Formal Banking and Economic Growth: Evidence from a Regression Discontinuity Analysis in India

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Abstract

This paper investigates the effects of formal banking expansion on economic growth. I exploit a previously unstudied reform to bank branching policy in India, which led to a large expansion in private credit to financially underserved areas. Using a regression discontinuity design at the district level, I trace the exogenous expansion of banking services through time and estimate their effect on agricultural and industrial growth. I am able to address concerns raised in other studies of policy driven banking expansion by accounting for the incentives generated by the reform in the context of India's unique banking environment. I show first that the expansion of financial services led to significant growth in agricultural yield and output of cotton, wheat, and other important revenue-generating crops. I then show that enterprises in states most affected by the reform experience faster growth in their total investments and capital labor ratios. Finally, I confirm the aggregate effect on local GDP growth by showing that areas with expanding banking services experienced higher rates of growth in nighttime light intensity in the years following the reform. The estimates imply that each additional private bank branch led to a 0.36% increase in local GDP. Overall, these findings offer strong causal evidence that the expansion of the financial system facilitates growth in productive activities important for driving economic development.

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1 Introduction

Access to credit expands the choice sets of households and firms, allowing them to smooth consumption and investments across time. The early literature on access to financial markets establishes the association between strong financial systems and economic growth King and Levine (1993); Jayaratne and Strahan (1996); Rajan and Zingales (1998). The intuitive force behind this connection is that productive firms, particularly small ones, often lack the ability to self-finance and rely on external resources to achieve optimal levels of investment and growth. The extent to which such firms remain credit constrained can result in hindered economic growth at the aggregate level. An obvious policy prescription to facilitate growth would be to adopt policies that broaden access to financial markets. In the context of developing economies, this can often mean a literal spatial expansion of bank networks into unbranched or under branched markets.

The fundamental question is then whether policy induced branches actually affect firm and household access to credit. Though the answer may appear to be obvious and affirmative, a lower presence of the formal commercial banking system likely reflects underlying market characteristics. If banks are compelled under regulation to open branches in locations with high costs to doing business, extreme information asymmetries, or difficulties in aligning branch incentives with those of the bank, then new branches may fail to generate new bank business. Policies that do not address these underlying issues must instead focus on expanding branches in areas with a low banking presence explained by high fixed costs of entry. In either case, banks may simply be competing for market share with an informal lending sector, which can often be extensive in developing areas. If informal lenders adequately meet the needs of borrowers, formal credit expansion would be unlikely to produce additional growth.

Accounting for the concerns raised above, this paper examines the effect of expanding access to the formal banking system on economic growth. To gain deeper insight as to the potential channels generating growth that may lead to poverty alleviation, I investigate responses in agriculture and manufacturing to exogenous changes in the availability of formal credit. Examining a previously unstudied branching policy reform in India from 2005, I rely on institutional knowledge of the reform and India's banking environment to construct an empirical strategy and connect the timing of strong effects observed in the banking system to details dictating the reform implementation. The exogenous variation in access to formal banking generated by the policy reform facilitates the clear identification of the effects of banking on agriculture, manufacturing and growth. The seminal empirical paper on bank branching and development, Burgess and Pande (2005), exploits the timing of earlier reforms to show that a rapid expansion of the banking system in India during the 1977-1990 Social Banking Period corresponded with large reductions in the incidence of poverty. The analysis in the current paper identifies the potential deeper mechanisms underlying the effects of greater access to formal banking.

