.rbi.org.in/hindi
Website : www.rbi.org.in
इ-मेल email: helpdoc@rbi.org.in

संचार विभाग, केंद्रीय कार्यालय, एस.बी.एस.मार्ग, मुंबई-400001

DEPARTMENT OF COMMUNICATION, Central Office, S.B.S.Marg, Mumbai-400001
फोन/Phone: 91 22 2266 0502 फैक्स/Fax: 91 22 22660358

November 08, 2016

Withdrawal of Legal Tender Status for ₹ 500 and ₹ 1000 Notes: RBI Notice

Government of India vide their Notification no. 2652 dated November 8, 2016 have withdrawn the Legal Tender status of ₹ 500 and ₹ 1,000 denominations of banknotes of the Mahatma Gandhi Series issued by the Reserve Bank of India till November 8, 2016.

This is necessitated to tackle counterfeiting Indian banknotes, to effectively nullify black money hoarded in cash and curb funding of terrorism with fake notes.

Starting from November 10, 2016, members of public/corporates, business firms, societies, trusts, etc., holding these notes can tender them at any office of the Reserve Bank or any bank branch and obtain value thereof by credit into their respective bank accounts.

For their immediate cash needs, these notes of value up to ₹ 4,000 per person can be exchanged for cash over the counter of these bank branches.

Public are advised to present a valid proof of identity for availing this exchange facility.

Value credited to their bank accounts can be freely used by issue of cheques or by remitting through various electronic modes of transfer like NEFT, RTGS, IMPS, mobile banking, internet banking etc. Cash withdrawals from bank accounts, over the bank counters, will be restricted to a limited amount of ₹ 10,000 per day subject to an overall limit of ₹ 20,000 a week from November 9, 2016 till end of business on November 24, 2016. The limits will be reviewed after this.

All ATMs and other cash machines will remain shut on November 9, 2016 to facilitate recalibration. When ready, they will be reactivated and cash drawals from ATMs will be restricted to ₹ 2,000 per day per card up to November 18, 2016 and the limits shall be raised to ₹ 4000 per day per card from November 19, 2016.

Any person who is unable to exchange or deposit the specified banknotes in their bank accounts on or before December 30, 2016 shall be given an opportunity to do so at specified offices of the Reserve Bank or such other facility until a later date as may be specified by the Reserve Bank.

For more details members of the public may visit RBI website www.rbi.org.in and Government web site www.finmin.nic.in for further information and details.

Alpana Killawala
Principal Adviser

Press Release : 2016-2017/1142

Figure 1

प्रेस प्रकाशनी **PRESS RELEASE**

भारतीय रिज़र्व बैंक
RESERVE BANK OF INDIA
वेबसाइट : www.rbi.org.in/hindi
Website : www.rbi.org.in
इ-मेल email: helpdoc@rbi.org.in

संचार विभाग, केंद्रीय कार्यालय, एस.बी.एस.मार्ग, मुंबई-400001
DEPARTMENT OF COMMUNICATION, Central Office, S.B.S.Marg, Mumbai-400001
फोन/Phone: 91 22 2266 0502 फैक्स/Fax: 91 22 22660358

November 08, 2016

Issue of ₹ 2000 banknotes with inset letter 'R'

The Reserve Bank of India will shortly issue ₹ 2000 denomination banknotes in the Mahatma Gandhi (New) Series, with the inset letter **'R'**, bearing signature of Dr. Urjit R. Patel, Governor, Reserve Bank of India, and the year of printing '2016' printed on the reverse of the banknote.

The design of these notes to be issued now is similar in all respects to the ₹ 2000 banknotes in Mahatma Gandhi (New) Series which was notified through Press Release No. 1144 dated November 08, 2016.

The banknotes issued earlier vide Press Release No. 1144 dated November 08, 2016. will continue to be legal tender.

Press Release : 2016-2017/1145

Alpana Killawala
Principal Adviser

Figure 2

भारतीय रिज़र्व बैंक
RESERVE BANK OF INDIA
वेबसाइट : www.rbi.org.in/hindi
Website : www.rbi.org.in
इ-मेल email: helpdoc@rbi.org.in

संचार विभाग, केंद्रीय कार्यालय, एस.बी.एस.मार्ग, मुंबई-400001

DEPARTMENT OF COMMUNICATION, Central Office, S.B.S.Marg, Mumbai-400001
फोन/Phone: 91 22 2266 0502 फैक्स/Fax: 91 22 22660358

November 08, 2016

Issue of ₹ 500 banknotes inset letter 'E' in Mahatma Gandhi (New) Series

The Reserve Bank of India will shortly issue ₹ 500 denomination banknotes in Mahatma Gandhi (New) Series with inset letter 'E' in both the number panels, bearing the signature of Dr. Urjit R. Patel, Governor, Reserve Bank of India, the year of printing '2016' and Swachh Bharat Logo printed on the reverse of the Banknote.

Figure 3

Table 1. History of demonetization in countries around the world

Countries	Year	Demonetized Currency & Purpose	Results
United States of America	1873 & 1969	1873: Coinage Act of 1873 ordered the elimination of silver as legal tender in favor of the gold standard	1873: Money supply contraction and a 5-year economic downturn. Led to Bland-Allison Act of 1878, re-monetizing silver as legal cash.
		1969: All currencies over $100 would be null to combat existence of black money	1969: Huge success, credited for the formation of American banking system. To date, $100 is highest circulated denomination.
Ghana	1982	Demonetized 50-cedi currency to curb tax evasion	Resulted as a failure and emergence of a new currency illicit market
Soviet Union	1991	50- and 100-ruble notes were removed from circulation to combat parallel economy	Economic disruption and eventual disintegration of the USSR.
North Korea	2010	Unknown specifics – proposed currency adjustment to stop the black market and strengthen the economy	Failure as cost of products rose and finance minister was assassinated.
Zimbabwe	2015	Replace Zimbabwe dollar with US dollar to stabilize hyperinflation	Failure due to loss of competitiveness

Source: https://wealthbucket.in/blog/history-of-demonetization/

Table 2. Digital Payment Methods – User share of households

Variable Type	Digital Payment Instrument	Income Groups			Total
		Bottom 40%	Middle 40%	Top 20%	
PPI	Paytm, PhonePe	80%	79%	78%	79%
PPI	UPI	56%	45%	56%	52%
NA	Have smart phone	57%	72%	90%	68%
Mobile Banking	Banking through bank app	14%	37%	59%	31%
Mobile Banking	Use phone for banking	5%	17%	30%	14%

Source: NPCI Price Report 2020

Table 3. Summary Statistics for PPI and Mobile Banking

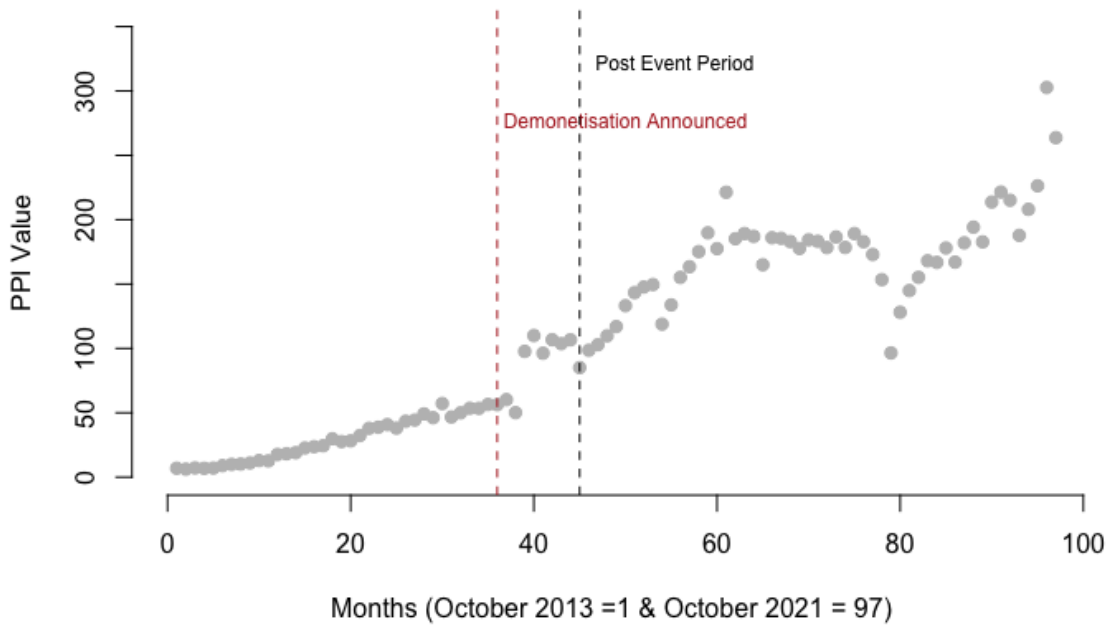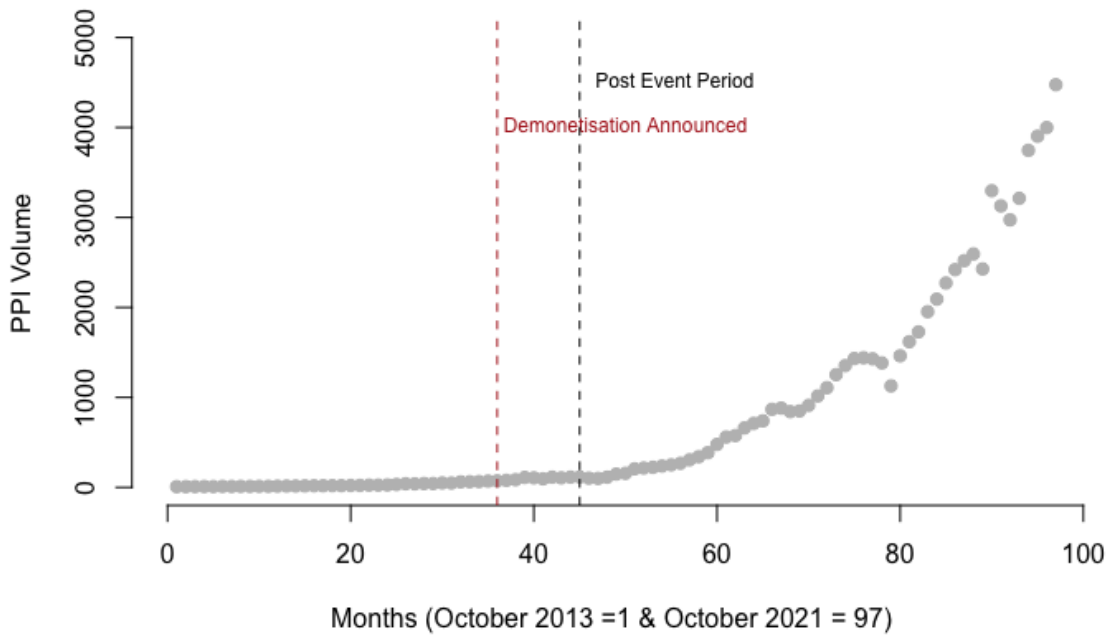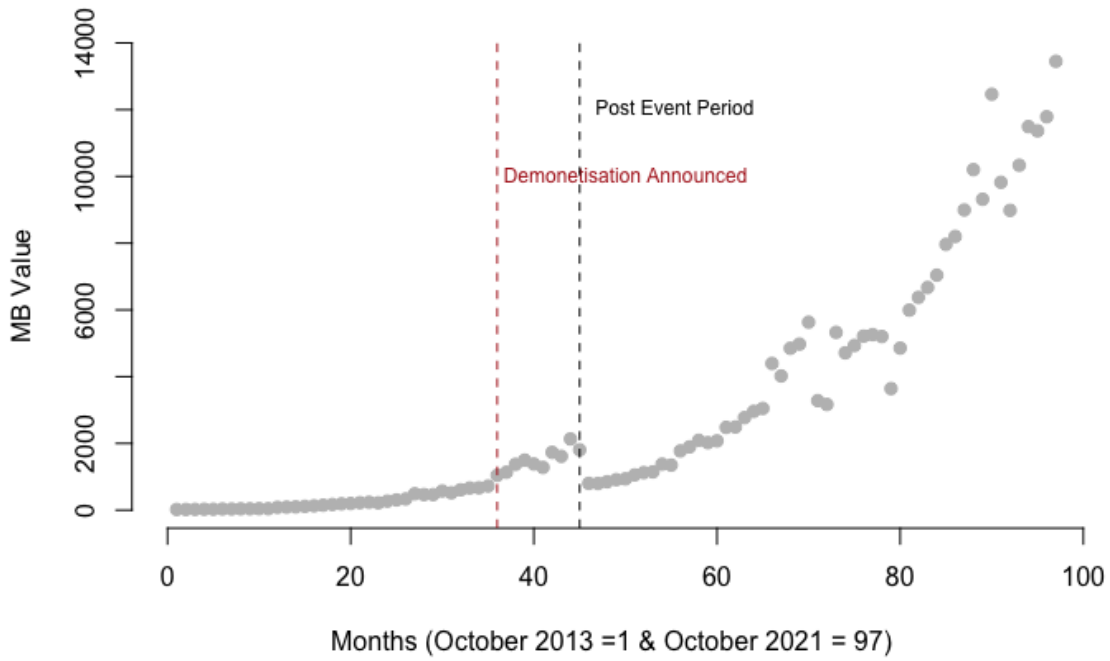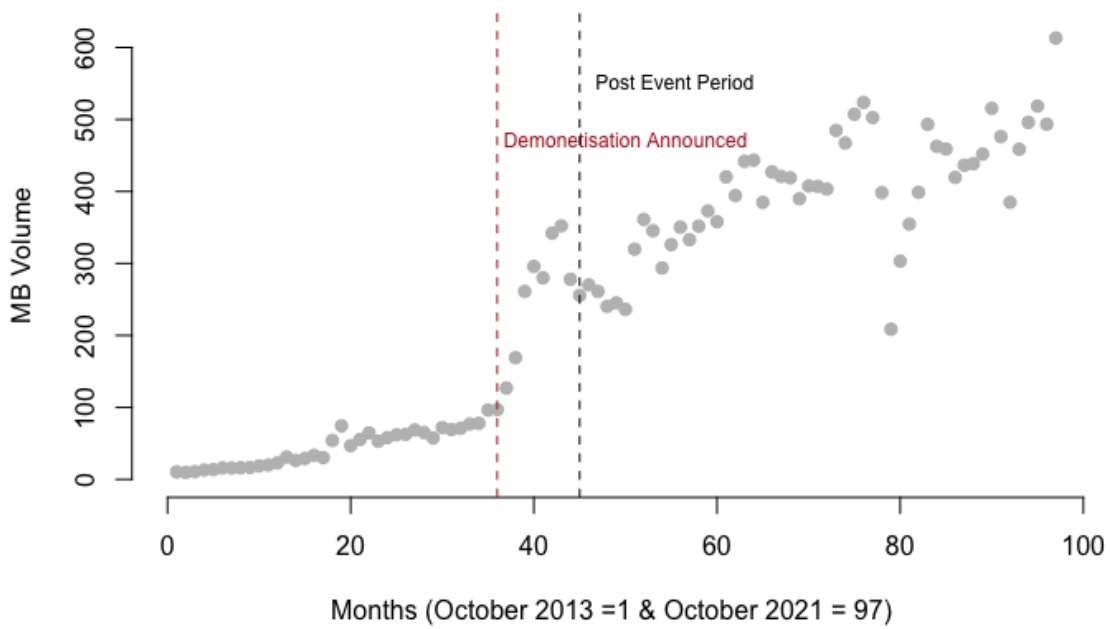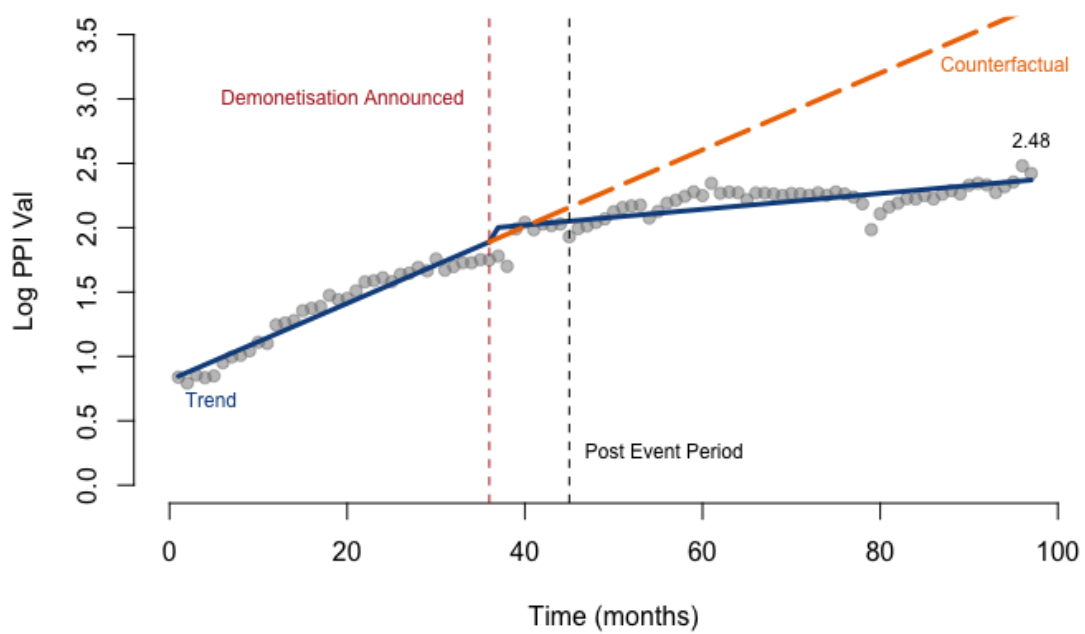| Variable	Obs.	Mean	Std. Dev.	p25	Median	p75
PPI_Value	97	112.16	74.69	40.81	110.01	178.44
PPI_Vol	97	767.07	1099.31	32.48	147.82	1127.60
MB_Val	97	2960.84	3489.47	305.68	1378.44	4855.13
MB_Vol	97	256.38	181.27	62.66	293.66	419

Figure 4

Figure 5

Figure 6

Figure 7

Figure 8
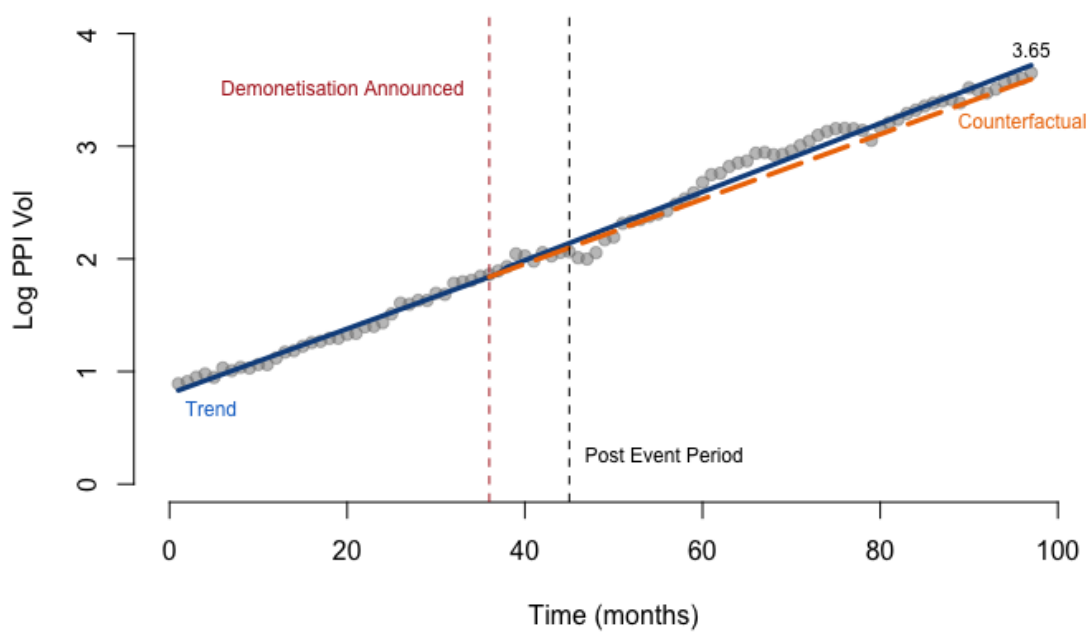

Figure 9
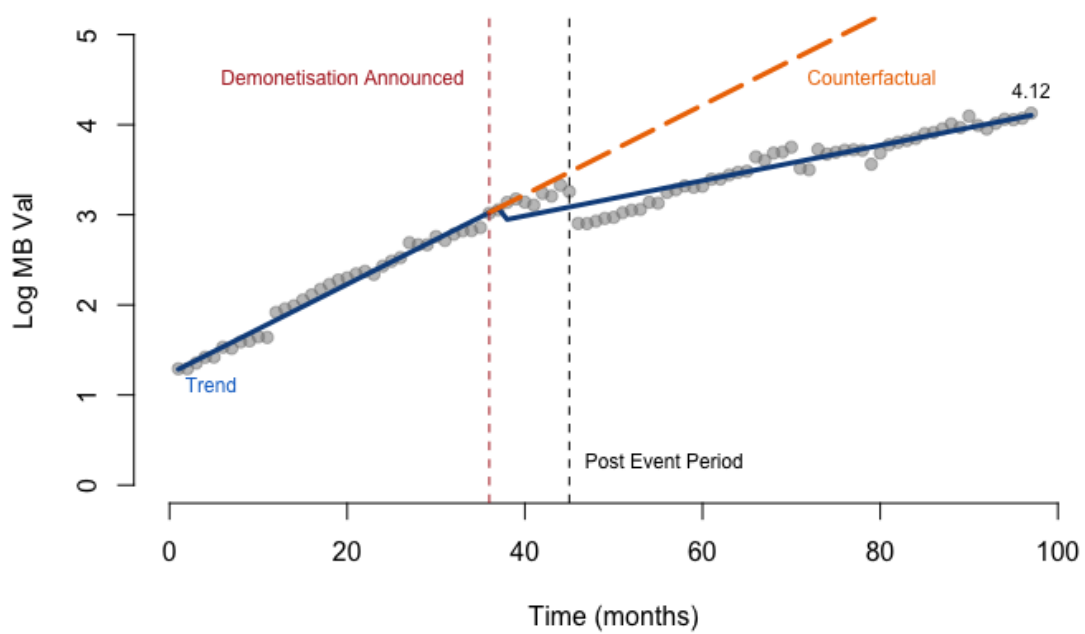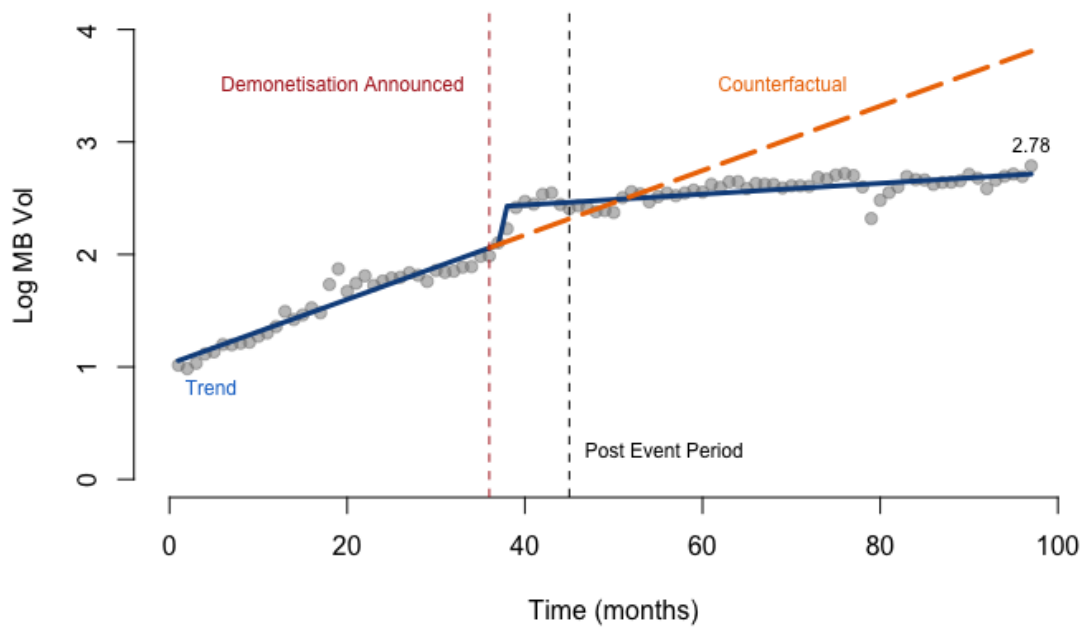
Figure 10

Figure 11

Table 4. Regression Results

VARIABLES	(1) LogPPI_Val	(2) LogPPI_Vol	(3) LogMB_Val	(4) LogMB_Vol
tbeta1	0.0402***	0.0192***	0.0288***	0.0513***
	(0.0114)	(0.00508)	(0.00624)	(0.0161)
delta0	0.498	-0.419*	-0.773***	0.706
	(0.482)	(0.214)	(0.249)	(0.654)
delta1	0.0298***	0.0287***	0.0498***	0.0286***
	(0.00130)	(0.000680)	(0.00101)	(0.00110)
alpha0	0.0455***	1.933**	1.584**	0.454***
	(0.485)	(0.223)	(0.258)	(0.655)
alpha1	0.00451***	0.0304***	0.0227***	0.00471***
	(0.000760)	(0.000838)	(0.000915)	(0.000567)
Constant	0.318	1.224***	2.007***	0.322
	(0.482)	(0.214)	(0.248)	(0.654)
Observations	97	97	97	97
R-squared	0.971	0.993	0.989	0.978

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

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