The Transmission of Monetary Policy Within Banks: Evidence from India

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Abstract

India's central bank frequently injects liquidity into banks or drains liquidity by altering the cash balances that banks must maintain with it. We analyze the lending responses *within* banks to these quantitative tools of monetary policy. We use internal data from over 125,000 branches of banks, and estimate empirical specifications that control for time-varying unobserved heterogeneity in banks and geographies. We show that the within-bank variation in lending is economically significant, and is explained by a rich suite of branch asset, liability, and organizational variables. Branches that are larger, make loans with smaller ticket size, are deposit rich, make shorter term loans, have fewer non-performing assets, and greater managerial capacity respond more to monetary policy. Responses are more sluggish in state-owned banks. Thus, besides the external financing frictions faced by banks, internal frictions within banks significantly explain the lending responses to funding shocks.

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1 Introduction

Central banks set monetary policy. How the policy is transmitted through the financial system has been a question of long-standing interest to both policy makers and academics. Understanding transmission has become especially important after the 2008 financial crisis. Doubts about the efficacy of fiscal policy, political debates surrounding its size, scope, and form, and the related inside and outside lags in its implementation, have given monetary policy a central role in macroeconomic stabilization. How banks respond to monetary policies remains an important and relevant economic question.

We provide new evidence on bank lending responses to monetary stimulus using a large bank lending dataset from India. Our analysis is of interest from three viewpoints. First, we characterize transmission *within* banks. We show that besides the external frictions between banks and markets emphasized in prior work, *internal* or intra-bank frictions also condition lending responses to monetary policy. We show that the within-variation is economically important and characterize its nature using internal data on bank branches. A second point of interest is the tool of monetary policy. We focus on essentially instantaneous injections or retractions of cash by the central bank into banks in a formulaic fashion. Thus, we study a direct version of the widely discussed "helicopter drop of money" into banks. Finally, we introduce granular controls for unobservable heterogeneity through saturated bank-year and local geography-year interactive effects.

We contribute to the work on the bank lending channel of monetary transmission. As Kashyap and Stein (1995) write, analyses of transmission using aggregates are often difficult to interpret.[1] Thus, research analyzes variation in transmission across banks. Following Kashyap and Stein (2000), much of the work classifies banks according to the external financing frictions they face. The basic tool of exploiting heterogeneity in lending responses across banks is used in other settings as well. For instance, Campello (2002) uses it to

[1] From their article, "... almost any movement in the composition of external finance can be explained away by appealing to a sufficiently creative story about heterogeneity in credit demand." Peek and Rosengren (2013) provide a recent and relatively thorough survey of recent work.

analyze standalone banks versus those in conglomerates while Khwaja and Mian (2008) and Cetorelli and Goldberg (2012) use it to understand global transmission of monetary shocks.

Our contribution to the cross-sectional literature is to highlight that besides external frictions faced by banks, internal frictions, or those *within* banks are also important. We study a setting in which the central bank makes large injections or drainages of cash from banks. These changes are essentially instantaneous and have the effect of altering lending resources at bank headquarters. How they translate into lending outcomes on the ground is our focus. The literature (Stein (1997), Stein (2002)) suggests that internal organizational hierarchies can determine the nature of the capital allocation. However, as Cetorelli and Goldberg (2012) and Skrastins and Vig (2014) remark, micro data on resource allocation within organizations are scarce. We contribute towards filling in this gap with an extensive dataset that covers over 125,000 branches over nearly two decades. We show that within-bank variation in lending is significant. Using data on branch assets, liabilities, and organizational variables, we shed light on the type of internal frictions that explain the within-variation.

The focus on within-bank variation is also of econometric interest as it lets us soak up more sources of unobserved heterogeneity through bank, geography, and bank-year and geography-year fixed effects. Bank-year interactive fixed effects absorb sources of across-bank variation including those that vary over time. For instance, following Kashyap and Stein (2000), banks can face different wedges between internal and external finance, and the wedges can change from year to year. Bank-year fixed effects control for these variations. Likewise, district-year fixed effects absorb local geographical variation in credit including the annual fluctuations due to factors such as weather or economic activity.[2] What remains is the internal response of branches net of unobservables at the bank and district level as well as their variation from year to year.

Branches are important sources of both economic and econometric variation. Our sample comprises 150 banks operating through 126,873 branches that are located in 683 districts spread over 29 states and 7 union territories. Within-bank variation is quantitatively important.

[2]The district controls are granular. As of December 20, India has 683 districts.

A variance decomposition across banks shows that the within-variation dominates, and its share increases over time. For instance, it accounts for 73% at the beginning of our sample period and 90% of the variance in 2013.

Branches also matter given how lending activities are organized. Lending proposals originate at the branch. Line staff screen and conduct credit analysis according to processes set or approved by headquarters. What happens next depends on the credit specifics. Some credits are locally approved while others move up the bank hierarchy often through multiple levels. Branches are delegated authority for lending decisions for which expertise likely resides in branches.[3] Branches are also the key focus of regulators. India's nationalization of its banking sector in 1969 and 1980 created a large state-owned bank network and a regulated banking sector with significant entry barriers. New bank licenses are granted infrequently. Branches also face regulations but are easier to open as they are deemed central in meeting objectives (Burgess and Pande (2005), Cole (2009)).

The tool of monetary policy, the cash reserve ratio (CRR), represents another point of interest. The CRR denotes the cash balances that banks operating in India must maintain with its central bank. Increases in CRR drain funds from banks while decreases inject funds into banks. The changes occur immediately through credits or debits to banks' accounts with the central bank formulaically as a percentage of deposits without regard to any individual bank's condition. Funds are released or retracted with no new conditions on end uses. Changes are frequent in both directions during our sample period. The funding shocks are also potent as CRR earns no interest while outside lending rates are in or near double-digits during this period. Conversely, failure to maintain CRR attracts significant penalties of spreads exceeding 300 to 500 basis points above bank lending rates.[4]

Studying cash injections or drainages also informs the banking and finance literature on financing constraints. Much of the literature centers on non-financial firms.[5] Our study

[3]In one large bank we talked to in December 2015, a branch manager can automatically sign off on loans below about $300,000. Larger or complex loans require clearance from bank hierarchy.

[4]CRR changes are also of current policy interest as they are deployed elsewhere. For instance, China cut its reserve requirements on February 29, 2016 to ease credit conditions.

[5] See, e.g., Lamont (1997), Fazzari, Hubbard, and Petersen (1988), Kaplan and Zingales (1997), Whited

contributes to this strand of literature by providing micro evidence on interventions that both impose and relieve financial constraints on banks. As Kashyap and Stein (1995) and Kashyap and Stein (2000) remark, the same frictions that exist for nonfinancial firms do so for entities such as banks that have opaque assets.

Our data come from the Reserve Bank of India Basic Statistical Returns (BSR), which has over a billion individual loan observations. We aggregate BSR data into roughly 1 million bank-branch-year loan observations between 1996 and 2013. Log credit at the bank, branch, and the year level is the response variable. The dataset has identifiers for bank, amount, and the originating branch. The key monetary policy variable is the CRR, the fraction of deposits that banks must hold with the central bank. Interactions between monetary policy and branch characteristics indicate the types of branches that are likely to be less or more responsive to monetary stimulus. We also include triple interaction effects, for example, between CRR, branch characteristics, and an indicator for whether the bank is state-owned or private.

The branch level explanatory variables capture the intra-organizational processes that govern lending. We later discuss the variables and results in greater detail but as motivation, we discuss the key variables here. Loan ticket size determines the delegation of loan authority. Small loans are handled at the branch level while larger loans require zonal, regional, or headquarter level approval. Likewise, long-term loans require greater investment in information gathering and analysis. Branches dealing with these more complex types of credit are less likely to respond to monetary stimuli. Larger branches are likely to be repositories of greater expertise and organizational capital in lending. These branches are likely to house more senior managers with greater lending experience and are likely to have better processing capacity to handle loan flows. The interactions and communications with headquarters are also likely to be more, so lending frictions are likely lower in large branches.

Another characteristic likely to drive lending responses is the availability of local resources

and Wu (2006), Hennessy and Whited (2007), Paravasini (2008), Hadlock and Pierce (2010), Ball, Hoberg, and Maksimovic (2015), Farre-Mensa and Ljungqvist (2016) at the branch. Whether deposit rich branches lend more or less in response to monetary injection at the headquarters is ambiguous. Branches not rich in resources may be ready targets for any new resources available at headquarters. However, if deposit gathering is costly and headquarters readily funds deficits, branches may have less incentives to gather deposits. In this situation, headquarters may allocate more resources to branches that raise more internal deposits. Thus, lending responses can be greater for branches rich in deposits.

We also consider the credit to deposit ratio. Consider a branch with $1 of deposits. The extent to which the $1 is deployed in lending depends on the costs of making loans, which includes the costs of finding customers, screening them, processing the loans, and monitoring the loan ex-post. Branches lend to the point where revenues from lending equal the marginal costs of finding, processing, and monitoring a new customer. Branches with higher costs will lend less and have lower credit to deposit ratios. Of course, credit to deposit ratios are also functions of local demand conditions, but the inclusion of district-year interactive fixed effects controls for these conditions.

We also analyze differences between rural and urban areas. This dimension is of both economic and practical interest. In India, rural branches are characterized by excess demand for credit relative to supply. Given the excess credit demand in rural areas, the supply side responses of banks to injections or withdrawal of loanable funds are more likely to be reflected in greater credit expansion or contraction in rural branches relative to their urban counterparts. These effects are likely to be more pronounced in state-owned banks that have long histories of operation in rural areas. At the same time, rural areas are difficult to reach so rural loans may be difficult to make. The distance to lending effect would imply that transmission should be weaker in rural branches (Petersen and Rajan (2002)).

We consider branch level non-performing assets (NPAs). Poor loan performance can lead headquarters to penalize branches to contain risk-taking. If so, headquarters would curb risk-taking by branches. If the disciplining argument is correct, high NPA branches should lend less when resources are freed through CRR cuts. Following, e.g., Cole (2009), these effects likely to matter more in private sector banks rather than state-owned banks. We also control for local measures of risk-taking by computing branch level interest rate spreads relative to similar size and industry loans throughout the country. The excess spread is a control for the marginal investment opportunities of the branch akin to marginal Q, or for omitted credit risks or a risk-Q measures at the branch level.