Identifying the effect of banking on specific channels of growth is generally difficult because banks tend to concentrate in profitable areas that are also likely to experience higher rates of economic growth. During times of policy intervention, banks may instead concentrate in poorer areas with slower growth. The bias from this endogeneity can vary widely, overestimating the impact of banks in the first circumstance and underestimating it in the second. Obtaining the necessary exogenous variation required to make causal inferences can be extremely challenging, particularly in development settings. Policy reforms, that may lead to natural experiments, if implemented at too fine of a geographic or demographic level may be impossible to evaluate for lack of granular enough data. Broader reforms may target areas receiving multiple interventions simultaneously making the effect of one particular mechanism inseparable from those of the others. Kochar (2011) studies the effect of banking on inequality in India during the Social Banking Period and raises just such a concern that the growth of subsidized credit distributed through the Integrated Rural Development Program (IRDP) correlates closely with branch expansion at the state level.[1]

The identification strategy pursued in this paper constitutes a key contribution as it allows the use of district level data across all of India, while still separating the effect of the exogenous expansion in formal banking induced by the policy reform from other interventions introduced around the same time. I exploit the selection process of the reform that designated certain districts as being under banked and encouraged entry in these districts relative to those not receiving the status. The rule, based on district population per branch relative to the national average, generated an environment exploitable via regression discontinuity analysis using the national average as a cutoff and each district's population per branch as the running variable. Since the list of under banked districts remained essentially unchanged over the course of the policy, I am able to trace the policy effect on branching and credit, as well as agriculture and manufacturing, through time. I show the lack of a significant discontinuity in the pre-reform period, then a strong and accumulating expansion in private bank branches following the 2005 reform. I trace the effect through time by estimating the average treatment effect of the reform separately for each year from 2002 to 2012.

The timing of the policy response generates additional insights into bank behavior under the regulations. Due to policy details, banks were able to delay branch openings for a period following the policy implementation. Private bank branching in under banked districts remained low during that window, after which it steadily climbed. Meanwhile, the credit extended by private banks exhibited an immediate response consistent with the revelation of information that signaled a pending reform to branch licensing. The disparity in timing be-

[1] Kochar (2011)also discusses the timing and nature of branching policies from the Social Banking Period that are discussed in greater detail in an unpublished comment by Panagariya (2006) and a report by a working group in the Reserve Bank of India (RBI) (RBI, 2009).

tween branches and credit supply is consistent with the optimal strategy of profit maximizing banks that exhibit market power and anticipate future entry. Such banks may expand credit in anticipation of intensified future competition to lock in consumers who face positive switching costs. I provide a simple theoretical framework to outline the intuition for the incentives resulting from the confluence of the reform and India's banking environment. I estimate the strongest responses to the reform from the private sector of India's banking system which is consistent with predictions based on the incentives generated around the cutoff. I cannot rule out, however, the possibility that the public sector also increased banking services due to the reform, but did so in districts away from the cutoff.

I draw on several different sources for the data in this analysis, including India's central bank the Reserve Bank of India (RBI), the Ministry of Agriculture, India's Annual Survey of Industries (ASI) and remote sensing data on the amount of light emitted at night and measures of rainfall. The detailed data from the RBI on bank branches and credit, from separate data sets, help provide a cross check for the two broad banking outcomes. Additionally, with credit reported annually at the district level with further disaggregation by bank group, population group and industrial sector, I am able to examine more detailed banking effects such as the expansion of credit to agricultural activities in rural and semi-urban areas following the reform. I combine separately reported data on district level crop production statistics and farm harvest prices from the Ministry of Agriculture to examine responses in agricultural productivity.

I conclude that the policy reform resulted in a significant expansion of banking services by the private sector in underserved areas. The cumulative effect of the reform is estimated as an average additional 10 private bank branches per district by the start of 2012. This constitutes approximately 50% of the sample average of operating private branches per district in districts around the threshold. I find evidence that private banks exploited the timing allowed in the policy to delay branch openings in under banked areas. In contrast, credit responded to early information regarding the reform consistent with banks racing to secure market shares. In 2006, the reform had already induced an average increase of 6,725 private bank accounts for under banked districts, approximately 52% of the sample average around the threshold. Growth in the credit extended for agricultural use in rural and semi-urban areas of under banked districts demonstrates that reform effects were not solely concentrated in high population areas. This is an important finding due to the popular concern that banks, particularly those from the private sector, exclude rural areas from service.

Increases to agricultural productivity that are consistent with the expansion of credit are observed. Agriculture constitutes a major employment activity in India, with over 56% of workers in 2001 engaged in agricultural endeavors. Further, policy makers placed particular importance on the availability of credit to rural and semi-urban agriculture leading up to the reform, suggesting early effects may concentrate in this sector. Positive responses in yield (output per hectare) and raw output are estimated for several important crops including cotton and wheat. These results are suggestive of a positive effect of banking on agricultural productivity, though a measure capturing responses across crops and incorporating harvest prices is preferred. Turning to an index of crop yield across several important revenue crops in India that weights by each crop's share of district revenue, I estimate an increase of 1,000 private bank credit accounts in a district raises average crop yield by 3%. This effect is a little less than half of the effect Jayachandran (2006) measures on crop yield from positive rainfall shocks, measured as district rainfall being above the 80th percentile of rainfall for that district. This result may reflect the ability of farmers to apply higher quality inputs purchased with credit, such as fertilizers or machinery. A redistribution of crop selection by high productivity farmers responding to loan availability may also contribute to this effect.

Effects are also observed in the amount of borrowing and production activities in manufacturing using data from the ASI. To analyze the ASI data that are available at the state level, I identify a set of treatment and control states based on the share of a state's population close to the threshold on one side or the other. I then perform a difference in differences analysis to estimate the effects of the reform. I estimate that enterprises in states with populations most affected by the reform experienced faster growth in the amount of loans they carried in the order of 23%. This result is consistent with the reform affecting the availability of credit to manufacturing. These enterprises also reported higher total investments, working capital and capital labor ratios following the reform. These responses are consistent with manufacturers being credit constrained in the pre-reform period and expanding their levels of capital given increased access to credit.

Finally, I confirm the aggregate effect on local GDP growth by showing that areas with expanding banking services experienced higher rates of growth in nighttime light intensity in the years following the reform. Henderson et al. (2012) established that so called "nightlights" provide a reliable proxy for economic growth under certain caveats when regularly reported data on traditional measures are unavailable, as is the case for district level GDP in India. Taking the estimated elasticity of nighttime light to GDP from Henderson et al (2012) of 0.3, the effect estimated in the current analysis implies that each additional private bank branch led to a 0.36% increase in local GDP. Overall, these findings offer strong causal evidence that the expansion of the financial system facilitates growth across productive sectors and encourages economic development.

1.1 Related Literature

These results are largely consistent with two analyses examining effects of branching in the United States. Dehejia and Lleras-Muney (2007) examine the effect of two forms of financial development in the United States from 1900-1940 on agricultural and manufacturing sector development. They find that while increased bank branching encouraged growth in these sectors, deposit insurance had negative effects. Krishnan et al. (2014) show that increased branching activity in the United States, following the Interstate Banking and Branching Act of 1994, led to greater efficiency gains by previously credit constrained manufacturers. Unlike the policy reform in the current analysis that directed banks toward targeted areas and resulted in policy driven branching, the mechanism of branch expansion in these other two analyses was legislation granting banks greater ability to branch, enabling banks already wishing to expand to enter new markets. The results in the current paper confirm the positive effects of branching on both agriculture and manufacturing. The three analyses differ in their consideration of manufacturing. Dehejia and Lleras-Muney (2007) focus on expanding labor demand in manufacturing; Krishnan et al. (2014) explain increased efficiency through the adoption of more productive projects, while the current analysis focuses on capital use, showing increases in investment and capital intensity in production. To the extent that firms remain capital constrained, lower aggregate TFP due to resource misallocation as argued for the case of India in Hsieh and Klenow (2009) may be partially attributed to lower financial access. The consistency between the broad effects is not surprising given that the expectation in the current context on the private sector banks is to compete and expand access to credit conditional on entry.

The differences that I observe between private and public sector banks, in their responses to the reform, likely reflects differences in the incentives and objectives generated under those respective ownership structures. La Porta et al. (2002) show that a higher incidence of government ownership in banking is correlated with slower growth looking across countries. In a series of joint and separate papers, Banerjee, Cole and Duflo examine the activity of banks from the public sector in India (Banerjee and Duflo, 2001; Banerjee et al., 2004; Banerjee and Duflo, 2014; Cole, 2009). They show evidence of under lending to productive firms, inertia in credit limits extended to firms and little difference in delivering development oriented lending resulting from government ownership. The main argument for these effects are misaligned incentives within banks, with loan officers facing few benefits from financing productive projects but punishments for loans that fail. De Quidt et al. (2013) demonstrate theoretically how market structure can greatly effect financial sector outcomes in the context of microfinance, comparing for-profit and non-profit lenders. The current analysis addresses these issues of bank ownership and incentives by analyzing private and public sector banking responses separately. The private sector, which is more likely to face profit maximizing objectives, shows a strong response to the reform around the cutoff. The public sector shows little evidence of a response near the cutoff, but this may reflect a different set of objectives that could concentrate their efforts in districts away from the cutoff, where my identification strategy does not apply. These findings highlight the importance of accounting for the institutional environment in crafting policy interventions.

In the next section I describe the important institutional aspects of India's banking system and the policy reforms to the branch licensing policies utilized for analysis. In section 3 I outline a simple theoretical framework to provide intuition for potential responses to the policy reform. In section 4 I review the regression discontinuity framework and describe how I translate its principles for analyzing the manufacturing sector with difference in differences. In section 5 I describe the data used in analysis. Then in section 6 I first establish a clear response in branching behavior to the policy reforms, then identify corresponding responses in aggregate private sector credit. I then examine responses in the agricultural sector followed by manufacturing. I then present results on overall growth using nightlights. Section 7 concludes.

2 Policy Reform and Institutional Background

2.1 Policy Reform

The Master Circular on Branching Authorisation Policy released September 8, 2005 implemented the policy reform on branch licensing utilized in this paper. The banking sector in India does not permit free entry of banking firms or branches. New bank licenses are granted infrequently by the Reserve Bank of India (RBI), India's central bank, through special campaigns with recent waves in the early 1990s and again in the early 2000s. Banks must also acquire licenses prior to opening all new branches, as well as receive permission to close or shift branches in most markets. Prior to the 2005 reform, banks applied for each of these changes on a case-by-case basis through the regional office of the RBI. No broad directive with regards to the composition of markets served by the bank, such as a requirement to open branches in rural areas, existed following the end of the Social Banking period in 1990.[2]

The reform in 2005 changed the regulatory environment in two fundamental ways. First, the reform effectively tied new branch licenses for highly sought markets to branch entry in markets designated as under banked. Specifically, banks were issued a set of criteria by which they would be judged during the review of proposed licenses. The "nature and scope of banking facilities provided by banks to common persons, particularly in under banked areas" would be considered when granting new licenses. In addition to offering "no-frills" bank accounts, meeting priority sector lending obligations and instituting a system for receiving and addressing customer complaints, banks were encouraged to open branches in "under banked districts and rural centres." The RBI provided a list of under banked districts with the circular. Though not stated explicitly, I will argue that a form of quota system operated requiring expansion in under banked districts for entry in rich markets. Second, the case-

[2]The LEAD banking scheme was in operation during this time, however, by which one bank was assigned to each development block and made responsible for meeting agreed levels of branching and banking services. These banks were typically selected from the set of government owned banks. The service area approach (SAA) also operated at this time, partitioning rural areas between banks for implementing development objectives.

by-case application procedure for licenses was substituted with an Annual Branch Expansion Plan (ABEP) framework. Under the new system, each bank would prepare a set of proposed network changes (branch openings, closings and shifts) to be implemented over the next year. The plan would be submitted to the RBI for review, after which the bank management would meet with RBI officials to revise and finalize a set of permissions to be valid for the next year (Master Circular Branch Authorisation Policy, 2005).[3] The rule governing the assignment of under banked status was based on the district average persons per branch relative to the national population per branch for India (RBI Report 2009). The spatial implications of branch licensing from the reform around the national average cutoff provide the identifying variation exploited in this analysis and is discussed in detail in section 4.

Important differences exist between the above policy and those implemented under Social Banking. The degree of choice given to banks in selecting locations in which to open under the 2005 reform far exceeds that available during Social Banking. Unlike the 4:1 entitlement policy studied in Burgess and Pande (2005), that required intervention branches be opened strictly in unbanked markets, banks could choose among any markets within under banked districts to satisfy their obligation, allowing for the potential of increased direct competition between branches and banks. In stark contrast to the planned approach to district-wise branch expansion implemented in the 1980s (RBI, 2009; Kochar, 2011), banks under the current reform could choose between under banked districts for entry, as well as decide their own level of total entry, which affected their amount of entry in under banked branch districts.

Finally, the banking environment differed drastically in its composition and scope of business. The private sector, largely inert under social banking, expanded and gained vitality following the deregulations beginning in 1990 and infusion of "new private" banks. Government owned banks, consisting of the State Bank of India and its Associated Banks, the set of nationalized banks, and most regional rural banks (RRBs), have traditionally dominated the banking system in India. Following reforms and deregulation after a current account crisis in 1991, a sizable private sector developed, operating alongside government owned banks. The entering new private banks were heavily vetted and selected from many candidates during a period of open applications in 1993 and again in 2001. According to RBI documents, the purpose of these new banks was to foster competition and modernize the banking system. The new private banks broadly face the same regulation as the other scheduled commercial banks, though carry the additional mandate of maintaining at least 25% of their branch network in population centers with fewer than one hundred thousand people. The other policies they face, as well as their requirements to the Priority Sector lending scheme, are identical to those on the SBI and Nationalised banks. RRBs and foreign banks face tailored regulations, including those pertaining to branching requirements.

[3] Permissions were valid for one year with the potential for extensions. Banks accomplishing 75% of their planned expansions could submit their next ABEP regardless of the lapsed time.

2.2 Policy Details and Timing

While the reform became official in September 2005, events leading up to its release likely provided signals as to its impending introduction. In a speech from December 2002, the director of the RBI pointed to the high share of bank investments in government securities, 39% relative to the regulatory minimum of 25%, encouraging banks to expand their commercial lending particularly in small manufacturing and agriculture (Mohan, 2002). The following November, the Vyas Committee was commissioned to investigate the flow of capital to agricultural activities. They met with several commercial banks during their investigation. In April 2004, they released an interim report followed by the final report in June, suggesting revisions to the service area approach (SAA) and encouraging greater lending by private and public sector banks. The report included a map identifying areas underserved by the formal banking sector, some of those identified as places where the "branch network of commercial bank[s] [is] below the national average (Vyas Committee Report, 2004)." The SAA program was subsequently discontinued, allowing all banks to freely apply for entry and operate in rural areas. The official list of under banked districts released in 2005 almost exactly matches selection based on district average population per branch relative to the national average, consistent with the language in the report. Thus, aspects of the Vyas Committee report could have provided solid signals to banks of the forthcoming reform.

The list of under banked districts initially released in 2005 was reissued in 2006 adding a small set of districts that satisfied the under banked requirement in both years but were left off of the 2005 list. Afterward, the list was reissued each year unchanged until 2010.[4] After 2010, certain states were made ineligible for under banked status, reducing the number of districts considered as "under banked districts of under banked states," but not introducing any new districts to under banked status. Although additional reforms altered the incentives for branch expansion both within and outside under banked districts, given the lagged nature of branch openings to license issuance, I would expect to and do find lasting effects through 2012. In section 4, I discuss the algorithm used for assigning under banked status to districts in detail and how I exploit it following a regression discontinuity design strategy to identify the effect of exogenous expansion in formal banking on real economic outcomes.

Although the reform became effective immediately upon its release, banks were essentially allowed a year long grace period to construct their first ABEP, with an implicit deadline for September 2006. Several banks, many of them from the private sector, waited close to the full year to submit their ABEP, during which time they were able to receive licenses in a

[4]Starting in 2008, certain centers within under banked districts were made ineligible to count toward a bank's serving of common persons. Specifically, centers within the municipal limits of state capitols, district headquarters and metropolitan centers were deemed ineligible. Further, centers within 100 km of Mumbai, New Delhi, Kolkata and Chennai, and 50 km of state capitols were ineligible. Exceptions were made for the state of Jammu and Kashmir, and the seven North Eastern states, Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland and Tripura.

disaggregated manner. The histogram of branch license dates for a large private sector bank is shown in figure 8.[5] Although annual branch expansion plans may not be observed directly, the large spikes in branch licenses set approximately a year apart are consistent with ABEPs. The figure shows the licenses from the first likely ABEP for this bank were granted in July 2006, roughly one year after the reform implementation. Similar patterns are identified for many private sector banks. Additionally, the licenses from ABEPs remain valid for a year, meaning that banks could effectively postpone the effect of the reform for nearly two years if preferable to quick entry. The optimal timing for entry from the perspective of the banks will depend on strategy and the underlying profitability of the locations. Early entry may allow banks to secure market shares, though they could delay costly entry into low profitable areas by waiting. The empirical evidence suggests most private sector banks chose to delay entry in locations of induced entry.

Finally, the shifting and closing of branches, particularly in under banked districts, was heavily regulated. Branches were not allowed to shift outside otherwise unbanked centers. Given the source location was served by another commercial bank branch (other than a RRB), a branch could only shift to centers in the same or lower population group classification, and in the case of branches in under banked districts, could only shift to centers within under banked districts. Little branch closure is observed in the data, though mergers and acquisitions of banks occur during which most branches are "closed" and "reopened" under the acquiring branch, with some branches converted to satellite offices and fewer still permanently closed.

2.3 Policy Reform Discussion

Incentives The 2005 branch licensing policy reform purposefully created new incentives for scheduled commercial banks to open in centers conditional on their district's under banked status. Licenses for branches in high profit potential centers in banked districts were used to leverage bank entry into under banked districts. This mechanism works most effectively during periods of high demand for bank branches in "rich" areas, as was presumably the case experienced in India during its time of high economic growth beginning in 2003 and continuing through the decade.

The branching policies and reform placed no requirements on the amount of banking required to occur at each branch. There are staffing requirements for branches, as well as minimal days and hours of operation. Banks must also offer "no-frills" accounts that carry limited fees and low minimal balances to prevent the exclusion of poor customers. Despite these requirements, though, banks could maintain staffed branches that simply minimized costs by not reviewing or approving any loan applications, not pursue new customers, and only accept deposits.

[5] Known acquisitions of branches from other banks have been excluded for the histogram analysis.

Banks are also required to meet Priority Sector lending ratios. Banks must maintain 40% of their outstanding credit in loans to the priority sector. However, the requirement must only be met at the bank level, meaning some branches may carry heavy amounts of priority sector loans while others lend nothing to the priority sector. In 2007, new guidelines were adopted for the priority sector, reducing the set of loan categories eligible for priority status.[6] The reformed guidelines concentrate lending in direct and indirect agricultural endeavors and limited the amount going to microfinance institutions and other indirect modes of lending. The priority sector reforms apply uniformly at the national level. Banks failing to meet their 40% requirement must make up the difference with loans to the NABARD RIDF fund at deterrent rates. Banks typically come very close to meeting the requirement, overshooting slightly in some years and falling short in others.

3 Theoretical Framework

This section articulates a simple theoretical framework to provide intuition for the effects of the reform and the heterogeneity of responses across districts and bank groups. The theoretical framework demonstrates how the 2005 policy reform may have incentivised higher rates of entry in under banked districts and increased lending without addressing the underlying profitability conditions of those districts. Further, it rationalizes an expansion of credit in under banked districts following the policy announcement, prior to a significant increase of branches.

The framework begins from a standard characterization of financial intermediation with adverse selection of borrowers common to credit markets in developing economies. