The Power of a Financially Literate Woman in Intra-Household Financial Decision-Making

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Abstract

Using India's national benchmark survey for financial literacy and inclusion, we observe a step change in financially literate women, who possess higher levels of sole and joint responsibility with their spouse to manage their households' finances. Considering ownership information in eighteen different financial products, alternative investments (such as gold, property) and informal banking (such as savings at home, loans from moneylenders), we find that household product holdings are greatest where the husband and wife are jointly responsible for financial decision-making, and in particular where the wife is financially literate. Such households benefit from men's preference for higher risk-return products, whilst also holding security-focused products, such as savings and insurance products, favored by women. The findings emphasize the importance of financial literacy and spousal teamwork in intra-household financial decision-making.

1   Introduction

Historically, inequality in income and education meant that intra-household decision-making roles for men and women remained segmented. However, in recent times women are increasingly more active in the workforce and have become greater contributors to household income. For instance, women own 27 percent of global wealth, with the highest annual growth observed in Asia (excluding Japan), reaching nearly 30 percent in 2009 (Damisch et al., 2010). This means that there is a growing interest in understanding the financial outcomes of households when intra-household financial decision-making is shared between husband and wife, rather than one spouse.

However, recent worldwide evidence shows that it is men who tend to be responsible for important financial decisions within households. A recent survey conducted by UBS Global Wealth Management reveals that the majority of women worldwide leave investing and financial planning decisions to their spouse. Less than one in four women (23 percent) are involved in making long-term planning decisions within their households (UBS, 2019). This leaves women exposed to significant financial risks when faced with unexpected family crises, unless they respond with investing in financial knowledge (Hsu, 2016). There could be several reasons for women leaving financial decision-making responsibilities to their spouse. For example, recent studies document that women's influence in intra-household financial decision-making is constrained by the social contexts households operate in and implicit gender norms differentiating men's and women's roles within households (Ke, 2021; Guiso and Zaccaria, 2021). A skills-based explanation is that women possess

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lower levels of financial literacy than men (Lusardi and Mitchell, 2008; Bucher-Koenen et al., 2017; Hasler and Lusardi, 2017) and therefore may be unwilling to take on the responsibility of financial decision-making.

2   Our study

In this study, we use information on women and men's financial decision-making levels (either sole or joint decision-making with spouse), financial literacy scores of these decision-makers, and granular ownership information on a large set of financial and alternative instruments, to investigate two unanswered questions. First, what is the role of financial literacy in empowering women to be involved in intra-household decision-making and in turn, leading their households to participate in different types of financial products and services? A priori, it is likely that the balance sheets of households led by financially literate female and male decision-makers will look different. For instance, since women tend to be more risk-averse, they may prefer holding a safer household financial portfolio, as compared to households led by men. This leads us to investigate the second important question: is there a material difference in portfolio holdings when a husband-and-wife team is jointly making financial decisions, over one spouse taking sole responsibility in managing household finances? The findings contribute to the understanding of financial (non-)participation rates of households with different financial management structures.

3   Data

We utilize India's first nationally representative survey for financial literacy and inclusion fielded in 2015, with granular information on financial responsibility levels, and financial portfolio holdings information of around 60,000 Indian households. We observe three levels of decision-making responsibility among respondents: (i) solely responsible for making the household financial decisions; (ii) jointly responsible with spouse; or (iii) no responsibility for financial decision-making. For each household, the survey records whether they hold financial and alternative instruments from six different product categories, including savings schemes, investment products, stocks, insurance products, loans and credit cards, and alternative investment products. We take into account the ownership decisions of eighteen different financial products within the six different product categories, including recurring and fixed deposits, post office savings schemes, Kisan Vikas Patra, public provident fund, mutual funds, bonds, stocks, life insurance, health insurance, home insurance, cattle and crop insurance, personal loans, (subsidized) credit cards, loans from microfinance institutions, chit-funds, collective investment schemes, investment in gold/silver, and investment in property. We also consider participation in informal banking activities, including saving money at home, saving money informally, and holding loans from money lenders.

4   Empirical model

We assess the differentials in portfolio holdings of households solely or jointly run by financially literate men and women decision-makers, which is the main goal of the paper. For this, we estimate a structural model, jointly modeling the ordered responsibility levels and the probability of holding financial instruments as a system of equations. The estimation seeks to capture the influence of financial literacy on an individual's financial responsibility levels within their household, and conditional on the responsibility levels, their probability of owning different types of financial products and services. The structural model estimation enables us to accommodate for any endogenous treatment effects arising from the fact that both financial responsibility levels and the decision to own financial products can be influenced by financial literacy and thereby confound our findings.

5   Summary of the findings

The results of the structural model reveal the following: First, we find that financially literate women have a greater probability of jointly leading household money matters with their husband. When we study participation in informal banking activities, such as saving money at home and borrowing money from moneylenders, we observe that both financially literate men and women tend to possess significantly lower levels of responsibility for money matters in such households.

Secondly, once we model the effects of individuals' financial literacy on responsibility levels in the first stage of the structural model, we find that greater levels of financial responsibility (either joint or sole responsibility) do not have any significant relationship for financial product ownership decisions. This means that possessing increased levels of responsibility in itself is not significantly related to increased financial product holdings, and what matters for participation in financial markets is the financial literacy levels of decision-makers.

Thirdly, a series of interesting findings emerge when evaluating the cross-marginal effects of the changes in financial literacy on the likelihood of holding financial products, for different responsibility levels among men and women. The key findings are summarized below:

- We firstly consider individuals taking sole responsibility. Financially literate male decision-makers display significantly greater holdings in the product areas with higher risk-return, such as investment products and stocks. In contrast, female decision-makers, who are known to be more risk-averse, show a greater focus on security by investing more in savings schemes, insurance products and alternative investments. Further, households solely led by financially literate women participate less in informal banking activities, including saving money at home, saving money informally and taking loans from moneylenders.

- When we consider households where financially literate women are jointly responsible with their spouse for financial decision-making, the addition of the husband in financial decision-making has significant effects on financial holdings across the board. The greatest effects among women are seen for investment products and stocks – a holdings increase of around 88% for women jointly making decisions with their husbands, as opposed to women acting alone. This shows that joint decision-making with spouse not only helps financially literate women to benefit from men's preference for higher risk-return products, but also it emboldens women to play to their strengths by investing even more in the security-focused products, such as savings and insurance products, favored by women.

- Among financially literate male decision-makers, the addition of their wives in financial decision-making likewise results in increased product holdings, albeit to a lesser extent. The greatest influence is seen on their holdings of insurance products and savings schemes, as well as a lower participation in informal banking activities. This indicates that the financially literate men also benefit from involving their wives, who naturally focus on security. Interestingly, the inclusion of women to jointly lead with male decision-makers does not reduce the product holdings that men prefer, such as investment products and stocks.

The above results suggest that financial literacy interventions targeting women can empower them to take on higher levels of financial responsibility within their households and help reduce the gender gap observed in financial market participation. Moreover, the household as a whole benefits from the addition of a financially literate woman in a husband-and-wife decision-making team, with such households displaying greatest holdings in financial products across the board, and least participation in informal banking practices. The results substantiate the important role of financial literacy in reducing the barriers to owning financial products, as also documented by previous studies (see, for example, Van Rooij et al., 2011; Balloch et al., 2015; Lusardi and Mitchell, 2017). Additionally, the results highlight the benefits accrued from holding a diversified portfolio for a financially literate household (Reinholtz et al., 2021).

When we consider marginal gains of financial literacy across the caste hierarchy, which captures the social norms in India, the General Caste (highest on the hierarchy) have higher participation gains in savings

products, investment products and the stock market, as compared to the other castes. The Scheduled Tribe (lowest on the hierarchy) is observed to have the lowest financial literacy marginal gains for participation in insurance products and alternative investments. These results show unequal participation in the different castes, an important aspect to consider by policy makers designing financial literacy interventions to increase the uptake of various financial products and services. When studying the different intra-household decision-making arrangements, across all castes, the highest marginal effects for the probability of holding financial products are observed when women are financially literate and jointly leading financial decisions with their husbands.

Overall, this study documents that empowering decision-makers with financial literacy has the potential for improving households' financial decision-making abilities and can also serve as an important intervention tool to increase gender equality and social parity. Our results are of particular relevance to the policy discussions concerning empowering women with financial literacy to reduce the gender gap in financial product holdings and increase household participation in financial product markets. The financial education treatment effects on behavior changes in the area of personal finance are confirmed by recent studies (Kaiser et al., 2020). Moreover, the growing longevity gap between males and females in India implies that India's older adult population is growing increasingly female (Agarwal et al., 2020). This means India faces an increasingly female and disproportionately financially vulnerable aging population, highlighting the need for policy makers to target financial education interventions for women.

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The Effects of Regulation on the IPO Market in India

Introduction

Many firms raise capital by going public through Initial Public Offerings (IPOs) and listing their shares on various exchanges. Initially, the price per share is either fixed or determined through the book-building process. The primary market investors bid within the price bracket set by the firm for efficient price discovery. As soon as the shares are allotted through the primary market, traders and investors initiate the buying and selling of stocks in the secondary market. Because of uncertain initial prices in the secondary market, many traders and investors speculate in IPOs to reap immediate profits. The high volume of speculative trading in the initial days of an IPO further increases price volatility, leading to abnormally high prices. To tackle this situation, the Securities Exchange Board of India (SEBI) brought introduced a new regulation in January 2012. As per this regulation, daily returns of IPOs raising less than INR 2.5 billion are bound within a bracket of ±5 %, and daily returns of IPOs raising greater than INR 2.5 billion are bound within a bracket of ±20 %. The price limits are maintained for the first 10 trading days after IPO listing. This restriction led to many changes in both the behaviour of IPO issuing firms and the trading activity by various investor types, post IPO listing. We will discuss these trends through the results of our tests treating the introduction of the new regulations as the setting of a natural experiment. We use a customized data set from the Bombay Stock Exchange (BSE) in India for pre- and post-regulation periods. Moreover, we used matched sample analysis to compare IPOs in the pre- and post-regulation periods.

1) Lower Price Variability

The ratio between the open price and the highest price for the day was calculated for all IPOs listed in pre- and post-regulation periods. As shown in Fig. 1 (a), the mean of the open-high ratio – represented by horizontal dashes- declined significantly from around 1.21 pre regulation to 1.05 post regulation. Also, the interquartile range of open-high ratio – represented by the vertical lines – declined post regulation as well.
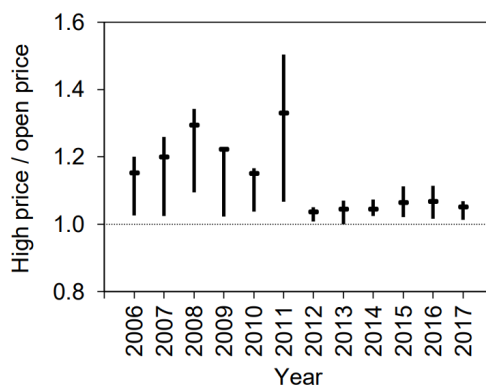

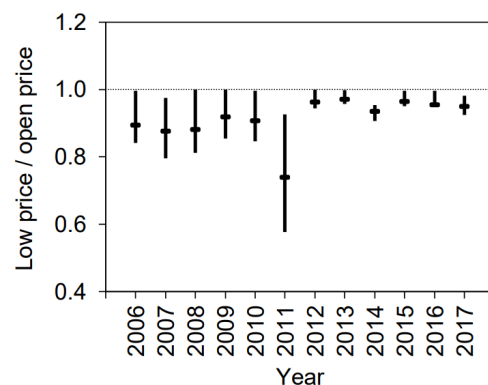*Fig 1(a): Distribution of high relative to open prices*

Fig 1(b): Distribution of low relative to open prices on

Similarly, Fig. 1(b) depicts the open-low ratio for the pre- and post-regulation IPOs. The mean open-low ratio has decreased (in absolute terms) from 1.13 pre regulation to 1.04 post regulation. The reduction in the mean open-high and open-low ratios and the reduced interquartile ranges depict that the IPO market price movement became less variable after 2012, thus reducing speculative opportunities.

On an open-close basis, the returns for the first day of the IPO, after being capped is shown in Fig 2(a). The abnormal lottery-like returns evident in the pre-regulation period declined drastically in the post-regulation period, leading to less opportunities for speculation. Although the price brackets were imposed for a period of 10 days after IPO listing, further computation of the standard deviation of returns for an entire month suggests that the volatility, in general, reduced even beyond the 10th day (except for the spill-over effect visible on the 11th day) when compared to pre-regulation periods, as visible in Fig 2(b). The key reason behind this could be the reduced uncertainty around the IPO as it reaches the 10th day of trading.
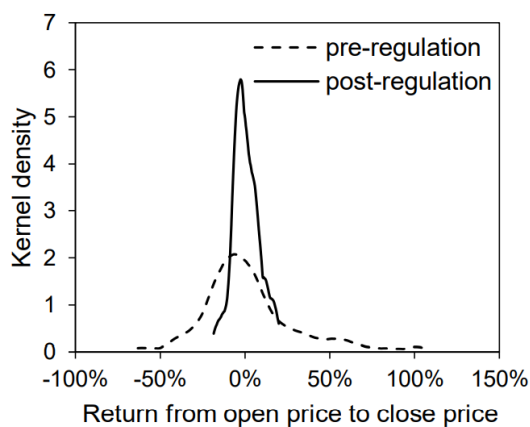
Fig 2(a): Open-to-close return
on first day of trading
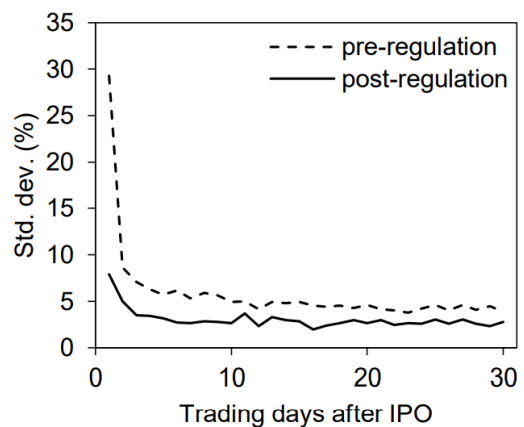
Fig 2(b): Standard deviation
of daily return after IPO

2) Lower demand for IPO stocks

The reduced volatility post regulation made it difficult for retail investors to speculate. Thus, the usually high demand for the IPOs declined drastically. The demand by retail investors declined, as evidenced by a decline in subscription rates from 9 times the shares allotted to them in the pre-regulation period to 4.7 times their allotted shares. Other investor segments, such as qualified institutional buyers (QIBs), also demanded fewer IPO shares post regulation, visible in the decline from subscription rates of 36.1 times pre regulation to 12.6 times post regulation. This trend was not evident for high net worth individuals (HNIs) as their demand rose from nearly 49 times in the pre-regulation period to 75 times in the post-regulation period. Other investor segments like employees also showed a similar trend, whereas the existing shareholders' trend was not significant enough in the two periods.

Share allocations were similar between the two periods, likely due to existing regulations on how IPO shares should be allocated among investor groups. One exception is the increase in shares allocated to HNIs, possibly due to their increased demand, as discussed above.

	Pre-regulation	Post-regulation	Difference
Times subscribed:			
Qualified institutional buyers	36.086	12.603	− 23.483
Retail investors	9.042	4.678	− 4.364
High-net-worth individuals	48.643	75.437	26.794
Employees	0.384	0.208	− 0.176
Existing shareholders	0.038	0.171	0.133
All investors	28.613	18.970	− 9.643
Percent allocation:			
Qualified institutional buyers	55.174	53.954	− 1.220
Retail investors	31.343	30.051	− 1.292
High-net-worth individuals	11.684	14.817	3.133
Employees	1.457	0.672	− 0.784
Existing shareholders	0.342	0.506	0.164
All investors	100.000	100.000	0.000

Table 1: Subscription and allocation by investor type

3) Changes in Investor Trading Behaviour

The number of orders per minute is a factor that indicates the general level of sentiment in the market. A higher number of orders per minute suggests a positive sentiment and thus a higher level of speculative trading. This sentiment was distinctly visible on the first trading day of an IPO in the pre-regulation period. After the imposition of the new law, the trading activity declined from 502 trades per minute to 247 trades per minute. A similar declining trend can be seen in factors like share traded per minute relative to share offered, and share traded per minute relative to shares outstanding.

	Pre-regulation	Post-regulation	Difference
Number of trades per minute	502.540	246.850	− 255.690
Shares traded / shares offered per minute (%)	0.438	0.051	− 0.387
Shares traded / shares outstanding per minute (%)	0.107	0.011	− 0.096

Table 2: Overall trading activity by investor type

Due to the capped returns and lesser lottery-like payoffs, individual investors became net sellers after the regulation period. As a result, their sell volumes were 16.1% higher than their buy volumes. In contrast, institutional investors became net buyers post regulation, with a 15.7% increase in net buying activity. Other investor groups did not show significant changes in buying or selling activities from pre to post regulation.

To ensure an even more efficient IPO price discovery in the secondary market, SEBI implemented an hour-long pre-market auction where the stocks are traded and settled at an equilibrium price taken as the open price for that day in the normal market. After considering the trading activities in the pre-market auction, retail investors once again are the main sellers, with a 68.9% share in all sell volumes and a total of 82.5% share in all sell trades.

All these findings indicate that retail investors became net sellers post regulations if we consider the first day of trading an IPO and the pre-market auction.

4) First day returns in IPOs

We calculated the returns on the first day itself by considering both offer-to-close as well as offer-to-open returns. The latter would signify the IPO's first-day returns, excluding the returns of the first trading day. When the unmatched samples, i.e., random samples from pre and post-regulation periods are examined, there is a visible decline from 15% to 11.5% in offer-to-open returns and 19.5% to 11.5% in offer-to-close returns. However, these results are not statistically significant. We see a similar trend when we compare matched IPO samples. The first day returns decrease from 14.2% pre regulation to10.9% post regulation. Again, however, the differences between all these data points are statistically insignificant.

	Pre-regulation (N=297)	Post-regulation (N=96)	Difference	t-statistic	p-value
Unmatched samples					
Open price / Offer price − 1 (%)	15.041	11.528	− 3.513	− 1.358	(0.175)
Close price / Offer price − 1 (%)	19.511	12.483	− 7.028	− 1.522	(0.129)
Matched samples					
Open price / Offer price − 1 (%)	14.205	10.900	− 3.305	− 1.080	(0.282)
Close price / Offer price − 1 (%)	12.714	11.956	− 0.758	− 0.190	(0.852)

Table 3: IPO first day returns (results are not statistically significant)

There is no significant change in the percent returns on the first trading day of IPOs even after the price bands were in effect post regulations. These combined results indicate that IPOs were underpriced, and that the underpricing is approximately similar pre and post regulation.

5) One year returns in IPOs

In the pre-regulation period, higher speculation abnormally inflated the prices of the IPOs during the initial days of their trading, thus leading to negative returns on a yearly basis. In contrast, after the price bands were imposed in 2012, the annual returns became positive due to reduced speculation in the initial days. This conclusion follows from an analysis of future returns in two matched IPO samples, pre and post regulation. After factoring in the normal market return for that particular year, an investment in a pre-regulation IPO gave a negative abnormal return, whereas an investment in a matched IPO post regulation gave a positive abnormal return (Fig 3).
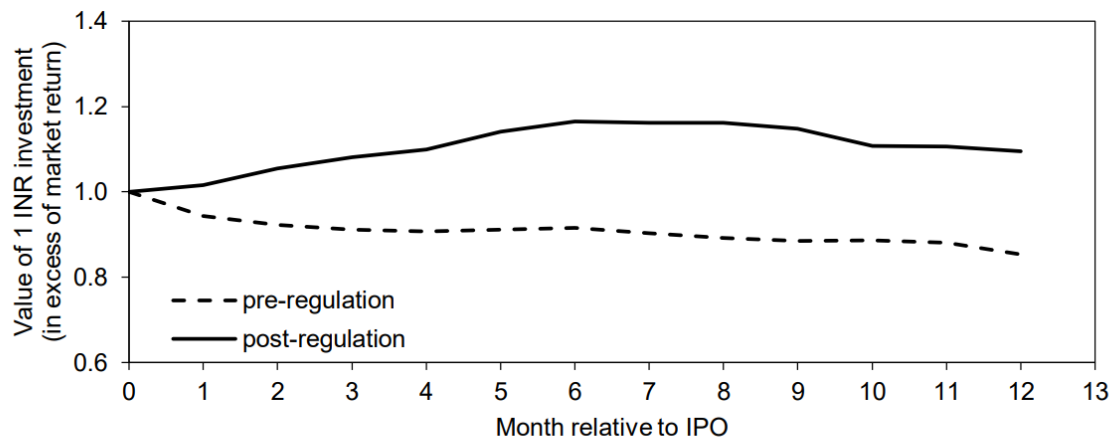
Fig. 3: Value of INR 1 investment over the first year after IPO

Further analysis of returns of monthly portfolios containing IPOs listed in the past 12 months to factor in other parameters like size, value, and momentum of an IPO gave a similar result. The pre-regulation monthly portfolios of IPO stocks returned -1.2% per month or around -13.5% annually. In contrast, the post-regulation monthly portfolios of IPO stocks returned +1.5% per month or around +19.5% annually.

6) Changes in types of IPO listed

A stricter price band of ±5 % on IPOs raising less than INR 2.5 Billion led to a drastic reduction in the number of small-sized IPO listing post regulation (Fig 4). As a comparison, nearly 71% of all IPOs listed pre regulation were raising less than INR 2.5 billion. This number drastically dropped to 20.8% post regulation. Several reasons led to such an extreme decline in the IPOs raising less than INR 2.5 billion post regulation. Key factors include attributes of small IPO firms like lower offer price, low VC backing, low reputation of underwriters of the IPO, and a stricter price band regulation on trading by SEBI.

Also, there is an average of 54 IPOs per year being listed on SME exchange with proceeds less than INR 2.5 billion between 2012 and 2017. It suggests that there was no sudden decline in relatively smaller firms in India. Rather they existed just like in the pre-regulation periods, but they chose not to list their IPO on BSE/NSE, the main stock exchanges, probably due to the above-mentioned reasons.
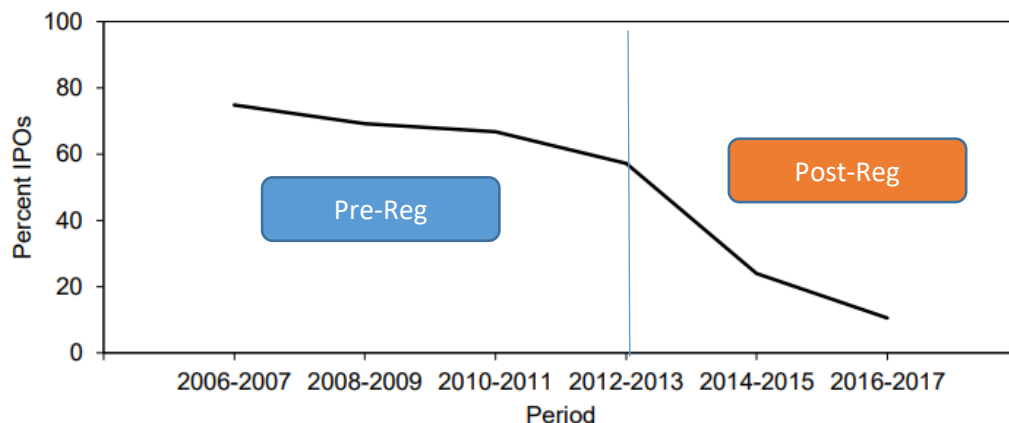

Fig. 4: Percentage IPOs with proceeds less than INR 2.5 billion over the years

Conclusion

The imposition of price bands on returns from trading IPOs in the first ten days by SEBI in January 2012 led to various changes in the behaviour of different market participants and the firms raising capital through IPOs. Our analyses suggest a significant reduction in price variability of IPOs in the post-regulation period, and thus a reduction in the chance of high profits from speculation. Also, we find a substantial decline in the IPO subscription rates by retail investors post regulation. In fact, all other investor segments, except HNIs, show a decrease in the demand for IPOs and hence the subscription rates remained low, as compared to the pre-regulation period. Although there is no distinct change in IPO underpricing from pre to post regulation, there is significant evidence of higher future returns and lower initial market prices due to the imposed price bands. Lastly, we find a considerable decline in IPOs of relatively smaller firms being listed after the new regulations. We also see large firms being listed on the main exchanges and the somewhat smaller firms listed on SME exchanges, with a sharp reduction in medium-sized IPOs.

We also conducted an analysis to determine the measure of coincidence between the reduction of speculation amongst traders due to the new law imposed by SEBI and a general change in the traders' demand for speculative stocks. This analysis was based on factors like trading activity, past returns, turnover, and market cap of a particular stock. All the tests suggested no decline in the traders' demand for speculative stocks over the years and no change in investor sentiment. Thus, our findings indicate that the reduction in speculation of IPO stocks was primarily due to the new law imposed by SEBI on the return of IPO stocks in 2012.

Do Government Guarantees Help Financial Stability?
Evidence from an Emerging Market

Madhu Kalimipalli, Vijaya B. Marisetty and Lakshmi Shankar Ramachandran[1]

1. Introduction

The relationship between government guarantees to banks and financial stability has been the subject of intense debate since the global financial crisis or GFC (Allen et al., 2015; Allen and Gu, 2018).[2] The post-GFC (i.e. 2010-2018) period, and more recently Covid induced global financial compression, have witnessed significant interventions in the form of explicit or implicit government guarantees, recapitalizations, and loans in countries around the world. The evidence from the Capital Purchase Program (CPP) related to the US government sponsored Troubled Assets Relief Program (TARP) shows that capital infusion significantly reduced contributions to systemic risk, particularly for larger and safer banks, and those in better local economies (Berger et al., 2020).

While government led bank capital infusions in US and other developed markets have been usually contingent an external shock or crisis episode, India presents a unique setting where significant capital infusions happen regularly "every year" to stabilize the weak balance sheets of the public sector banks. Do such repeated government sponsored bank capital infusions lower the financial risks and improve the financial stability? Our study addresses this question.

Extant research finds *conflicting evidence* on the relationship between government guarantees and subsequent bank performance (Allen et al., 2015, Kelley et al., 2016; Acharya et al., 2018). *Guarantees can increase firm value* by (a) reducing asymmetric information as better monitoring by governments can improve financing for corporates, and in turn help GDP growth; (b) improving credit ratings, lowering funding costs, and increasing franchise value; (c) lowering potential systemic risks if the underlying firm falls into Too big To Fail (TBTF) category; and (d) providing a downside insurance (or put option) value to banks especially during crises periods.

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[2] Financial stability is measured using systemic risk, which refers to quick propagation of illiquidity and insolvency risks, and financial losses across the financial system as a whole, impacting the connections and interactions among financial stakeholders (Billio, et al., 2012).

However, guarantees can have unintended adverse consequences by increasing (a) the tendency to take on excessive leverage by firms; (b) moral hazard problems arising from increased risk taking by the borrower; (c) unproductive use of capital by the borrowers affecting the industry wide productivity; and (d) counterparty risks to the guarantor arising from system wide shocks (or systemic risks) and potential bail-out costs for the tax payer. The ultimate effect of "repeated" government guarantees is therefore an open empirical question.

2. Research Issue

In this paper, we shed light on this debate by studying the effect of government guarantees on improving financial stability and thereby averting financial crisis. Specifically, we ask, "Do government guarantees help lower the systemic risks and help financial stability?", and provide comprehensive evidence through the lens of *repeated capital infusions* in an emerging market. In particular, focusing on an emerging market that underwent significant policy and regulatory changes, we undertake a comprehensive study of the impact of repeated government sponsored bank capital infusions on fostering financial stability.

India as the emerging market of particular interest for at least three reasons: (a) Indian public sector banks witnessed significant growth in Non-performing Assets (NPAs) adversely affecting their solvency, and jeopardizing the onerous bank recapitalization effort by the Indian government (Rajan, 2018); (b) Indian markets witnessed multiple domestic and foreign exogenous shocks since GFC that affected the funding costs and loan quality of local banks [3]; and (c) the post-crisis period was also marked by mounting corporate debt among emerging market firms, including India, as corporate leverage significantly increased in the post- GFC crisis period, giving rise to financial stability concerns (Acharya et al., 2015; Dodd et al., 2021).

3. Data Sample

We employ data on Indian government capital infusions into public sector banks for the period 2008-2017 (source: Controller & Auditor General of India, Report No. 28, 2017). The C&AG data is available until 2017; we hand collect data from media sources for two more years and extend the total sample to 2019. The capital infusion data is combined with multiple databases on firm-level financial and default risk, and aggregate risk variables: (a) CMIE (Centre for monitoring

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[3] The domestic shocks include Demonetization (2016), Asset Quality Review (2015-16), Insolvency and Bankruptcy Code Implementation (2016), domestic banking frauds (2017-18), and Non-banking Financial company crisis (2018-19).

Indian Economy) Prowess database for data on firm-level financial variables and stock, both firm and index, returns; (b) additional firm-level firm level balance sheet data from Capital IQ, and market level data on India and global (U.S.) market factors sourced from Datastream; (c) Credit Research Initiative database of the Risk Management Institute (RMI) of the National University of Singapore (NUS) for the company-level monthly data on probability of default (PD) and distance to default (DTD), and (d) Credit default swap data from Markit.

For the period 2000-2019, we identify 670 financial firms, consisting of 46 banks (both public and private), 519 non-banking financial institutions - or NBFIs -(public and private) and 105 non-financial institutions (broker-dealers, financial subsidiaries of other non-financial corporations, specialized investment vehicles such as funds and securitized assets). We drop all the 105 non-FI firms. From the sample of 46 banks, our data filters yield 24 public and 16 private banks. Out of the NBFI sample of 519 firms, we extract 11 public and 25 private firms (i.e. largest 25 private NBFI firms out of the sample of 505 firms based on asset size). We focus on the final sample of 76 financial institutions consisting of 40 banks and 36 NBFIs. We conduct our study by evaluating several credit risk (PD, PD slope and DTD) and systemic risk (NSRSIK, CoVaR and Network[4]) measures. We provide comparative analysis of the capital infusion effects of treated public banks versus several alternate control samples that respectively include public sector banks not receiving capital infusion, private banks, public NBFIs and private NBFIs.

4. Findings

We provide six key findings on the impact of capital infusions on default and systemic risks.

(1) The treatment public banks receiving government capital infusion have in general higher levels of default and systemic risks compared to the control banks and Financial Institutions (FIs). The time series plots imply that treatment sample banks have far higher implicit default and systemic risks compared to control samples, while public and private NBFIs exhibit higher default and systemic risks from year 2016 onwards (Figure 1).

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[4] MES is the marginal expected shortfall computed as the average stock return of a firm when the market return is in the bottom k^{th} percentile in a given year (where k is set to 5% or 1%). NSRISK is expected capital shortfall when the market return is in the lowest k% bracket in a given year, standardized by bank's market capitalization. CoVaR is conditional value at risk measure computed as the change in the value at risk (VaR) of the system when the firm is at the kth percentile minus the VaR of the system when the institution is at the 50th percentile in terms of its stock returns. We report negative of MES and CoVaR measures. Network risk score is a network based systemic risk measure of a financial institution following Das, Kalimipalli and Nayak (2020). Therefore higher MES, NSSRIK, CoVaR and network score measures all signal higher systemic risks.

(2) Univariate analysis shows that the default risk for treated banks increases following capital infusion compared to the other control samples. The default risk rises significantly for treated banks versus control FIs up to three quarters post-infusion. At the same time, the impact of capital infusion on systemic risk of the public sector banks is not significantly different from the control samples. Therefore, univariate results show no support implying reduction of default or systemic risks post infusion for the treated banks (Figure 2).

(3) Robust difference-in-difference regressions reveal several effects.

    a) We find strong evidence of network effects following capital infusions. In particular, capital infusions to public banks are followed by reduction in risks for control samples - default and capital shortfall risks for rest of the public banks and default risks for other FIs - not receiving capital infusions over the following two to three quarters.

    b) Regressions also show that capital infusions are associated with decreases in default and network risks for the treated banks. However, capital infusions are related to significant increases in capital shortfall risks. This implies that while capital infusions help lower the default and network risks, they are associated with significantly higher capital shortfall, signaling a moral hazard problem where treatment banks take on more risky investments.

    c) Further examining the effect of larger sized infusions, we find that larger infusions help treated banks overcome the capital shortfall constraints, yet significantly increase the network risks.

The results are robust to alternate control samples, risk and capital infusion measures, and Placebo tests. Our results therefore highlight the "regulatory trade-offs" in providing capital infusions to the banks.

(4) We next examine three stress periods characterized by significant jumps in capital infusions: 2010-11 (1576%), 2015-16 (256%) and 2017-18 (260%), where the percentage numbers respectively capture the percentage increase in capital infusion amounts compared to the previous year. We find that capital infusions during stress periods helped mitigate overall default and systemic risks for the financial institutions by lowering the capital shortfall and network risks, though CoVaR tail risks shot up. We also find additional risks arising from possible moral hazard driven risk taking.

(5) We further study the channels through which capital infusion affect the risks. Capital infusion can be beneficial in reducing credit and systemic risks for stronger banks that have high valuations (market to book), high deposit capital (deposits to assets), strong performance (ROE) and low risks (low loans to assets). Similarly, our findings show that certain high ex ante risky firms also benefitted. In particular, we observe reduction in credit, capital shortfall and network risks for smaller banks (in terms of total assets), banks with high interest commitments (low interest coverage ratios), and Low Tier 1 capital banks. However, larger infusions in above settings

exacerbate default and network risks, and in some cases increase market tail exposure i.e. CoVaR risks.

(6) Finally, we examine if capital infusions help lower aggregate risks. We find that aggregate PD spreads become negative post-infusion implying that aggregate default risk of the treatment firms' decrease compared to the control sample. There is, however, no evidence to show that infusions are related to decreases in aggregate systemic risk measures.

5. Summary & Conclusions

Based on the exhaustive sample of government capital infusions into the public sector banks for the period 2008-19, we find no unequivocal evidence that capital infusions persistently lower systemic risks for Indian banks. In fact, banks receiving capital infusions have consistently been risky throughout the sample period, and capital infusions have elicited moral hazard related risk taking by the banks and not necessarily permanently attenuated the underlying capital shortfall or network risks. The emerging market results stand in contrast to the TARP experience in the U.S. markets. To the best of our knowledge, this study contributes to the literature by providing the first study of how government guarantees impact financial stability in the context of emerging markets.

The results from our paper have three main policy implications: *first*, while capital infusions help lower default risks of the recipient banks, policy makers face 'regulatory trade-offs' with respect to mixed effects on systemic risks, as they need to balance the capital shortfall versus network risks. Capital infusions in general lead to lower network risks but higher capital shortfall risks by banks, arising from possible moral hazard concerns. Large infusions are therefore needed to lower capital shortfall risks but they can set off higher network risks. *Second*, during stress periods, policy makers face regulatory challenges as capital infusions in general can help lower capital shortfall, CoVaR and network measures of systemic risk; however, 'large' infusions can increase such risks. *Third*, capital infusions benefit strong as well as weak banks by lowering their credit and systemic risks. Weaker banks include smaller banks, and banks with onerous interest commitments and adverse tier-1 ratios, and hence capital infusions need to be applied to them without exacerbating the moral hard problems.

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Figure 1: Time series plots of Probability of default (PD), standardized Expected Capital Shortfall (NSRISK) and Network risk score measures over the sample period 2008-2018

We present aggregate time series plots for the treatment and four different control samples for the sample period. Scaled plots are normalized by setting starting values at the beginning of the sample 01/01/2008 to 100. All the variables are defined in footnote 4.
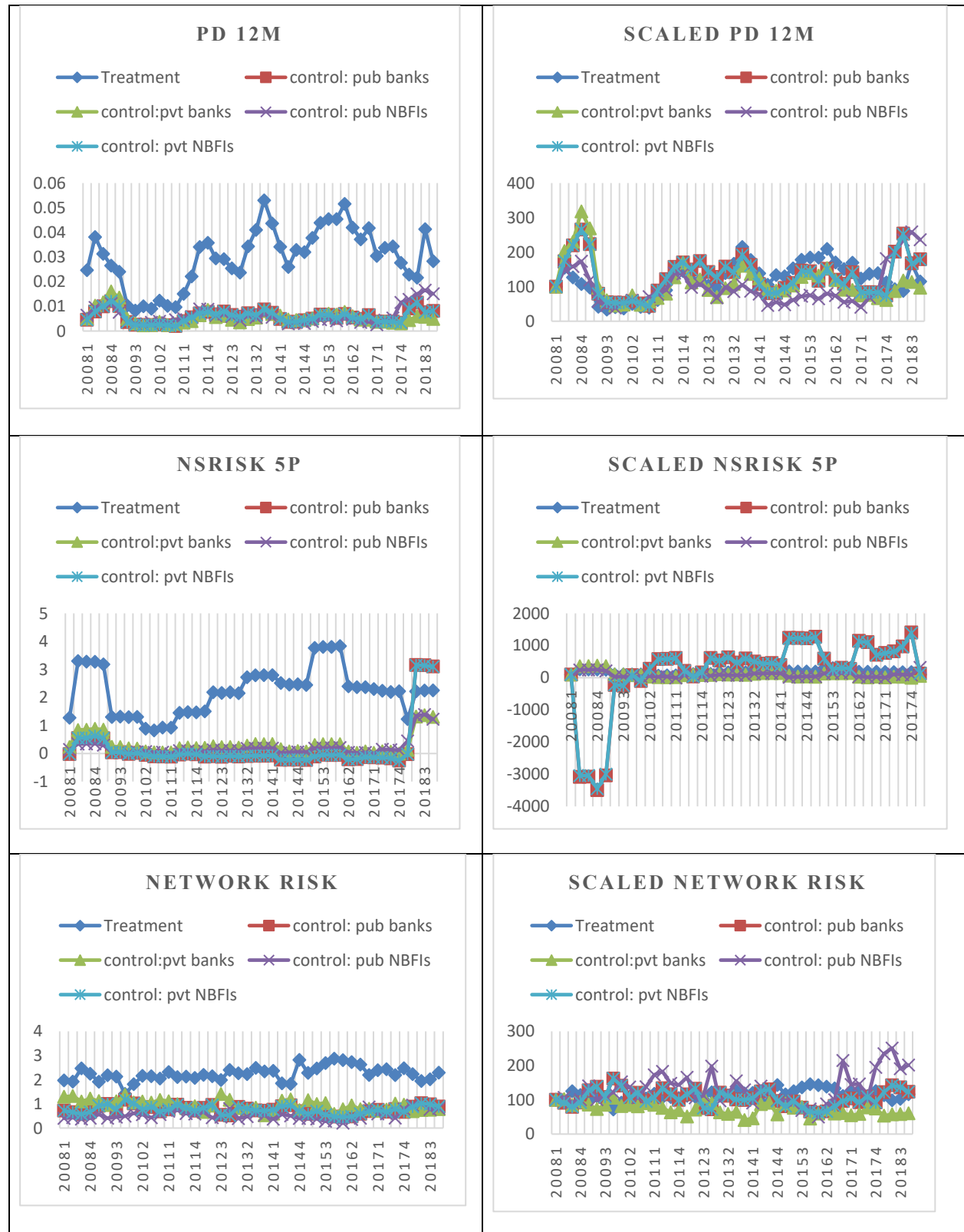
Figure 2: Event window plots of Probability of default (PD), standardized Expected Capital Shortfall (NSRISK) and Network risk score around capital infusion

We present quarterly mean plots (both raw and scaled) for the treatment and four different control samples for the sample period. Scaled plots are normalized by setting starting values at the pre-event 4th quarter to 100. We present ± four quarters around the event (period zero), which denotes the capital infusion date. All the variables are defined in footnote 4.

NYU-NSE Research Initiative White Paper

Correlated Portfolio Inventory Risk of Liquidity Providers: Frictions and Market Fragility[*]

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Correlated Portfolio Inventory Risk of Liquidity Providers: Frictions and Market Fragility

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1. The Academic and Policy Questions

Limit order book ("LOB") markets are now the dominant exchange structure for equity trading globally. Unlike affirmatively obliged old-world NYSE Specialists or London/NASDAQ market makers, the *de-facto* 'market-maker' in LOB markets emerges endogenously and voluntarily to provide liquidity to other traders; i.e., be ready and willing to buy when someone wants to sell a stock, and to sell when someone wants to buy a stock. We label such a *de-facto* 'market-maker' as a 'voluntary liquidity provider' (hereafter "VLP"). A VLP is, in aggregate, a net liquidity provider, trading on its own account with incoming buy and sell orders, bearing the risk of unbalanced inventory exposures, and earning the premium for doing so (Anand and Venkataraman, 2016; Menkveld, 2013; Glosten, 1994). The cost of providing liquidity depends largely on the risk of VLP inventory positions.

Typically, a VLP simultaneously participates in multiple securities. Ho and Stoll (1983) show that, for markets with multiple liquidity providers, possibly with heterogeneous beliefs, a VLP's trading and liquidity provision in a stock is a function of her *"equivalent portfolio inventory"* in that stock – rather than just her inventory in that stock. This *equivalent portfolio inventory* (hereafter "correlated portfolio inventory" or just "portfolio inventory") includes the effect of her correlated inventory risk exposures from the other stocks in her portfolio. This *equivalent portfolio inventory* is **not** the same as the unconditional sum of all stock inventories held. It is *stock-specific*, representing overall portfolio inventory after accounting specifically for the *correlations with that particular stock*.

Hence, a stock's liquidity would be a function not only of the liquidity providers' inventory in that stock, but also of their inventory in *other correlated* securities. The management of these liquidity providers' correlated portfolio inventories can arguably be a significant source of contagion-induced fragility in equity markets, since liquidity shocks in one security can propagate to another security through this channel.

1.1 The Academic Question

Notwithstanding the intuitive appeal of Ho and Stoll (1983), Naik and Yadav (2003a) – the only other study (to our knowledge) to examine market-making in the context of correlated portfolio inventories – find that market-maker firms in the old pre-1997 pure dealer market on the London

Stock Exchange overlooked inventory risks in correlated securities at the overall firm level, and argued that this could be due to organizational agency costs, difficulties in real-time communication amongst the firm's traders in a telephone-based trading environment, and their affirmative obligation constraints to always stand ready to provide liquidity at the level of individual stocks. On the other hand, VLPs in today's LOB markets' are typically not constrained by affirmative obligations, and positions' data across stocks is continually accessible contemporaneously in real time. Hence, one should expect to find support for Ho and Stoll (1983) from a liquidity provision perspective at the trading unit level.

However, in view of the voluntary nature of market-making in today's LOB markets, VLPs could also deviate from a pure market-making strategy and adopt a more information-driven strategy. Specifically, VLPs could learn about a security's fundamental value from prices of other securities with correlated returns (Pasquariello and Vega, 2013; Cespa and Foucault, 2014). In such a scenario, they could potentially take similar positions across correlated stocks rather than the offsetting positions predicted by Ho and Stoll (1983).

Therefore, establishing the net influence of correlated inventories on the trading behaviour of VLPs is not necessarily unambiguous, and requires empirical analysis. *We accordingly investigate the cross-security implications of VLPs' portfolio inventory management in LOB markets with data on VLP trading accounts.*

1.2 The Policy Question

There has been great regulatory concern[1], in line with academic evidence, that LOB markets remain uncomfortably dependent on stability in the supply of liquidity from VLPs. This can be problematic, especially in peak load and stress periods.[2] In spite of this heightened regulatory concern, we know very little about the determinants of liquidity-induced market fragility in LOB markets. We also know very little about the impact of correlated trading of liquidity providers on market quality or fragility in liquidity supply. Papers that study inventory effects have largely investigated dealer markets with affirmatively obligated market-makers or specialists, and these cannot address fragility in the liquidity supplied by purely *voluntary* liquidity providers. For LOB markets, all we know in this context is that extreme levels of VLPs' inventory imbalances drive episodic market fragility.[3] In this context, we address the following question: *do large correlated portfolio inventories significantly increase the likelihood of market fragility, as measured using extreme price movements and transitory jumps in stock returns*? In other words, *are VLPs' correlated portfolio inventories a significant determinant of LOB market fragility?* In this context, our paper also has significant policy relevance in informing exchange and regulatory perspectives on affirmative obligations and designated market-making.

2. How Do We Contribute?

Our study contributes to several streams of the literature.

First is the literature on the effect of dealer inventories on their trading behavior. For example, Madhavan and Smidt (1993), Manaster and Mann (1996), Hansch, Naik, and Viswanathan (1998), Reiss and Werner (1998), and Naik and Yadav (2003b) document that differences in inventories across dealers on the LSE affect their trading with customers and with other dealers. However, these

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[1] See, for example, CFTC-SEC Flash Crash Report:
http://www.cftc.gov/ucm/groups/public/@aboutcftc/documents/file/jacreport_021811.pdf.
[2] See, for example, Bessembinder, Hao and Zheng (2015), Anand, Tangaard, and Weaver (2009), Menkveld and Wang (2013), and Raman, Robe, and Yadav (2018a, 2018b).
[3] See, Anand and Venkatraman (2016), Kirilenko et al. (2017), and Getmansky et al. (2018).

studies only consider the effect of individual stock-level inventories. In contrast, our focus is on market-makers' *portfolio-based* inventory control that incorporates correlated inventories in other stocks. Naik and Yadav (2003a) is, to our knowledge, the only directly relevant existing study on market-makers' portfolio-based inventory control; and our results are in sharp contrast with their results. One reason for the difference in results could be because their data was only at the *centralized* level of the whole (market-making) firm, not at the level of individual trading units within the firm, and these firms were so large that only about 15 market-making firms were responsible for all London market trades. The telephone-based OTC market structure would have also made it difficult to share real-time positions' data across stocks and across the firm's trading units. Naik and Yadav (2003a) were hence unable to test whether correlated portfolio inventories drove the primary-level decision-making of a trading unit within the firm, the level at which Ho and Stoll (1983) should apply with minimal confounding influences. In this paper, we use data that separately identifies each VLP trading account, and our VLPs are able to instantly trade electronically thereby enabling smooth, real-time monitoring and management of positions across stocks. Hence, we can cleanly test the predictions of Ho and Stoll (1983) for the trading of liquidity providers, and our results are strongly supportive.

Second, our study significantly contributes to our understanding of the effect of correlated portfolio inventories on market quality and fragility. Papers that study inventory effects have typically only considered NYSE specialists' or aggregate brokerage houses' inventory risks (Comerton-Forde et al., 2009; Coughenour and Saad, 2004). However, since NYSE specialists are affirmatively obligated to supply liquidity, studies focusing on NYSE specialists cannot answer questions about the influence of purely *voluntary* liquidity provider inventories on market fragility. When we turn to LOB markets, most empirical studies have ignored inventory costs altogether.[4] Recent studies by Anand and Venkatraman (2016), Kirilenko et al. (2017), and Getmansky et al. (2018) show that VLPs turning from liquidity providers to liquidity demanders due to unsustainable levels of inventory imbalances is an important precursor to episodes of market fragility. Our results show that, along with stock-level inventories, large correlated portfolio inventories significantly increase the likelihood of market fragility, measured using extreme price movements and transitory jumps in stock returns. VLPs' correlated portfolio inventories are a significant determinant of LOB market fragility.

Furthermore, while correlated trading of liquidity providers has received recent attention (Chabound et al, 2014), we know very little about the impact of such trading on market quality. Our result that episodes of market fragility are more likely when portfolio inventories are less dispersed across VLPs contributes to our understanding of the adverse effects on market fragility of correlated trading by liquidity providers. We contribute in informing academic, exchange, and regulatory perspectives on affirmative obligations and designated market-making by investigating VLPs' management of correlated inventory exposures across different securities.

Finally, our results provide a cleaner understanding of a supply-side channel for cross-security price pressures. Studies that examine the effect of inventories on price pressures have typically focussed only on stock-specific inventories (e.g., Hendershott and Seasholes, 2008; Hendershott and Menkveld, 2014). We build on this literature to show that, even after controlling for the effect of stock-level inventories, VLP positions in other correlated securities create significant cross-security price pressure. Another strand of literature uses aggregate order imbalance (OIB) data to examine cross-security price pressures (e.g., Andrade, Chang and Seasholes, 2008; Pasquariello and Vega, 2013; Friewald and Nagler, 2019). Given the lack of granular inventory data, these studies are unable to directly test the channels through which price pressures propagate across stocks. Cross-security price pressures could be brought about by the portfolio inventory management of liquidity

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[4] See, for example, Biais et al. (1995), Hall and Hautsch (2004), and Ellul et al. (2007).

providers and/or the portfolio rebalancing of liquidity demanders.[5] It would be difficult to distinguish between these two sources while using only aggregate order imbalance data. In contrast, since we accurately track VLP inventories across stocks, and simultaneously control for other market-wide variables, our results provide a clearer picture of the precise role of portfolio inventory management of intermediaries in the transmission of price pressures across stocks.

3. What Data Do We Use?

In order to test the extent and the consequences of a liquidity provider's portfolio inventory management, we need to be able to identify each trader, and do so with a trader code that does not change for different stocks. Such trader identification is not easily provided by Exchanges. The data we use has been provided by the National Stock Exchange (NSE) in India, currently the second largest equity market globally on the basis of the total number of trades (as per World Federation of Exchanges website.) Besides complete information on trades and orders, our proprietary data includes masked trader identification, enabling us to calculate inventories of each trader in the market over time and across stocks. Specifically, our sample comprises all 50 stocks in NSE's NIFTY-50 index over a three-month period from April to June 2006. Access to more recent data was not forthcoming. As in the case of Anand and Venkataraman (2016), algorithmic trading was not allowed during our sample period as well. Given that portfolio-driven trading should be considerably easier and quicker to execute with algorithmic trading, each of our results should arguably be even stronger in presence of computerized decision-making and trade execution.

4. What Do We Find?

We document several interesting results.

First, VLPs' portfolio inventories mean revert significantly – more than 30% – faster than ordinary, stock-level inventories. Furthermore, consistent with the central predictions of the Ho and Stoll (1983), our analysis of order imbalances and order placement decisions show that a VLP is significantly more likely to place sell (buy) orders than buy (sell) orders in a stock to offset the excess positive (negative) correlated inventory risk exposure in the rest of her portfolio.

Second, we find that correlated portfolio inventory imbalances matter particularly when these imbalances are large, when stock returns are highly volatile, or when VLPs suffer abnormal losses in their portfolio holdings. Interestingly, consistent with the information hypothesis, we find that portfolio inventory imbalances matter significantly less for VLPs whose trading is more likely to be driven by informational reasons, relative to those who may be trading purely for market-making reasons.

Third, our panel regressions show that market liquidity improves when the variation in VLP correlated portfolio inventory levels across different VLPs is high. These results indicate that bid-ask spread in a stock would reduce when VLPs' inventories in other correlated stocks are more dispersed, because VLPs significantly long in these other stocks would reduce the ask prices in the stock and VLPs significantly short in these other stocks would increase the bid prices in the stock. Accordingly, we further find that greater aggregate accumulated positive (negative) portfolio inventory of VLPs is associated with greater depth on the sell-side (buy-side) of the order book than the buy-side (sell-side). Furthermore, consistent with predictions of Brunnermeier and Pedersen (2008) and Gromb and Vayanos (2002), we also find that bid-ask spreads worsen when the magnitude of VLPs' aggregate

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[5] Several papers find evidence of supply-side (Coughenour and Saad, 2004; Comerton-Forde et al., 2010; and Karolyi et al., 2011) and demand-side (Koch, Ruenzi and Starks, 2015) sources of commonality in liquidity.

portfolio inventories are relatively high. These results continue to hold even after we control for measures of market-wide liquidity and informed trading.

Fourth, results from the Kalman-filter analysis of our state-space model show that correlated portfolio inventories are also a significant source of price pressures. After controlling for the effect of stock-level inventory, a one-standard deviation increase in portfolio inventories decreases returns by 5.4 basis points, which is almost double the average bid-ask spread. The effect of portfolio inventories is particularly high during periods of low dispersion of VLP portfolio inventories across different VLPs.

Finally, we find that liquidity providers' portfolio inventories influence the likelihood of market fragility. We identify episodes of market stress using two measures: extreme price movements (Brogaard et al., 2017) and transitory jumps in stock returns (Lee and Mykland, 2008). The likelihood and the number of extreme price movements or jumps in stock returns significantly increase with the magnitude of aggregate correlated portfolio inventories, and decrease with the dispersion of these portfolio inventories across different VLPs. A one-standard deviation increase (decrease) in the magnitude (dispersion) of aggregate portfolio inventories is associated with an increase (decrease) in the odds of observing an extreme price movements episode in the next time period by a factor of 14 (by 74%); and with an increase (decrease) in the odds of observing a transient jump in stock returns by about 44% (78%). Since extreme price movements and jumps in stock returns could also be due to information spillovers from other stocks, we control for market-wide informed trading in all our analyses. Further, to mitigate the concerns of reverse causality, wherein extreme price movements or transient jumps trigger traders to rebalance their portfolio and reduce portfolio inventories, we further employ vector autoregressive regressions. Consistent with our panel regression results, the impulse response functions show that EPMs and transient jumps in stock returns are higher in number following periods of large and correlated portfolio inventories.

5. Our Overall Conclusions

We have the following main conclusions. First, in accordance with the predictions of Ho and Stoll (1983), VLPs in LOB markets do manage their inventory risk on a *portfolio* basis in addition to a stock-by-stock basis. Second, a VLP's trading and order placement strategy is significantly influenced by her inventory in the other correlated securities in her portfolio. Third, consistent with information-driven objectives, the offsetting influence of correlated securities is less pronounced for VLPs whose trading is more likely to be driven by informational strategies. Finally, our results are consistent with the hypothesis that, even in the absence of algorithmic and high-frequency trading, as a security's liquidity worsens, it experiences greater cross-security price pressures and episodes of market stress when VLP positions in correlated securities are large and undispersed.

Overall, the bottom-line view that emerges from our results is that, while the management of correlated portfolio inventories in LOB markets with voluntary liquidity suppliers maximizes intermediaries' utility and capacity for liquidity provision, it is also inherently a source of significant market frictions, contagion, and liquidity fragility.

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What Explains the Geographic Variation in Corporate Investment?[*]

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September 9, 2021

Abstract

We show that history can explain the geographic concentration of investment over and above traditional agglomerative forces, geography, and expectations. We use spatial variation in direct and indirect British rule to identify differences in historical circumstances. Using this within-country variation in historical circumstances, combined with a local identification approach and instrumental variable strategy, we explain the spatial differences in investment. Differences in historical origins can explain 13% of total geographic variation in investment. Moreover, investment is 8-10% lower in direct ruled areas. Our results indicate that history can have long-run consequences through its effect on economic organizations and state capacity.

1 Introduction

What explains geographic concentration in investment? What role does history play? It has been established that investment is geographically concentrated. From Steel City to Silicon Valley, the formation of economic clusters has garnered attention from academics and policymakers alike. Understanding the forces behind the development of such clusters is fundamental to understanding the micro-foundations of geographic inequality – why are certain areas richer than others, and what can be done to address these differences? Thus far, the literature has focused extensively on the role of agglomerative forces – the availability and cost of factors of production – and geographic advantages to explain the rise and fall of such clusters. In this paper, we diverge from the extant literature, focusing on a novel aspect that can explain the geographic concentration of investment: history. We consider how the eventual investment concentration depends on the initial starting point, set by historical factors. Specifically, we emphasize the role of the destruction of well-established economic organizations and emergence of state capacity, resulting from differences in historical circumstances, as key factors in explaining the investment concentration today.

The central role of history may seem obvious if investment is assumed to follow a path-dependent process. However, establishing the empirical relationship between history and investment is difficult. A key element in the theoretical models of firms' choice of location is the existence of multiple equilibrium. Krugman (1991) argues that the eventual choice of the equilibrium can either be driven by the history or self-fulfilling expectations. Hence, the empirical challenge lies in disentangling the two forces. Moreover, to clearly establish the relevance of history, one needs to rule out the effect of confounding unobservables such as agglomerative forces and geographic advantage.

In this paper, we attempt to address this issue and show that historical circumstances can explain geographic concentration over and above the traditional agglomerative forces, geographic advantages and self-fulfilling expectations. We do this by using a two-pronged approach. First, we combine within country analysis with plausibly exogenous variation in historical circumstances, originating from direct and indirect colonial rule. Second, in addition to using conventional approaches of comparison, we use (1) a local identification approach of comparing neighboring areas to rule out concerns related to differences in agglomerative forces, geography and expectations, and

(2) an instrumental variable strategy to rule out concerns related to selection bias and simultaneity. Hence, our empirical strategy is better adept at solving the difficult identification problems associated with establishing a direction of causality between history and economic activity, in general, and, in particular, investment concentration.

2 Historical Setting

This paper uses the within-country geographic variation in historical circumstances to explain spatial differences in investment. Colonial occupation of India provides such an environment. Before the onset of the British occupation of India starting in 1757, the Indian subcontinent was governed by local rulers. During the colonial era, different areas of the Indian subcontinent fell under the "direct rule" of the British, or, "indirect rule," under the administration of native rulers. All areas, regardless of their colonial history, were brought under an identical legal and administrative framework after independence in 1947. Moreover, we verify that the direct and indirect ruled areas were similar across several observable dimensions before the onset of colonial rule. Therefore, India provides an ideal laboratory to examine the consequences of differences in historical circumstances on geographic variation in investment concentration in the present.

3 Results

Investment if Geographically Concentrated: We begin with an aggregate analysis, showing that investment is concentrated within Indian states. Using data on district-level corporate investment, we compute a state-level measure of investment concentration, using the Herfindahl-Hirschmann Index (HHI). We compare the investment HHI with three benchmark measures – (1) equal investment in all districts, $\frac{1}{N}$, (2) investment proportional to geographical area of district relative to the state, and (3) investment proportional to the population of a district relative to the state. We conclude that investment is geographically concentrated within states, relative to a frictionless spatial equilibrium. Moreover, we show that states with a larger proportion of districts historically under direct British rule exhibit a higher geographic concentration of investment. Specifically, the level of within-state investment concentration is 20 percentage points higher relative to any of the benchmarks, and the proportion of districts under direct rule can explain 13% of total variation in within-state investment concentration.

Baseline Comparison of Direct and Indirect Ruled Districts: States with a larger proportion of direct ruled districts exhibit greater investment concentration. We argue that greater investment concentration in states with a larger proportion of direct ruled districts is driven by higher investment in indirect ruled districts. A direct comparison of direct and indirect ruled districts combined with project level data indicates that the size of investment projects in direct ruled areas is 8.8% lower than the size of investment projects in indirect ruled areas within a state.

Local Comparison of Adjacent Direct and Indirect Ruled Districts: A direct comparison of direct and indirect districts may potentially bias our inference in the presence of systematic differences between direct and indirect ruled districts. Hence, we address concerns of selection and omitted variables by focusing on contiguous direct-indirect ruled district pairs, separated only by administrative borders within a state. We compare a firm's investment in direct and indirect ruled districts within a district-pair. Specifically, we include firm × district-pair × year fixed effect, allowing us to identify the estimate using variation in the size of investment projects announced by the same firm within a district-pair. Such an approach allows us to implicitly control for traditional agglomerative forces of Marshall (1920), geographic features, investment opportunities, and expectations that are likely to be similar across contiguous district-pairs. Moreover, whether a district within a contiguous direct-indirect ruled pair was under direct rule during the colonial period is likely to be a matter of chance. Hence, indirect ruled districts are a valid counterfactual to the contiguous direct ruled districts. Our local identification approach suggests that the projects announced in direct ruled districts are 10.8% smaller in size relative to the projects announced in indirect ruled districts by the same firm within a contiguous district-pair.

Instrumental Variable Analysis Using Doctrine of Lapse: The comparison of direct ruled districts with indirect ruled districts may still be prone to selection bias, hindering our ability to interpret the baseline effect as causal. We address concerns of selection through an instrumental variable strategy. We exploit a unique feature of British annexation policy in India, the Doctrine of Lapse. The Doctrine of Lapse was in effect between 1848 and 1856, which allowed the governor-general of British India to annex Indian princely states where the ruler died without a natural heir. The relevance condition posits that the death of a ruler without a natural heir is associated with a territory coming under direct British rule. We verify the relevance condition associated with this instrument in the first stage. Our two stage least square estimates (2SLS) indicate that investment

is lower in direct ruled districts relative to indirect ruled districts within a state, validating our interpretation of the relation between contemporary corporate investment and direct British rule being causal. An important assumption of this test is the exclusion restriction, which posits that the death of a ruler without a natural heir affects current corporate investment only through the territory being under direct British rule. We verify this assumption through two falsification tests. In the first falsification test, we directly study the relation between investment and the death of the ruler without a natural heir in indirect ruled districts in periods when the policy was not applicable. In the second falsification test, we directly study the relation between investment and the death of the ruler with a natural heir in indirect ruled districts when the Doctrine of Lapse was applicable. Both tests yield null results, supporting the exclusion assumption.

4   Mechanism

We explore the underlying mechanism through which direct British rule affects investment. We focus on two key channels – (1) the destruction of well-established economic organizations, and (2) differences in colonial state capacity which persist to date. We rule out alternative mechanisms that may explain our results including the geographic differences in law and enforcement, provision of public goods, and trust.

We show that the East India Company (EIC) consolidated economic power through the annexation of cotton producing territories. Specifically, a cotton producing district was 40% more likely to be under direct British rule, relative to indirect rule. This allowed the British to directly control the supply of cotton, securing a monopoly on the supply of Indian goods and products (Sahoo (2015)). The direct control of cotton producing territories allowed the British to meet their objectives of protecting the interests of the British textile industry and increase Britain's share of global trade. Specifically, we argue that areas under direct colonial rule were subject to economic policies and practices that dismantled the well-established local economic organizations centered around the cotton industry. The destruction of flourishing and dominant economic industries resulted in significant economic losses, borne by the native population. Using precolonial cotton production as an instrument for direct British rule, we show that a firm reduces its project size by 20% in direct ruled areas relative to indirect ruled areas, within a pair of adjacent districts. We argue that the economic losses have endured to the present as the destruction of strong economic

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organizations (1) hampers the intergenerational transfer of skills and knowledge, and (2) disrupts the natural Marshallian process that develops over time and explains the agglomeration and dominance of industries.

Apart from the differences in the extent of economic exploitation, differences in the colonial occupation of India through direct and indirect rule altered the political incentives of the precolonial elites. While the British directly controlled the direct ruled areas in India, native rulers had considerable autonomy over the internal affairs of their dominion in indirect ruled areas. Iyer (2010) argues that the rulers in indirect ruled areas were under a constant threat of deposition by the British on account of misrule. Hence, local rulers exerted tremendous effort to improve state capacity, to avoid the slightest hint of misrule. Moreover, the rulers of indirect ruled districts had longer tenures which granted them incentives to plan and invest for long-term development. While the colonial geographic differences in de jure institutions were eliminated after the Indian Independence of 1947, we argue and verify that precolonial geographic differences in state capacity affect contemporary state capacity, especially the ability of the state to provide public goods in a timely fashion. We show this using data on delays in road construction. Our results show that road construction projects are delayed by 10.2% more in direct ruled districts relative to a contiguous indirect ruled districts. This result is different from Iyer (2010) as we focus on differences in the timely provision of public goods, rather than differences in the quantity of public goods. We do not find any differences in the latter for our sample period.

5 Conclusion

In this paper, we show that history can explain geographic concentration of investment over and above the traditional agglomerative forces, geographic differences and expectations. This paper uses within country variation in historical circumstances, combined with a local identification approach and instrumental variable strategy to explain the spatial differences in investment. We use spatial variation in direct and indirect British rule to identify differences in historical circumstances. Our aggregate analysis shows that the differences in historical origins can explain 13% of total geographic variation in investment. Our micro-level estimate suggests that investment is 8-10% lower in direct ruled areas, relative to indirect ruled areas. We further explore two channels through which history affects investment – economic organizations and state capacity. First, we show that

cotton-producing districts are more likely to be under direct British rule, and subject to adverse economic policies, resulting in the destruction of existing economic organizations with long-run detrimental effects. Second, using data on public road constructions, we show that the state takes longer than estimated to finish its projects in direct ruled districts. This systematic delay in the construction of roads reflects inefficiency, indicating lower state capacity.

Our work has three distinct contributions. First, we focus on a novel aspect that can explain the geographic concentration of investment: history. Second, our empirical strategy is better adept at solving the difficult identification problems associated with identifying the relationship between history and economic activity. Third, we explain how differences in colonial rule can produce long-run consequences, through two distinct mechanisms, namely, the destruction of well-established economic organizations and state capacity.

Our findings demonstrate that history can have enduring influence on the trajectory of economic development within a country. More broadly, this work informs discussions on the root causes of inequality, aiding our understanding of how the vestiges of history can create cleavages within a nation. Future study on how historical processes can perpetuate inequality may be a fruitful area of work, to further the discussion on economic disparities.

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The Conflict Induced Costs of Lending

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Conflict can affect economic outcomes through the decisions of key individuals. However, observing these decisions and measuring such outcomes is not easy given the dangers present in a conflict zone. Consequently, there is a resultant lack of data on the impact of conflict on economic decisions by affected individuals. Contrary to popular perception, the incidence of conflict in a particular region does not result in a complete shutdown of all economic activity. Life in conflict zones continues, albeit with a renegotiation of contracts to better reflect the ground-level realities (Verwimp, Justino and Brück (2019)). The recent conflict in Afghanistan has further highlighted the role of informal contracts and the way they are structured in a war torn and volatile environment.[2] However, most studies in the past have relied on ex-post survey data to assess such re-negotiations and other implications, with the survey taken long after the conflict has ended.

Our paper aims to quantify the effects of conflict in a lending context and the "premium" the involved agents attribute to the resultant frictions arising there. In particular, we study the impact of mortar shelling along the border of the Indian state of Jammu & Kashmir from October 2014 to November 2016. Our unique setting and data allow us to measure this premium better than extant work for three reasons. First, we investigate the impact of contemporaneous and repeated incidences of conflict on a singular, simple, yet pervasive business contract, i.e., the bank-to-business credit contract. These incidences occur within a relatively short time-period on average eight months after one another. This allows us to minimize the possible measurement bias arising due to the inter-temporal nature of human recall where events that are more recent tend to be weighted more heavily (Bjork and Whitten (1974)). Indeed, the long look-back periods present in many conflict surveys may induce such errors of

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[2] https://www.nytimes.com/2021/08/18/opinion/taliban-afghanistan-economy.html

judgement, which we can avoid by using actual and contemporaneous information around frequently repeated incidences.

Second, our study covers an intense period of conflict, war-like almost, when a large number of people living close to the border out of fear for their lives and damage to their local communities decided to temporarily leave their homes. In contrast, many earlier studies on conflict often rely on incidences with limited or no such level of fear. Finally, our usage of a region-level credit database allows us to directly estimate the ex-post outcomes. Conversely, other studies on conflict commonly only observe outcomes after conditioning affected individuals with a set of emotions bringing them "back in time" to the conflict situation. Our study is the first to investigate the impact of contemporaneous and repeated incidences of intense conflict on the conditions present in actual bank credit contracts.

Our estimates show that loan interest rates cumulatively increase by about 20-22 basis points (bps) across the sample period for branches located in areas affected by shelling with the effect intensifying over time. The increase for the first two events is about the same, i.e., 6 bps each, but we see a jump of about twice that for the third shelling event. While we observe a pronounced increase in the interest rates, there are only negligible changes in disbursed loan amounts. We control for demand by saturating our specification with district and time fixed effects. In addition, to account for shelling-specific localized changes in demand, we use the work demand pattern from the government mandated Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS). We also use the level of bank deposits to account for changes in demand arising out of changes local deposits (Drechsler, Savov, and Schnabl (2017)) apart from accounting for branch level census characteristics.

Our results also inform us about both the immediate and delayed costs of conflict allowing us to understand the premium loan officers place on operating in conflict zones.[3] The short-run reaction of loan officers to shelling is similar to the reaction of loan officers in areas that were continuously exposed to conflict, something that we could therefore consider the long-run response. The difference between the immediate and long-run response is also not statistically distinguishable from zero. However, once the loan officers experience subsequent events, they charge higher interest rates compared to the long-

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[3] Please refer to https://www.youtube.com/watch?v=vUzX1O-PDDE&feature=youtu.be&ab_channel=KarlRock for a detailed documentary on the physical and psychological effects of mortar shelling in these regions.

run levels. Our empirical results show this difference is negligible for the first event, increases in intensity after the second event and persists well into the third event. Overall, our estimates shows that operating in conflict zones entails a cost for financial institutions who transmit the same to borrowers.

We also assess the change in the dispersion of the interest rates. While the interest rates progressively increase over successive events, their dispersion decreases. This implies that the loan officers' beliefs about interest rates "hardens" over time as they become more certain about the effects of the shelling events. Repeated incidents reduce the uncertainty associated with shelling while the loan officers begin to incorporate a premium for any perceived negative fallout of these incidences. A stylized Bayesian model we include also makes similar predictions. The model predicts that over successive events, as the uncertainty regarding the shelling decreases, the standard deviation of the interest rates levied by the loan officers decreases while the interest rate by itself increases. Our empirical results are in line with the simulated results of the model.

The armed conflict we study is international in nature and involves India and Pakistan in the districts of Jammu, Samba and Kathua. These districts are situated in the erstwhile Indian state of Jammu-Kashmir along the Radcliffe Line (International Border).[4] The inter-state conflict in these border districts manifests itself primarily through shelling, i.e., mortar gun firing across both sides of the border.[5]

We use a staggered difference-in-differences methodology as our primary identification strategy. Our events correspond to those periods where shelling along the three border districts was so intense that it warranted a migration of the population. This distinction is important to make, as isolated incidents of shelling or small arms firing occur as well. The treatment group corresponds to those branches, which lie within 10 kilometres (km) of the international border whereas the control group corresponds to those branches, which lie between 10 and 20 km from the international border. The choice of 10 km is dictated by a variety of considerations. The range of the mortar guns is about 7 km whereas the Indian government classifies residents dwelling within 6 km as "affected". We extend the classification, as it is

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[4] As of 31st October, 2019 the state of Jammu-Kashmir was reorganized and divided into the two separate federally administered territories of Jammu-Kashmir and Ladakh. No changes were made to the district boundaries

[5] The border runs from the Line of Control (LoC), which separates Indian-administered Kashmir from Pakistani administered Kashmir, in the north, to the Zero Point between the Indian state of Gujarat and Sindh province of Pakistan, in the south.

plausible that people bank in branches, which are a few kilometres outside the "affected" categorization. Moreover, our results are robust to the alteration of the cutoff for the treatment group for various values between 7.5 and 10 km. Our identifying assumption is that the areas situated around the cutoff of 10 km do not vary widely with respect to their local and demographic characteristics thus ensuring that the coefficients we estimate largely capture the effects of shelling.

We also explore the channels, which could be responsible for the observed outcomes. At first sight, it is possible to attribute these changes in the behaviour of the loan officers to altering risk preferences.[6] However, it is possible that the outcome could be due to a combination of (or effect in isolation) changing risk preferences or changes in beliefs about expected future default. Past literature on early-life as well as contemporary experiences tends to entirely attribute outcomes to altering preferences. We, on the other hand, provide suggestive empirical evidence that beliefs dominate the channel, which results in the effects that we observe. Further, as robustness, we also control for generic variations in supply using percentage of lending target achieved. We attribute the results thus obtained to supply effects emanating from the incidents of shelling. Additionally, we also limit our sample to loan types which tend to be more affected by shelling and observe similar results. Our analysis also reveals a reallocation of lending towards safer loans which are less impacted by the shelling. Finally, we reject any possible political interventions that might be driving our results by limiting our sample to close contest assembly constituencies where such interventions would be more burdensome.[7]

While our results are primarily focused around conflict episodes, they can also be used to explore lending behaviour following more commonly observed political shocks. As these events occur very close to one another, exploring the short-, medium- and long-term response of loan officers to these incidences could be instructive in understanding how credit tightening works when they are faced with such shocks. In such circumstances, especially the excessive restricting of credit availability in the medium term by altering loan terms could accentuate downward spirals and credit freezes in environments, which are already credit constrained.

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[6] We use the terms loan officers to signify a group of individuals working at a particular branch. However, many of these branches are fairly small and have just one person responsible for loan vetting, approval and handling.

[7] Where the difference in votes between the first and second placed candidate was less than the votes polled by the third placed candidate.

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