We show that the branch level asset, liability, and organizational variables matter. An increase in loanable resources increases lending more in branches that have less complicated loan structures, have more expertise and are loaded by less bureaucracy, are sustained by local funds, are located in rural areas, and make less risky loans. State-owned banks appear to be more sluggish than private sector banks. We also find some asymmetries between loosening and tightening episodes. Finally, our results remain robust to variations in samples, controls, and econometric methods including lags, differencing, and a horse race of CRR with other macroeconomic variables. Collectively, the results make the essential point that besides the external financing (or non-financing) frictions faced by the bank as a whole, the internal frictions, and the organizational processes, determine how lending responds to monetary stimulus.

The rest of the paper is organized as follows. Section 2 presents a brief review of the literature, Section 3 discusses the data. Section 4 describes the econometric specification and identification strategy, Section 5 presents the empirical findings and tests for robustness and heterogeneity. Section 6 concludes.

2 Related Literature

To position our findings relative to received work, we briefly survey related work. We focus on material that is incremental to our prior discussion or that clarifies or explains it in greater detail. Our paper is related to at least three strands of literature that we discuss.

2.1 Monetary Transmission

Bernanke and Gertler (1995) point out that received work on the bank lending channel is motivated by two facts. First, the direct interest rate effect of monetary policy variables does not calibrate observed economic aggregates very well. Second, monetary policy typically targets short-term rates but responses are seen in the spending on long-lived assets such as durables. Both findings can be reconciled if one introduces a role for intermediation. Monetary policy has greater potency in models that incorporate its delivery through banks. In such models banks are special so economic agents rely on banks for funding. If, for instance, banks themselves face capital, liquidity, or external financing constraints, monetary policy effects will reflect banks' constraints in addition to banks' roles in maturity, risk, and liquidity transformation.

The above observation has spawned a vast empirical literature on how bank lending responds to monetary policy (Peek and Rosengren (2013)). Early work such as Bernanke and Blinder (1992) examines aggregates in time series settings. While the specific experiment designs in the subsequent work vary, a key thrust has been to move from time series analysis of macro aggregates to micro-level analyses. The approach of choice in recent work has been the difference-in-difference approach that compares responses to monetary stimulus between different institutions or different markets. An alternative narrative approach is pioneered by Romer and Romer (1989).

An early example of the difference-in-difference approach is Kashyap, Stein, and Wilcox (1993). They argue that if fluctuations in bank credit supply simply capture effects of changes in aggregate demand, commercial paper and bank loans should move similarly in response to monetary policy. However, they report that monetary policy tightening has asymmetric effects. It increases commercial paper usage but reduces bank credit, consistent with supply effects in which banks tighten credit in response to monetary contraction and firms shift to commercial paper. Kashyap and Stein (1995, 2000) rely on differences between different types of banks. They show that financially constrained banks exhibit greater sensitivity to monetary policy.

Peek and Rosengren (2013) note in their review that the work on how transmission varies across different types of banks is voluminous and continues to attract new work that exploit newer settings. For instance, studies have analyzed how transmission varies depending on whether banks are part of a larger holding company (Campello, 2002), participation in securitization markets (Loutskina and Strahan, 2009), internationalization of banks (Cetorelli and Goldberg, 2012), and state-owned versus private banks (Morck, Yavuz, and Yeung, 2013). Our study differs in focus from these cross-sectional studies in that we examine variation within banks to understand the lending responses to monetary policy.

2.2 Internal Capital Markets of Conglomerates

The resource allocation decisions and internal capital markets of corporate conglomerates are studied in the finance literature (Maksimovic and Phillips (2013)). A focal question in this literature is how funds are allocated across conglomerate divisions. Our study sheds light on this issue. We observe CRR funding shocks in which resources are taken away from or granted to headquarters. We observe subsequent allocation decisions across branches, which are individual entities residing in the conglomerate organization.

Banks with branch structures resemble conglomerates. Each bank branch is managed by a manager who is delegated decision making authority within limits and subject to oversight of headquarters. As in conglomerate divisions, branches serve diverse product markets. However, there are interesting variations that we note. Unlike conglomerate divisions, branches differ mainly in the geographical areas served rather than in their business segments they compete in. Another key difference is in the liabilities of divisions. In conglomerates, resource raising is at the headquarters, and divisions are allocated capital through internal capital markets (Berger and Ofek, 1995, Stein, 1997, Maksimovic and Phillips, 2013). However, in banks, branches can and do raise their own funds through deposits and use internal capital markets to balance any surpluses or deficits.[6] With greater homogeneity in assets, liabilities and human resources, ongoing supervisory, operational, and personnel exchanges between branches are also more frequent. The branch structure is also organizationally different from the bank holding company structure in which each bank is a legally distinct entity (Avraham, Selvaggi, and Vickery (2012), Campello (2002)).

2.3 Financing Frictions

Understanding financing frictions is an important topic in the finance literature. One strand of research measures whether firms are constrained and generates indexes measuring the severity of financial constraints. Other papers attempt to assess the real effects of financial constraints (see references in footnote 5). Our findings inform the literature on financing frictions. CRR decreases inject funds into banks and thereby relax financial constraints. CRR increases drain funds from banks, imposing financing constraints. We study the responses of banks to such stimuli.

Related work includes Lamont (1997), who examines whether cash flow shocks from oil alters non-oil division investments of oil companies. Our funding shocks are at headquarters rather than divisional level. Campello (2002) argues that standalone banks are more sensitive to funding shocks than banks within a conglomerate holding company. We take this work further by examining variation *inside* standalone banks. Paravasini (2008) studies a 1990s lending refinancing program for Argentinian banks lending to qualified borrowers through the MYPES on-lending program. Ours is a different experiment. We observe the imposition and relaxation of financial constraints and not just their relaxation as in the Argentinian program studied by Paravasini. More importantly, the funding through CRR changes is not conditional and thus requires no commitments on the quantity or direction of end use. It is a direct and instantaneous release of internal funds without restriction.

[6] Section 9.3 in https://www.rbi.org.in/scripts/NotificationUser.aspx?Id=16&Mode=0 (accessd, April 4, 2016) gives the central bank guidelines on transfer pricing.

3 Data and Descriptive Statistics

3.1 BSR Dataset

Our data come from the Basic Statistical Returns (BSR-1 and BSR-2) collected by the RBI. Other work using this data includes Cole (2009) and Kumar (2014), who analyze the data at the bank rather than the branch level. The dataset reports loans outstanding annually by every branch of every scheduled commercial bank in India. The report comprises two parts, BSR-1A and BSR-1B. BSR-1A compiles all accounts with individual credit limits above a cutoff, which is ₹25,000 until March 1999 and ₹200,000 after March 1999.[7] For credit limits below the cutoffs, amounts are consolidated at branch levels by broad occupational categories and reported as aggregates by branch.

BSR-1A contains a number of useful fields that we exploit in our analysis. These fields include location, which refers to the district where credit is utilized. India has a federal structure in which the nation is divided into states or union territories, each of which is subdivided into districts. There are currently 36 states or union territories that comprise 630 administrative districts. The data also identifies the credit utilized according to the population agglomeration group. Rural branches are located in census city centers covering a population of up to 10,000, semi-urban branches between 10,000 and 100,000, urban branches between 100,000 and 1 million and metropolitan branches cover areas with population exceeding 1 million. We create a single category called urban by combining the semi-urban, urban, and metropolitan branches. The branch classifications by location do not vary significantly over time. Relatively few branches, about 5%, change classifications over our sample period.

The loan amount outstanding is as of the last reported date. We use it to generate branch aggregates as well as average loan size. BSR-1A also classifies loans by maturity e.g. long or short-term loans. We also obtain data on whether an asset is non performing or not. Indian banks classify assets as standard, sub-standard, doubtful, or loss assets. We classify assets

[7] The local currency unit, rupee, is denoted by the symbol ₹. As of April 2016, 1 US$ equals about ₹67.

as either standard or non performing assets (NPAs). This figure is computed at the branch level. We obtain the interest rate on the loan, which we later use to generate measures of excess spreads at the branch level.

We extract bank liability data from BSR-2 to develop branch level measures of the credit-to-deposit ratio and of branches that lose or gain deposits. BSR-2 also gives us data on branch staffing. We obtain the number of officers in a branch, which can proxy for the expertise in a branch. We also obtain the non-officer staff count in a branch. This can proxy for the processing capacity in a branch or the supervisory demands on branch managers.

We aggregate the loans at the branch level to create a panel dataset in which a unit of observation is a bank, branch, and year. For example, we aggregate over 128 million loan accounts for 2013. The branch data are reported as of fiscal year-end, which is March 31 in India. The dataset provided to us begins in the fiscal year ending March 31, 1996 and ends on March 31, 2013.

3.2 Branch Networks

Table 1 provides a snapshot of the bank lending data at the end of fiscal 2013. The data cover 150 banks. There are 26 state-owned (public sector) banks, 20 domestic private banks, 40 foreign-owned banks, and 64 regional rural banks (RRBs). Figure 1 shows how the number of banks has changed over time. The number of state-owned banks has remained roughly the same. The number of private sector banks decreases from 35 to about 20 at the end of our sample period. The number of foreign banks increases from 28 to 40 after the global financial crisis but they tend to maintain small operations.

Branch networks have been a major focus of banking regulations in India especially after a bank nationalization program in 1969. Branches are seen historically as distributive instruments that foster the state's developmental priorities (Burgess and Pande, 2005). As attention shifted towards broader credit needs and the financial soundness of the banking system, policies required banks to pay due attention to commercial viability. These changes are roughly concurrent with the 1991 big bang economic and financial liberalization in India. Our sample begins several years after these changes and thus covers a period with a relatively stable bank branching regulatory structure. Are branches relevant when many other industries are witnessing the disappearance of brick-and-mortar structures? As Cortes (2015) points out, branches may remain valuable as they generate private information. In India, branches remain relevant as relatively few businesses are handled through centralized verticals, for which the necessary credit and information infrastructure are still developing.

For further context, it is useful to point out that bank branching is also important in the US. The regulatory structure is, however, somewhat different. In the U.S., interstate banking compacts and laws govern how banks may expand (Jayaratne and Strahan, 1996, Krishnan, Nandi, and Puri, 2015). The Indian banking market is national so banks are relatively free to move across state borders. Thus, India has had banks with national franchises throughout her history, resembling what the U.S. has now. State Bank of India, India's largest bank, has 20,833 branches. The approximately 6,300 branches of Wells Fargo represent the largest branch network among the U.S. banks.

The banks in our sample have 126,873 branches. Figure 2 displays the time trends in branch networks. The number of rural branches is relatively stable in the early years of our sample but starts increasing after 2006. Urban branching witnesses a steady and intensifying growth over the sample period. The number of urban branches more than doubles during the sample period while rural branches expand by about a quarter. The share of rural branches in credit decreases from 43% to 30% over the sample period.

3.3 Lending

Local practice expresses lending in local currency with monetary units of one thousand crore where 1 crore = 10 million. Thus, ₹100,000 crore equals ₹1 trillion. We follow this practice to maintain comparability with official statistics. At the exchange rate in April 2016 of about US$1= ₹67, ₹100,000 crore is about $14 billion.

Table 1 shows that the average lending by a banking institution is about ₹36,800 crore (about $5 billion). There is significant variation in this figure by bank type. On average, state-owned banks lend ₹156,500 crore ($23 billion), roughly three times the average lending by a private bank of ₹52,500 crore ($8 billion). State-owned banks account for about 75% of total lending while private banks have the second largest market share at about 20%.

Regional rural banks (RRBs) are entities that are sponsored by and operate under the umbrella of other banks. They cater to rural areas and represent a means of using the operating infrastructure of existing banks to reach underserved rural areas. Although there are several RRBs, they comprise a very small fraction of the market share (2%). On average, they lend far less than public or private banks. For instance, the average lending by an RRB is about ₹2,000 crore ($300 million), which is less than 5% of the amount loaned by a public sector bank. Given their relatively small size, we exclude RRBs from our analysis but the results are robust to their inclusion.

Figure 3 shows how the market shares of different types of banks evolve over time. We divide state-owned banks into the State Bank of India (SBI) group and the rest. SBI is the largest state-owned bank in India. Its market share declines from 29% to 23% between 1996 and 2013. The remaining state-owned banks have about a 50% market share in aggregate credit in our sample. Private banks grow significantly in our sample period. Their share in total lending increases from 8% to 19% between 1996 and 2013. Foreign banks have a relatively small presence and their market share declines over our sample period from 9% to 5%. Many foreign banks maintain small branch networks and geographical footprints.

Panel B of Table 1 describes how banks and branches change over time. The number of banking institutions actually shrink over time from 283 in 1996 to 150 in 2013. At the same time, the number of branches increase from 62,465 branches in 1996 to 101,603 branches as of fiscal year 2013. The average credit per branch increases from roughly ₹4 crore ($0.6 million) to ₹54 crore ($8 million). This is a 13-fold increase in credit per branch compared to an 8-fold growth in GDP over the period. Thus, credit per branch expands more than the economy as a whole even as the number of banks actually shrinks. The importance of branches increases over time.

Table 2 provides further evidence on the economic importance of branches using a familiar ANOVA two-way decomposition of variance. The variation across banks is small relative to variation across branches. Moreover, variation across branches has increased over time. It accounts for 90% of the variance in lending in 2013 compared to 73% in 1996 and we find similar results when analyzing within-district data. The bottom line is that branches are historically important and their importance has increased over time.

Figures 4-6 display data on lending by branches. Figure 4 shows that urban branches comprise the large fraction of bank lending, accounting for about three quarters of all lending. This is a striking mirror image of the 27% of the Indian population living in urban areas according to the 2001 Indian census. Figure 5 displays the number of accounts in our sample. The number of loan accounts increases in both urban and rural regions especially in the later part of our sample period. In 2013, urban branches had close to 80 million loan accounts, which account for close to 70% of all accounts in our sample. Figure 6 displays the average loan ticket size. We find that the ticket size increases over the period and the increase is especially pronounced outside the urban areas. For instance, the average ticket size of the loans made by rural branches in 1996 is ₹13,000, or about $200. It increases almost 10-fold to ₹126,000 ($\approx$ US$ 2,000) in 2013. In urban branches, the increase in ticket size over the same period is about 7-fold from ₹87,000 ($1,300) to ₹638,000 (about $9,900).

3.4 Reserve Requirements

As discussed above, CRR represents the cash banks must hold with India's central bank. We obtain the data on reserve requirements, the key monetary policy instrument we study, from publicly available data distributed via the Reserve Bank of India website.[8] Such requirements are commonly used in many countries although their size, nature, and main purpose vary.[9]

[8] https://www.rbi.org.in/scripts/BS_ViewMasCirculardetails.aspx?id=7340#2, April 2016.

[9] The reasons for holding reserves include a prudential motive to limit bank risk-taking and prevent panics or monetary control and liquidity management (Gray, 2011).

Figure 7 shows the evolution of CRR. The CRR exhibits frequent variation over time, moving from 14% to 4% with an intermediate trough and peak of 4% and 8%, respectively. The numbers represent the proportion of aggregate bank deposits and are thus economically significant.[10] While we focus on the CRR, we also control for policy rates by including repo rates in the models. The RBI conducts daily monetary operations through a Liquidity Adjustment Facility that lets banks borrow or lend money through repurchase (repo) or reverse repurchase (reverse repo) agreements, respectively. Figure 8 graphs the evolution of repo and reverse repo rates since 2001. Both rates are correlated. In the empirical analysis, we focus on the repo rate as a control. Figures 7 and 8 show that the policy rate and quantity instruments have often moved in the opposite directions. For example, between 2011 and 2012, rates tightened but CRR was decreased.

4 Empirical Strategy

Our approach exploits within-bank heterogeneity in lending responses. As Kashyap and Stein (2000) establish, across-bank heterogeneity is important. For instance, banks vary in their access to external finance, which can determine lending responses. Such constraints are not static but can vary from year to year. Focusing on within-bank variation lets us absorb all possible observed and unobserved heterogeneities across banks.

We absorb heterogeneity across banks through bank fixed effects, and more importantly, through bank-year interactive fixed effects. These interactive effects control for bank level variables that vary from year to year including time-varying external financing constraints or idiosyncratic shocks faced by banks in a year such as a bank's CEO changes. Likewise, we include interactive fixed effects at the level of the administrative district times the year, which controls for local geography as well as idiosyncratic events within a geography such

[10] Related to the CRR is the statutory liquidity ratio (SLR), which represents the fraction of demand and time deposits that banks operating in India must hold in approved assets, typically bonds issued by the Indian central or state governments (Lahiri and Patel, 2016). SLR changes are few and involve portfolio allocation decisions between interest earning assets. Moreover, Including SLR changes produces similar results.

as a shortfall in rain in a particular year.

Our baseline specification is as follows:

$$\log(L_{ijt}) = \alpha + \beta B_{ijt-1} + \delta M_t B_{ijt-1} + s_i \pi_t + s_d \pi_t + \epsilon_{ijt}, \tag{1}$$

where L_{ijt} is the value of lending by bank i at branch j in year t. B_{ijt-1} stands for a suite of variables at the branch level that we discuss later and is observed at $t-1$. M_t is the quantitative policy tool, the average CRR in year t. The variables s_i and π_t denote bank and year fixed effects respectively while the variable $s_i\pi_t$ represents the interactive bank-year fixed effects. Likewise, variable s_d denotes district fixed effects and $s_d\pi_t$ denotes interactive district-year fixed effects. Standard errors are clustered at bank-branch level but clustering at bank level produces similar results. The overall approach is like similar to Kashyap and Stein (2000) or the variants in recent work such as Jimenez, Ongena, and Saurina (2014).

In Eq. (1), the coefficients δ are the main objects of interest. They capture how the effect of monetary policy depends on branch characteristics. A positive coefficient indicates *weaker* lending responses. For instance it indicates that a cut in CRR increases lending less for the given branch characteristic. A negative coefficient indicates stronger transmission. For the variable associated with the negative coefficient, a cut in the CRR increases lending more. We introduce a number of branch level variables and discuss the insights they yield in our analysis. Table 3 presents summary statistics for the variables.

We include variants of specification (1) for further insights into monetary transmission. Following Jimenez, Ongena, and Saurina (2014), we also run a horse race in which interactions with the CRR M_t compete with interactions with other annual macroeconomic variables such as inflation, or other monetary tools. We also consider models with triple interactions, for instance models that estimate equation Eq. (1) separately for state-owned and private sector banks.

5 Main Results

The key variables of interest are branch level variables, specifically the coefficients for the interaction of branch characteristics and monetary policy, i.e., δ in equation 1. We classify a branch as high on a particular dimension if the 1-year lagged value of its the branch characteristic exceeds the median level for all branches for that year. A negative sign for the interaction term between the lagged value of the branch characteristic and the monetary policy variable indicates greater responsiveness to monetary stimulus while a positive sign indicates a slow response.

For efficiency and compactness, this section both motivates the branch level variables and discusses the relevant results. We divide the branch level variables into four broad categories: (i) Intra-bank organization variables, (ii) local funds at the branch, (ii) geographical location of the branch, and (iv) profits and risks of lending. We discuss the direction of results in terms of a stimulus that relaxes the CRR, or loosens the monetary policy but the discussion is easily recast in tightening terms as well.

Table 4 reports the coefficients on the interaction terms when the branch level variables are included one at a time. Note that all branch level variables are lagged by 1-year in order to address any endogeneity concerns. Table 5 reports the results in a multivariate setting, and includes a smaller set of variables. Most results are similar across the tables so we focus on the full multivariate specification estimates in Table 5. We also caution the reader that the number of observations vary across specifications. This is because some variables of economic interest are compiled in the RBI's BSR only after 2008. For specifications with these variables, the number of observations is lower as reported in the tables.

5.1 Intra-Bank Organization

Complexity and Costs of Making Loans The central hypothesis here is that transmission is likely to be weaker for loans that place greater demands on bank organizational hierarchies.

Complexity Loan size is perhaps the first proxy for lending decisions that must be pushed up bank hierarchies. Delegation of authority to branches is often based on loan size. For instance, in a large nationalized bank in India, loans of up to ₹20 million (about US$ 300,000) can be sanctioned by the branch manager but larger loans must go up the for credit approval.

Loan maturity can also matter. There are at least two effects at play here. Longer term loans are more complex credits that often involve more detailed analyses of business prospects. Making a case for a longer term loan is more burdensome than for a short-term line of credit secured by current assets. A second effect is that long-term loans are not easily reversed. Models of reversible investments predict that longer-term commitments are less likely as agents prefer to wait to invest when decisions are not easily reversed (McDonald and Siegel, 1986, Pindyck, 1988, Veracierto, 2002).

In Table 4, the ticket size interaction with monetary policy is not significant but it is positive and significant in the full multivariate specification in Table 5. The interaction term for branches with greater share of long-term loans is positive and significant in both tables. Thus, branches making more high ticket size loans or and long-term loans are more sluggish to respond to monetary stimulus.

Costs of Making New Loans A branch's credit to deposit ratio indicates the extent to which a marginal dollar of deposit raised is deployed within the geography served by the branch. In an environment where deploying credit is costly, it can be shown that credit to deposit ratios are negatively correlated with the marginal costs of deploying one dollar of incremental credit. This is because for instance, branches with diffuse customers spread over difficult terrain may find it more costly to acquire new customers to lend to and do enough due diligence to evaluate customers and make loans. Thus, when monetary policy loosens, we expect branches with higher credit to deposit ratio to exhibit a greater response than branches with low credit to deposit ratios.

The results are consistent with the marginal cost of lending interpretation of the credit-to-deposit ratio. In Tables 4 and 5, the interaction coefficient for credit to deposit ratio is negative and significant, suggesting that branches with high lagged credit to deposit ratios respond more to CRR changes.

Expertise and/or Bureaucracy Extending credit requires customer acquisition, processing, and ex-post monitoring. In customer acquisition, branches must make judgments about credit quality and need expertise in assessing credit needs to fit credit products to needs. This is especially relevant in an emerging market such as India with relatively low levels of financial literacy and unsophisticated customers, where the branch must often help borrowers put together the necessary loan application package, and managing the application process. We consider two proxies: branch size and a branch's human capital.

Branch size Greater loan volumes give branches the experiential knowledge to better handle lending pressures. Thus, banks with greater size may find it easier to respond to monetary stimulus. We measure size in two ways. One measures branch assets relative to assets of all branches in the banking system. The other measures the total branch assets relative to assets of other branches within the same bank. We expect transmission effects to be greater in large branches using either measure. Our results suggest that both measures of branch size have negative and significant interaction coefficients. Thus, larger branches tend to respond more to CRR changes than smaller branches.

Branch Human Capital Lending involves several steps ranging from origination to credit assessment to delivery. Human capital is necessary to handle many of these steps, particularly in the context of an emerging market like India where credit decision infrastructure is human capital intensive even today. To the extent these tasks are not routinized, line officers of the bank drive lending processes. We obtain measures of the human capital of the branch from report BSR-2 filed with the central bank. One measure is the number of officers in a branch. The officers in a banking system represent high-skill human capital, particularly in India where bank officer jobs are sought after and involve a very competitive screening process both in private and public banks.

We also obtain data on the number of clerical staff per officer. This variable can reflect the branch capacity to conduct the branch's administration process. First, it can denote the administrative load on officers, as a high clerk-to-officer ratio places more demand on the officer's time to administration as opposed to the lending business of the bank. A higher number of clerical staff can also be suggestive of more bureaucracy and less efficiency in the system. Alternatively, it can also reflect the degree of automation, or more specifically, the lack of automation in a branch. A high clerk-to-officer ratio could suggest a lower degree of automation.

We expect that the lending response to monetary stimulus is greater when a branch has more officers and lesser when a branch has high clerical staff to officer ratio. The human capital variables are both significant with the predicted sign. Branches with a high number of officers have a negative interaction term, so these branches are more responsive to monetary stimulus. Branches with greater clerical staff to officer ratios have a positive interactive coefficient, so these branches transmit monetary policy less.

5.2 Local Funding

We examine the extent to which a branch is dependent on headquarters, or resources from other branches through local capital markets within banks. The relevant variable is whether a branch is deposit rich or deposit poor. We examine two types of hypotheses in relation to deposits. One viewpoint is that branches with less internal capital are more external finance dependent, where external finance is defined as dependence of a branch on headquarters. Thus, fluctuations in funding at the headquarter level should be reflected the most in deposit-poor branches.

On the other hand, incentive theories generate the opposite prediction. Deposit raising is a core activity for banks and involves costly effort. Many banks explicitly set deposit raising targets for their branches. A bank whose headquarters perennially funds branch deposit deficits ends up subsidizing branches who make less effort in resource raising. These effects are especially pronounced if central offices have tastes for large size when branch managers exploit the ex-post inability of headquarters to shut down losers (Rajan, Servaes, and Zingales, 2000). To countervail such effects, headquarters can provide banks matching resources when they raise their own deposits. The empirical prediction is that transmission is weaker for branches with less deposits.

We test these hypotheses using the variable “low deposit,” which represents branches with 1-year lagged deposit levels below the median across all branches of the same bank in the same year. This is “high” when branches are more dependent on external funding from headquarters through internal markets for capital. We find that branches with low deposits, or those that are more external finance dependent, are less responsive to funding shocks. The results make the broader point that external finance dependence at the bank level acts quite differently from external finance dependence of the branch level. While external finance dependence of banks on capital markets implies more transmission, we find that the reverse is true of external finance dependence of branches on internal capital markets of the bank.

5.3 Geographical Location

We next examine whether the bank branch is located in a rural or urban location. The issue at hand is whether transmission should be stronger or weaker to in rural branches when surplus funds become available at headquarters. There are two possibilities. One is that the transaction costs of making new loans is higher in rural areas. The distance in lending between branches and borrowers is likely greater in rural areas (Petersen and Rajan, 2002). In addition, gathering the relevant soft information necessary for lending may be more difficult in rural areas. Moreover, expansions in rural credit may be driven more by political pressures (Cole, 2009) making rural credit less elastic to monetary stimulus.

The opposite prediction, or greater transmission in rural areas, comes from the viewpoint that rural areas are characterized by perennial credit shortages. Credit constraints of rural customers have been the primary motive for nationalization of the banking industry, and subsequent branch expansion and licensing norms in India. These credit deficits make it easier for banks to push loans to rural areas when monetary policy is loosened. We find support for this latter view in Tables 4 and 5. Rural branches have negative interaction terms with CRR, suggesting that they transmit monetary stimulus more than their urban counterparts.

5.4 Profits and Risks

We next focus on the level of non non performing assets (NPAs) of a branch. Greater NPAs can signal a branch that is taking excessive risks. New money available at the margin can fund branches that take more risks in the risk channel of monetary policy (Rajan, 2005, Diamond and Rajan, 2009, Jimenez, Ongena, and Saurina, 2014). On the other hand, poor loan performance at a branch can lead headquarters to penalize branches for indiscipline. If so, headquarters will push out extra funds released by CRR cuts to branches with low NPAs.

Non-Performing Assets We examine branch-level NPAs first. Table 4 and 5 show that branches with greater share of NPAs show less elastic lending responses, consistent with a view that headquarters disciplines branches generating NPAs. These branches receive less funding when new money becomes available at headquarters. They also contract less when funds are pulled out at headquarters, perhaps reflecting the difficulties in disengaging from difficult accounts.[11] As we also clarify later, the interpretation is helped by later tests that focus on private sector versus state-owned banks.

Interest Rate Spreads We compute a branch level interest rate spread variable as follows. Using the BSR-1 interest rate data, we compute the spread of each sector-loan size bin as the excess of the interest rate over its size and sector matched national average for the year. The weighted average of the excess spread across all sector-loan size bins for each branch represents the excess spread charged by a branch.

The excess spread can be interpreted in two ways. One is that it is a control for the marginal investment opportunities of the branch, similar to a branch level Q in a theory of

[11]The branch NPA results may appear to contradict the viewpoint that banks engage in excessive risk-taking when monetary policy is loosened. This is not necessarily true. Our analysis is *within* banks. It is possible (and plausible) that aggregate risk-taking occurs at the bank level. This is the familiar tradeoff between local effects, which a granular approach with fixed effects can tease out, versus aggregate effects, which it cannot (Kashyap and Stein, 1995).

Q-investment. This is because the excess spread measure is risk-adjusted and thus reflects the profits that the branch generates relative to its peers lending in the same sector and making similar sized loans. A profit maximizing CEO of a bank, for example, will increase lending more to profitable branches, when extra resources become available at the headquarters. From this viewpoint, branches with greater excess spreads should have greater lending responses when CRR is reduced. Excess spread, however, could also be a proxy for omitted credit risks. We thus include it in the regression specifications.

In Table 4 we find the coefficient for interest rate spreads is positive but not statistically significant. In the multivariate specification in Table 5, the coefficient for spreads is positive and significant. Branches with greater loan spreads have less elastic lending responses. The result is more consistent with the view that loan spreads reflect unobserved credit risk and that headquarters allocates less new resources to branches with greater risks (cf. footnote 11). The investment opportunities or the marginal Q of branches are probably picked up through the suite of district-year fixed effects.

To summarize the main findings from the empirical analysis, we find that each of the branch level asset, liability, and organizational variables matter. In particular, a cut in CRR increases lending more in branches that have less complicated loan structures, have more expertise and are loaded by less bureaucracy, are sustained by local funds, are located in rural areas, and make less risky loans. Our findings are summarized in Table 6.

6 Robustness and Additional Findings

6.1 Overall Effects

What is the overall effect of CRR on lending? In unreported results, we estimate a version of the multivariate specification in which the year fixed effects are replaced by the level of the cash reserve requirements in the year. This specification clearly places a structure on the annual fixed effects and is thus less general than including fixed effects. However, it has the virtue that of letting us estimate the overall effect of monetary policy. The overall effect of changes in the CRR is the sum of the coefficient on the CRR variable and those on the interaction terms. We find that the coefficient for CRR is negative, so the overall effect of CRR reductions is to increase lending. The positive elasticity of lending to injections of money into the banking system mitigates concerns about gross misspecification of the model. In the 2008-2013 period when the full set of explanatory variables are available, the coefficient estimates suggest that a cut in CRR by 1 percentage point increases overall lending by 13% for branches that have more complicated loan structures, have more expertise, are sustained by local funds, are located in rural areas, and make more risky loans..[12]

6.2 State-Owned Banks

We next analyze lending responses by state-owned and private banks. Morck, Yavuz, and Yeung (2013) find that monetary policy is more significantly related to credit in countries where a larger fraction of the banking system is state controlled. They explain these findings with the hypothesis that managers in state-owned banks are likely to be more responsive to political pressure, and thus more cooperative with monetary policy. Deng, Wu, and Yeung (2011) analyze the case of China. They show that the effectiveness of the 2008 monetary stimulus in China is linked to state-controlled banks' managers' obedience to the Communist Party hierarchy.

The Indian government controls state-owned banks but likely exerts less influence at the ground level. Managerial appointments and operating decisions at the lower level are largely free from day to day interference from the government. However, the government does enjoy soft and hard influence at the strategic level through the upper hierarchy of banks, for instance through its ability to appoint top management and board members (Cole, 2009). Moreover, as government owned entities, state-owned banks operate by encumbering a set of rules and regulations that make speedy responses difficult. From this viewpoint, state-owned banks may be slower to respond to monetary policy.

[12]We also note that the signs of the interactions of the CRR with the branch variables remain unchanged.

We report the results for state-owned and private banks separately in Table 7. There is some evidence for the slower transmission hypothesis for state-owned banks. For example, the sign of the coefficients on interactions of CRR with credit to deposit and number of officers are negative for both state-owned and private banks, but the magnitude of the coefficients are much lower for state-owned banks. A cut in CRR increases lending more for branches with high credit to deposit ratios, and for branches with more expertise, but the estimated effects are smaller in magnitude for state-owned banks. Similarly, the coefficients on interaction with branch deposits are positive for both state-owned and private banks, but they are more significant for state-owned banks. A cut in CRR increases lending less for branches with low deposits, even more so for state-owned banks.

An interesting result is the case of branch level non performing assets. In Table 7, this interaction coefficient becomes insignificant for state-owned banks suggesting that resource allocation systems in state-owned banks do not penalize poorly performing branches. Private banks appear to be more disciplined about containing loans made by branches with poor performance records. Interestingly, the rural branch coefficient flips signs for private banks. Thus, rural branches of private banks are less elastic to CRR changes. Rural branches of state-owned banks are more comfortable with expanding or contracting rural credit in responses to money supply. The result likely reflects the longer historical presence of state-owned banks in rural areas, which gives the banks greater comfort in making adjustments to their rural portfolios.

6.3 Loosening and Tightening Episodes

Table 8 analyzes the results for loosening and tightening episodes. Loosening episodes are defined as those in which CRR changes are negative, or banks have lower CRR requirements or more free resources to lend. Increases in CRR are classified as tightening. We find that during loosening episodes, lending increases more in response to a CRR change for branches with low ticket size, short-term loans, high credit-to-deposit ratio, more officers, greater deposits, and rural branches. On the other hand, lending increases less for branches with high ticket size loans, long-term loans, lower deposits, and for urban branches. Overall, these results suggest the findings presented in Tables 3 and 4 are likely to be driven more by loosening episodes.

We find that the coefficient for non performing assets flips signs to negative. The negative interaction term for NPAs during loosening episodes suggests that risk-taking increases in loosening episodes. We find that during tightening episodes, branches with greater ticket sizes, longer-term loans, lower credit to deposit ratio, lower deposits, high interest rate spreads, and high NPAs cut back more. On the other hand, branches with high credit to deposit ratio and greater expertise retract less. The coefficient for rural is insignificant, suggesting low elasticity of rural credit to increases in CRR, or tightening.

6.4 Other Robustness Tests

In the next robustness tests, we exclude a large state-owned bank, the State Bank of India (SBI) and its affiliates. The SBI group accounts for about a quarter of the total bank lending on average over the sample period and has an extensive network with over 20,833 branches. Given its size, it is an especially attractive target for government influence and is more likely to act in line with government priorities. We next include regional rural banks (RRBs) in the sample. In the baseline regressions, RRBs are excluded as their share in overall lending in less than 3% and has remained stagnant over time. Including many RRBs in a branch level regression could overstate the results relative to their economic importance if their observation counts are disproportionate relative to their assets.

Table 9 reports the results. The most significant change is in the coefficient for rural branches, which becomes insignificant when we drop State Bank of India. The results likely reflect the bank's muscle in rural areas from its long operating history in India. The inclusion of regional rural banks mutes the significance of the rural branch coefficient. Other branch asset, liability, and organizational variables remain similar.

The differential response of bank lending within branches could also be driven by macroeconomic variables other than monetary policy. Following Jimenez, Ongena, and Saurina (2014), we include as controls interactions with other key macroeconomic variables in Table 10. Given our focus on monetary policy, a candidate variable that may stack the odds against our specification is inflation. We thus run a horse race where interactions of the rural branch dummy variable with the monetary policy are stacked against similar interactions with inflation. Cole (2009) points out that electoral cycles can drive variation in lending. Cole finds an election cycle component of lending driven by the timing of state-level elections, particularly in sectors vulnerable to political capture. To control for potential confounding effects from elections, we include relevant dummy variables for state elections as controls. We include dummy variables for election years and their interaction with the rural branch dummy. Our results remain similar.

We examine the robustness of the specification to two other variables. One is the policy rate, which is the RBI's repo rate available to banks through the repo window. The other is the statutory liquidity ratio, SLR, which is the fraction of reserves required to be held in government securities, which is subject to occasional changes but concentrated towards the start of our sample period. We examine alternative econometric specifications. We lag the monetary policy variable by one year to address feedback issues related to using contemporary monetary policy. We also report the results with the specification in differences in lending. Fixed effect models in dynamic settings pose problems in inferences but we attempt estimation of these given the observation of Buddelmeyer, Oguzoglu, and Webster (2008) on potential mitigation when there are many cross-sectional units. While the alternative specifications are not standard models employed in the vast literature on the bank lending channel literature we nevertheless estimate these models as robustness. Table 12 shows that our results are not sensitive to these specifications.

7 Conclusions

A basic question in the literature on monetary policy is whether bank lending responds to monetary policy. This question is of special interest after the global financial crisis when monetary policy and interventions are at the center of economic stabilization efforts in the U.S., Europe, and Asia. We contribute new evidence on this issue.

Our specific focus is on the transmission of monetary policy *within* banks. In the spirit of the micro approach suggested by Kashyap and Stein (1995, 2000), our effort is to explore lending responses to monetary policy by exploiting heterogeneity across different units of the banking system. The existing literature focuses on how responses vary across institutions classified by proxies for external financial constraints. We examine within variation, or the responses of different units within the same bank, using intra-organizational data on branch asset, liability, and human capital. This type of analysis lets us rule out sources of unobserved heterogeneity by employing a full suite of granular fixed effects that control for institution, local geography, and the interactions of institution and geography with year. The monetary policy instrument we study is of independent interest as it injects or retracts cash from the banking system instantaneously. This shock is akin to a "helicopter drop" of cash into each bank that is immediately available for lending. The takeaway from the analysis is that besides the external frictions between banks and markets emphasized (rightly) in prior work, *internal* or intra-bank frictions also impact how banks respond to monetary policy.

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Figure 1
Number of Banks by Ownership

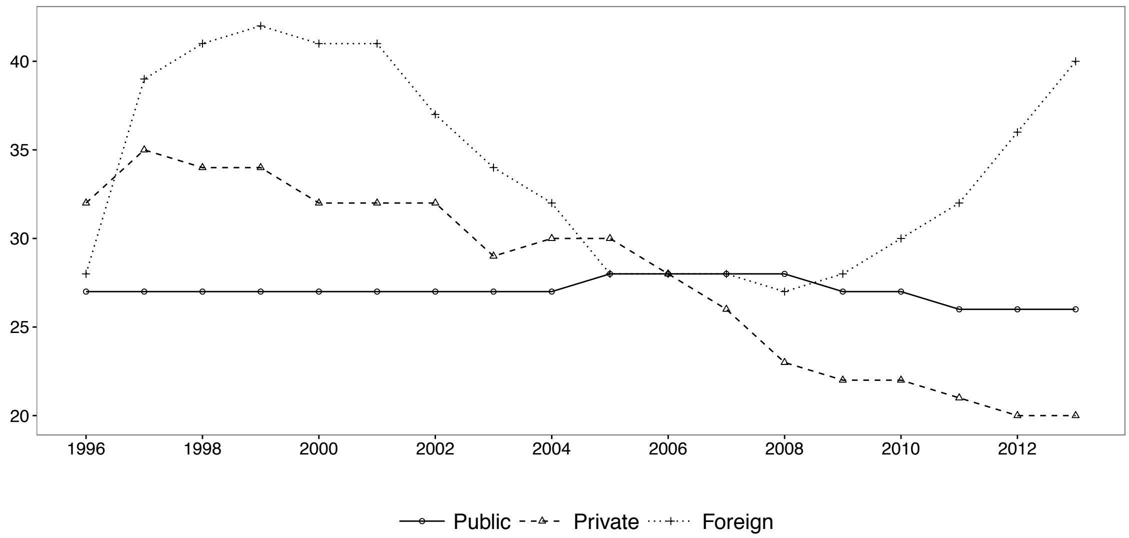

Figure 2
Number of Bank Branches: Rural and Urban

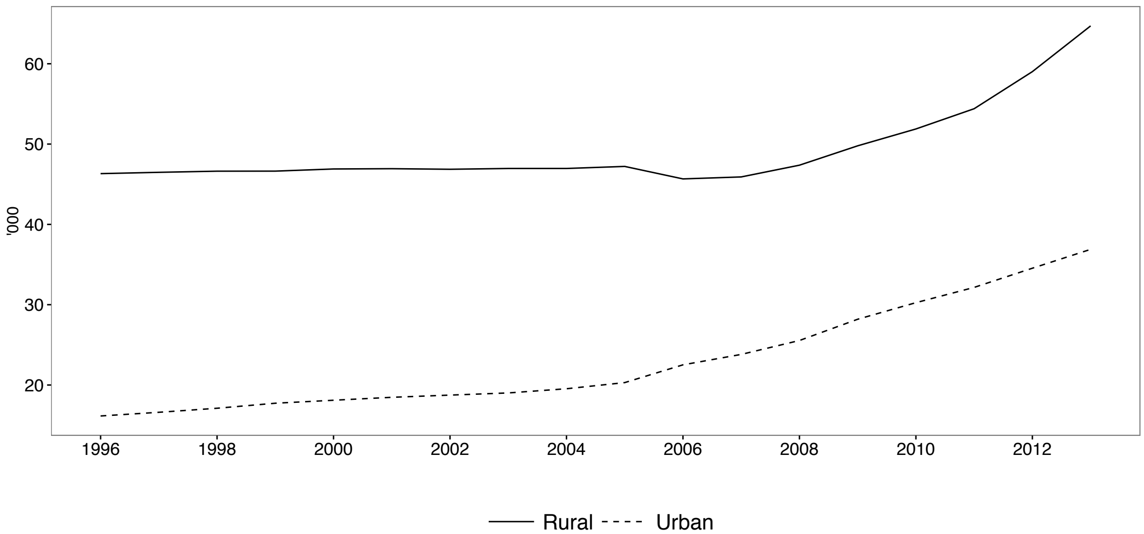

Figure 3
Share of Bank Lending by Ownership

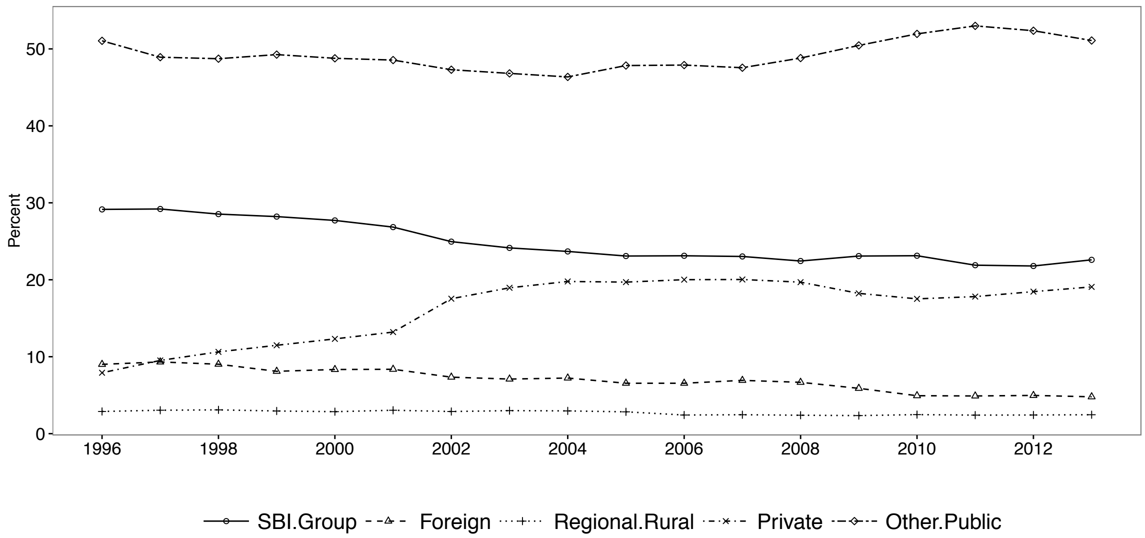

Figure 4
Value of Lending: Rural and Urban Branches

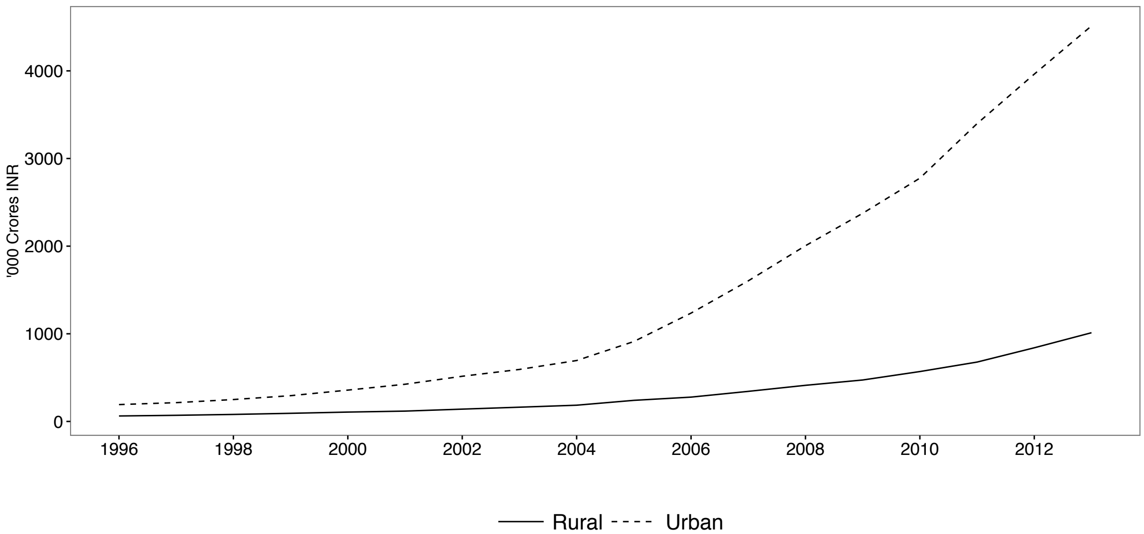

Figure 5
Number of Loans: Rural and Urban Branches

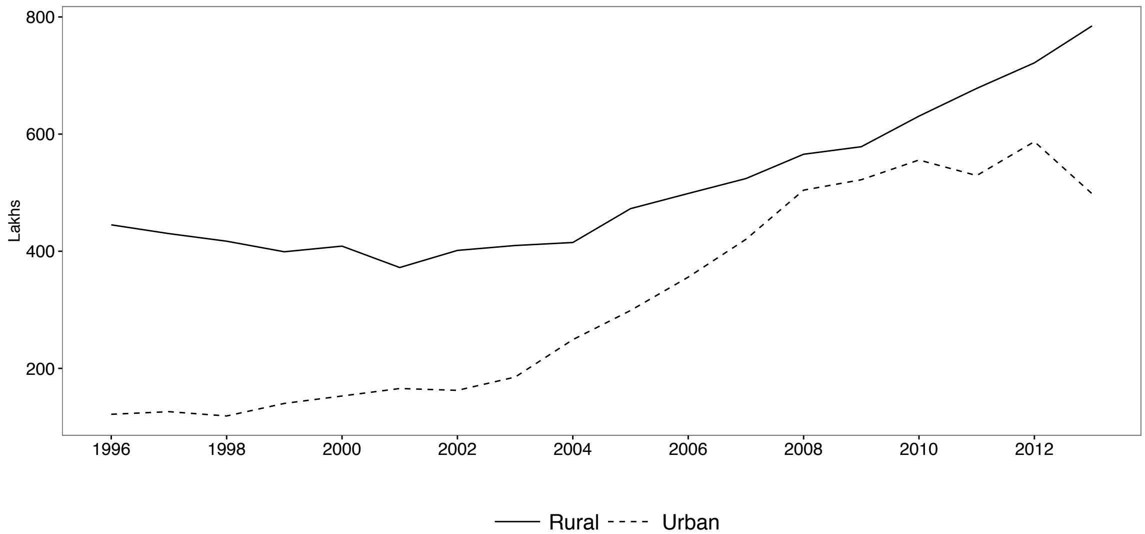

Figure 6
Average Ticket Size: Rural and Urban Branches

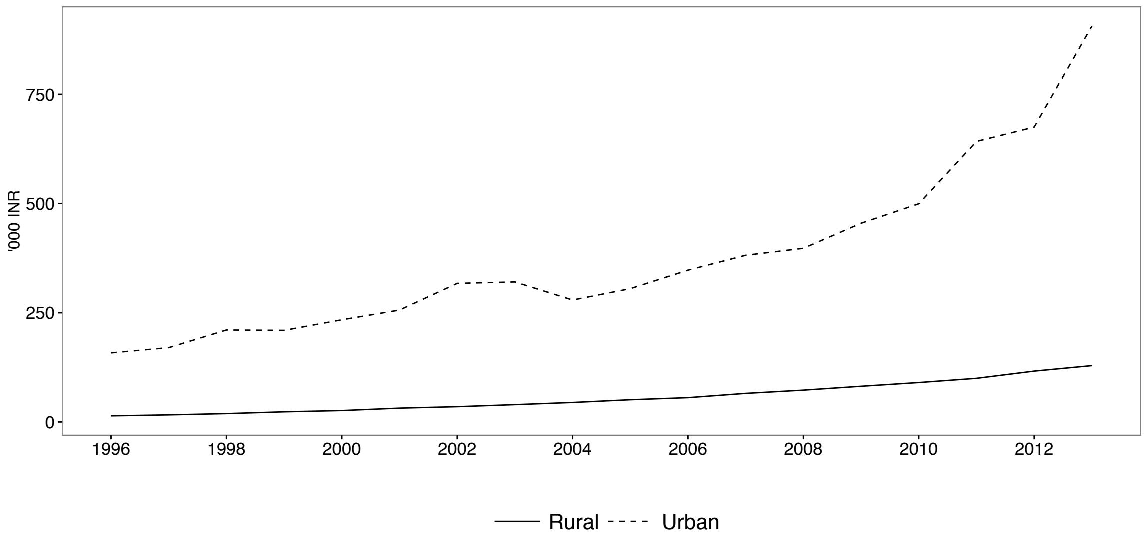

Figure 7
Cash Reserve Ratio

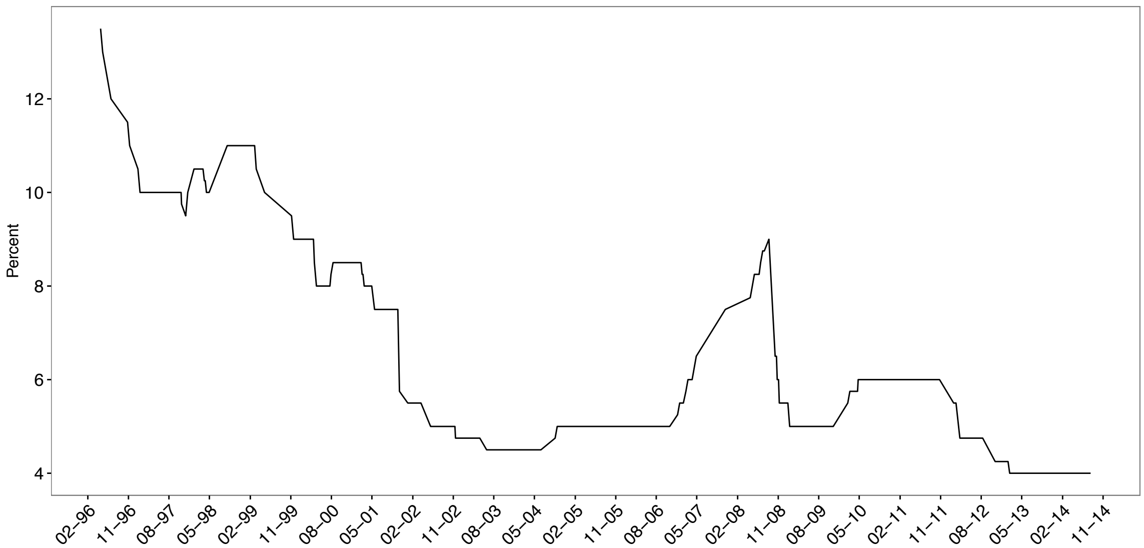

Figure 8
Policy Repo Rates

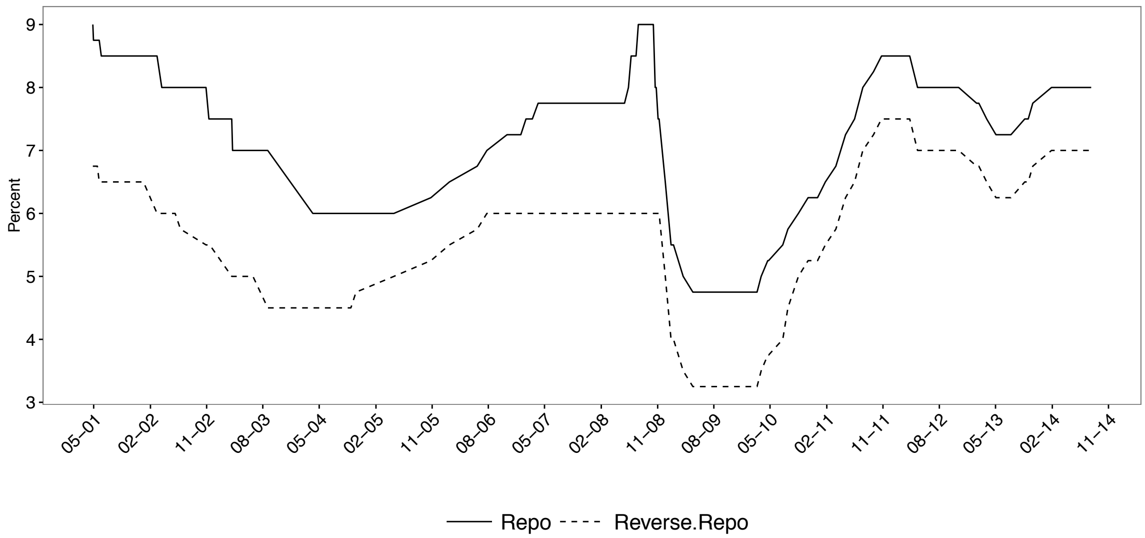

Table 1
Sample of Banks

Panel A: Bank Characteristics, 2013			
	Number	Lending (₹ crore)	Share in %
All Banks	150	36,800	100
Public	26	156,500	74
Private	20	52,500	19
Foreign	40	6,600	5
Regional Rural	64	2,100	2

Panel B: Bank and Branch Characteristics				
	Bank-level		Branch-level	
	Number	Lending (₹'000 crore)	Number	Lending (₹ crore)
1996	283	0.9	62,465	4.1
1997	297	1.0	63,088	4.5
1998	298	1.1	63,734	5.2
1999	299	1.3	64,364	6.1
2000	296	1.6	65,004	7.1
2001	296	1.8	65,406	8.3
2002	292	2.3	65,608	10.0
2003	286	2.6	65,975	11.1
2004	285	3.1	66,498	13.3
2005	282	4.1	67,519	17.1
2006	217	7.0	68,178	22.2
2007	178	10.9	69,720	27.9
2008	168	14.4	72,914	33.1
2009	163	17.5	77,972	36.5
2010	162	20.6	82,136	40.7
2011	161	25.3	86,556	47.1
2012	164	29.3	93,564	51.3
2013	150	36.8	101,603	54.4

Panel A shows the number of banks, average lending, and share in total lending at the bank level. Panel B shows the number of banks and average lending over time at the bank and branch levels. ₹ denotes local currency units, Indian rupee. 1 crore is equal to 10 million.

Table 2
Decomposition of Variance of Log Lending

	[1]	[2]	[3]	[4]
Source	1996	2005	2009	2013
Between banks	27	24	18	10
Within banks	73	76	82	90
Within district				
In %				
Between banks	14	15	16	9
Within banks	86	85	84	91

Table 2 reports estimates of one-way analysis-of-variance (ANOVA) models for log lending The estimates are in percentages and indicate the percent of total variation in lending explained between and within banks where the latter is variation across branches within a bank. The first panel shows the fraction of overall variation while the second is the variation in lending after filtering out district effects.

Table 3
Descriptive Statistics

	# Obs	Mean	Median	Std. Dev
Lending (in logs)	946,816	10.94	10.89	1.5
Ticket size (in ₹'000)	946,816	303.6	69.4	995.6
Credit to deposit ratio	943,586	64.4	38.1	84.0
Share of NPAs	330,049	4.4	0.7	10.5
Share of long-term loans	301,485	53.8	55.2	26.2
# officers	334,787	4.5	3.0	30.5
Clerks to officer ratio	334,787	1.3	1.0	1.0
Deposits (in logs)	943,684	11.7	11.7	1.4
Rural dummy	1,040,000	0.6	1.0	0.5
Interest rate spread	330,835	-0.2	-0.3	1.4

Table 3 provides descriptive statistics for the raw branch level variables from the Reserve Bank of India's Basic Statistical Returns from 1996 to 2013. Lending is the sum of all loan amounts recorded for a branch. Ticket size is the loan amount recorded for individual accounts domiciled in branches. The credit to deposit ratio is the ratio of total branch lending to total branch deposits. Share of NPAs is the ratio of non-performing assets reported by a branch to the total loan amounts at the branch. # Officers denotes the number of officers in a branch. Clerks per officer is the number of clerical staff per officer at the branch. Deposits is the sum of the current, savings, and time deposits at the branch. Rural is a dummy variable that takes the value 1 is the branch is located in an area designated as rural according to the national definition. Interest rate spread is the loan-amount weighted spread of interest rate minus the average interest rate for the sector and loan size for the entire sample in a year and is available only after fiscal year ending March 31, 2008.

Table 4
Lending Responses to CRR with Branch and Branch-CRR Interaction Effects: Single Variable Specifications

Dependent variable: log lending at bank-branch-year level

	Intra-Bank Organization: Complexity and Costs of Lending		
	High ticket size of loans	High share of long-term loans	High credit to deposit ratio
CRR*High	0.000	0.037***	-0.051***
	[0.000]	[0.003]	[0.001]
High	0.938***	-0.469***	1.147***
	[0.004]	[0.016]	[0.004]
Observations	946,816	301,485	943,586

	Intra-bank Organization Expertise and Bureaucracy			
	Large branch	Large within Bank	High number of officers	High clerical staff to officers ratio
CRR*High	-0.038***	-0.028***	-0.057***	0.034***
	[0.000]	[0.000]	[0.002]	[0.003]
High	1.853***	1.784***	1.551***	0.071***
	[0.003]	[0.003]	[0.012]	[0.016]
Observations	946,818	946,818	334,787	334,787

	Funding, location, and risk			
	Low local deposits	Rural	High % NPAs	High spreads
CRR*High	0.018***	-0.004***	0.089***	0.003
	[0.000]	[0.001]	[0.003]	[0.003]
High	-1.184***	-0.754***	0.182***	0.363***
	[0.003]	[0.004]	[0.015]	[0.016]
Observations	943,684	1,040,000	330,049	330,835

Table 4 reports estimates of the regression of log branch lending on branch characteristics and interactions with CRR with bank-year and district-year interactive fixed effects. High is a dummy variable for whether a branch characteristic is above median in a lagged year where the reference group is all banks in the year unless otherwise noted. In model [1], the branch characteristic is average ticket size; in model [2], it is the credit to deposit ratio; in [3], it is the percentage of a branch's long-term loans to total loans; in [4], large branches denote the total lending volume of a branch and the reference group is the entire nation, while in [5], branch size is with reference to other branches in the bank. In [6], High denotes branches with greater number of officers, in [7] High is based on the clerk to officer ratio for a branch. In model [8] High denotes a branch with greater headquarter funding dependence, or low local funds as proxied by deposits. In model [9], High is 1 if the branch is 1 if the census center associated with the branch is in a rural or semi-urban location. In models [10] and [11] High denote branches that have a high ratio of non-performing assets to total assets and high interest rate spreads relative to a national benchmark based on sector and loan size. The sample is from Reserve Bank of India's Basic Statistical Return BSR from 1996-2013 or 2008-2013 depending on availability of branch-level data. Standard errors are clustered at the bank-branch level. ***, **, *, and denote statistical significance at 1, 5, and 10 percent levels, respectively.

Table 5

Lending Responses to CRR with Branch and Branch-CRR Interaction Effects: Multivariate Specification

Dependent variable: Log (value of lending) at bank-branch-year level	
Intra-bank organizational variables	
CRR*Branch with high ticket size loans	0.039***
	[0.003]
CRR*Branch with high share of long-term loans	0.027***
	[0.002]
CRR*Branch with high credit to deposit ratio	-0.033***
	[0.002]
CRR*Branch with high number of officers	-0.099***
	[0.002]
Local funds	
CRR*Branch with low deposits	0.011***
	[0.003]
Geographical location	
CRR*Rural branch	-0.006**
	[0.002]
Profits/Risk	
CRR*High interest rate spreads	0.047***
	[0.002]
CRR*Branch with high share of NPAs	0.026***
	[0.002]

Table 5 reports results of the regression of log bank lending on several branch characteristics, and their interactions with the Cash Reserve Ratio (CRR). All regressions include the full set of bank*year and district*year fixed effects. See notes to Table 3 for details of the branch characteristics. The coefficients on the branch characteristics (without the interaction with CRR) are included but not reported for brevity. The sample period in all the regressions is 2008-2013. The standard errors in all regressions are clustered at the bank-branch level. ***, **, and * denote statistical significance at the 1,5, and 10 percent levels, respectively.

Table 6

Summary of the Mechanisms and Findings

Hypothesis	Measure	Expected Transmission	Sign of δ	Transmission Finding
I. Intra-Bank Organization Variables				
Complexity and costs	High ticket size of loans; long-term loans; low credit to deposit ratio	Weak	>0	Weak
Better expertise	Large branches; more officers	Strong	<0	Strong
More bureaucracy	High clerks to officers	Weak	>0	Weak
II. Local Funds				
Poor local funding	Low deposits	1.Strong if need based story 2.Weak if incentive story	>0	Weak
III. Geographical Location				
	Rural dummy	1.Weak if distance to lending story 2.Strong if credit constraint story	<0	Strong
IV. Profits and Risks				
	High NPA	1.Strong if risk-taking 2. Weak if less risk taking at branch level	>0	Weak
	High interest rate spread	1. Weak/strong if credit spreads indicate risk 2. Strong if credit spreads indicate profits	>0	Weak

Table 7
Lending Responses to CRR with Branch and Branch-CRR Interaction Effects:
State-Owned and Private Banks.

Dependent variable: Log (value of lending) at bank-branch-year level		
	State-Owned Banks	**Private Banks**
Intra bank organization		
CRR*Branch with high ticket size loans	0.023***	0.152***
	[0.002]	[0.016]
CRR*Branch with high share of long-term loans	0.023***	0.086***
	[0.002]	[0.015]
CRR*Branch with high credit to deposit ratio	-0.024***	-0.080***
	[0.002]	[0.012]
CRR*Branch with high number of officers	-0.090***	-0.155***
	[0.002]	[0.015]
Local funds		
CRR*Branch with low deposits	0.010***	0.010
	[0.003]	[0.013]
Geographical location		
CRR*Rural branch	-0.028***	0.111***
	[0.002]	[0.014]
Profits/risk		
CRR*High interest rate spreads	0.042***	0.074***
	[0.002]	[0.019]
CRR*Branch with high share of NPAs	0.003	0.208***
	[0.002]	[0.013]

Table 7 reports estimates of a regression of long lending on branch characteristics and their interactions with monetary policy for state-owned and private banks separately. All regressions include the full set of bank and district fixed effects. See notes to Table 3 for details of the branch characteristics. The coefficients on the branch characteristics (without the interaction with CRR) are not shown in the table for brevity. The sample period in all the regressions is 2008-2013. The standard errors in all regressions are clustered at the bank-branch level. ***, **, and * denote statistical significance at the 1,5, and 10 percent levels, respectively.

Table 8
Lending Responses to CRR with Branch and Branch-CRR Interaction Effects: Tightening and Loosening.

Dependent variable: Log (value of lending) at bank-branch-year level	**Tightening**	**Loosening**
Intra-bank organization		
CRR*Branch with high ticket size loans	-0.334***	0.063***
	[0.058]	[0.007]
CRR*Branch with high share of long-term loans	-0.192***	0.045***
	[0.055]	[0.006]
CRR*Branch with high credit to deposit ratio	0.222***	-0.106***
	[0.046]	[0.006]
CRR*Branch with high number of officers	0.191***	-0.125***
	[0.057]	[0.006]
Local funds		
CRR*Branch with low deposits	-0.173***	0.055***
	[0.059]	[0.007]
Geographical location		
CRR*Rural branch	0.009	-0.031***
	[0.051]	[0.007]
Profits/risk		
CRR*High interest rate spreads	-0.176***	-0.009
	[0.061]	[0.006]
CRR*Branch with high share of NPAs	-0.223***	-0.016**
	[0.056]	[0.006]

Table 8 reports estimates of a regression of long branch lending on branch characteristics and their interactions with CRR for episodes of tightening and loosening separately. Tightening and loosening are defined as years when the CRR is increased and reduced, respectively. All regressions include the full set of bank and district fixed effects. See notes to Table 3 for details of the branch characteristics. The coefficients on the branch characteristics (without the interaction with CRR) are not shown in the table for brevity. The sample period in all the regressions is 2008-2013. The standard errors in all regressions are clustered at the bank-branch level. ***, **, and * denote statistical significance at the 1,5, and 10 percent levels, respectively.

Table 9
Lending Responses to CRR with Branch and Branch-CRR Interaction Effects: Alternative Samples.

Dependent variable: Log (value of lending) at bank-branch-year level	**Drop SBI**	**Include RRBs**
Intra-bank Organization		
CRR*Branch with high ticket size loans	0.050***	0.041***
	[0.003]	[0.002]
CRR*Branch with high credit to deposit ratio	-0.035***	-0.049***
	[0.003]	[0.002]
CRR*Branch with high share of long-term loans	0.023***	0.023***
	[0.003]	[0.002]
CRR*Branch with high number of officers	-0.111***	-0.096***
	[0.003]	[0.002]
Local funds		
CRR*Branch with low deposits	0.012***	0.016***
	[0.003]	[0.002]
Geographical location		
CRR*Rural branch	-0.004	-0.003ˆ
	[0.003]	[0.002]
Profits/risk		
CRR*High interest rate spreads	0.042***	0.043***
	[0.003]	[0.002]
CRR*Branch with high share of NPAs	0.026***	0.022***
	[0.003]	[0.002]

Table 9 reports estimates of the regression of log branch lending on branch characteristics and their interaction with CRR for alternative samples. Column [1] excludes the state owned bank, the State Bank of India (SBI) and its affiliates. The regressions in column [2] include "Regional Rural Banks" (RRBs). All regressions include the full set of bank and district fixed effects. See notes to Table 3 for details of the branch characteristics. The coefficients on the branch characteristics (without the interaction with CRR) are not shown in the table for brevity. The sample period in all the regressions is 2008-2013. The standard errors in all regressions are clustered at the bank-branch level. ***, **, and * denote statistical significance at the 1,5, and 10 percent levels, respectively.

Table 10
Lending Responses to CRR with Branch and Branch-CRR Interaction Effects: Single Variable Specifications: Macroeconomic Variables

Dependent variable: Log (value of lending) at bank-branch-year level	**Elections**	**Other Macroeconomic Variables**
Intra-bank organization		
CRR*Branch with high ticket size loans	0.039***	0.044***
	[0.003]	[0.003]
CRR*Branch with high share of long-term loans	0.027***	0.030***
	[0.002]	[0.002]
CRR*Branch with high credit to deposit ratio	-0.033***	-0.036***
	[0.002]	[0.002]
CRR*Branch with high number of officers	-0.099***	-0.104***
	[0.002]	[0.002]
Local funds		
CRR*Branch with low deposits	0.011***	0.012***
	[0.003]	[0.003]
Geographical location		
CRR*Rural branch	-0.007***	-0.008***
	[0.002]	[0.003]
Profits/risk		
CRR*High interest rate spreads	0.047***	0.047***
	[0.002]	[0.002]
CRR*Branch with high share of NPAs	0.026***	0.026***
	[0.002]	[0.002]

Table 10 reports estimates of the regression of long branch lending on branch characteristics and its interactions with CRR and tests the robustness of the baseline results to omitted variables. Column [1] includes a dummy for year in which state elections took place, and the interaction of this dummy with the rural dummy. Column [2] includes the interactions of the all branch characteristics with another macro variable - the inflation rate. All regressions include the full set of bank and district fixed effects. See notes to Table 3 for details of the branch characteristics. The coefficients on the branch characteristics (without the interaction with CRR) are not shown in the table for brevity. The sample period in all the regressions is 2008-2013. The standard errors in all regressions are clustered at the bank-branch level. ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels, respectively.

Table 11
Lending Responses to CRR with Branch and Branch-CRR Interaction Effects: Other Macroeconomic Variables

Dependent variable: Log (value of lending) at bank-branch-year level		
Intra-bank Organization		
CRR*Branch with high ticket size loans	0.022***	0.045***
	[0.003]	[0.005]
CRR*Branch with high share of long-term loans	0.021***	0.028***
	[0.002]	[0.005]
CRR*Branch with high credit to deposit ratio	-0.020***	-0.032***
	[0.002]	[0.004]
CRR*Branch with high number of officers	-0.081***	-0.132***
	[0.002]	[0.005]
Local funds		
CRR*Branch with low deposits	0.004	0.002
	[0.002]	[0.005]
Geographical location		
CRR*Rural branch	-0.001	-0.027***
	[0.002]	[0.005]
Profits/risk		
CRR*High interest rate spreads	0.055***	0.011**
	[0.003]	[0.005]
CRR*Branch with high share of NPAs	0.034***	-0.021***
	[0.002]	[0.005]

Table 11 reports estimates of the regression of long branch lending on branch characteristics and its interactions with CRR and tests the robustness of the baseline regression to omitted variables. Column [1] includes the interactions of the all branch characteristics with the policy repo rate. Column [2] includes the interactions of the all branch characteristics with the policy repo rate and the statutory liquidity ratio (SLR). All regressions include the full set of bank and district fixed effects. See notes to Table 3 for details of the branch characteristics. The coefficients on the branch characteristics (without the interaction with CRR) are not shown in the table for brevity. The sample period in all the regressions is 2008-2013. The standard errors in all regressions are clustered at the bank-branch level. ***, **, and * denote statistical significance at the 1,5, and 10 percent levels, respectively.

Table 12
Lending Responses to CRR with Branch and Branch-CRR Interaction Effects: Alternative Dynamic Specifications

	One-year lagged CRR	First difference in lending and CRR	Lagged dependent variable
Dependent variable:	**Log (value of lending)**	**First difference of Log (value of lending)**	**Log (value of lending)**
Intra-bank organization			
CRR*Branch with high ticket size loans	0.052***	0.009***	0.027***
	[0.002]	[0.001]	[0.002]
CRR*Branch with high share of long-term loans	0.012***	0.001	0.009***
	[0.002]	[0.001]	[0.001]
CRR*Branch with high credit to deposit ratio	-0.036***	-0.007***	-0.002*
	[0.001]	[0.001]	[0.001]
CRR*Branch with high number of officers	-0.027***	-0.013***	-0.025***
	[0.002]	[0.001]	[0.001]
Local funds			
CRR*Branch with low deposits	0.010***	0.009***	-0.012***
	[0.002]	[0.001]	[0.002]
Geographical location			
CRR*Rural branch	0.056***	-0.006***	-0.034***
	[0.002]	[0.001]	[0.002]
Profits/Risk			
CRR*High interest rate spreads	-0.027***	-0.004***	0.018***
	[0.002]	[0.001]	[0.001]
CRR*Branch with high share of NPAs	-0.022***	-0.010***	0.010***
	[0.002]	[0.001]	[0.001]

Table 12 reports estimates of the regression of log branch lending on branch characteristics and their interactions with CRR and checks the robustness of the baseline results to alternative specifications. Column [1] includes the interactions of the all branch characteristics with one-year lagged CRR. Column [2] includes the first difference of log(lending) as the dependent variable, and the interactions of the all branch characteristics with the first difference of CRR. Column [3] repeats the specification in Table 4 by including a lagged dependent variable in the model. All regressions include the full set of bank and district fixed effects. See notes to Table 3 for details of the branch characteristics. The coefficients on the branch characteristics (without the interaction with CRR) are not shown in the table for brevity. The sample period in all the regressions is 2008-2013. The standard errors in all regressions are clustered at the bank-branch level. ***, **, and * denote statistical significance at 1,5, and 10 percent levels, respectively.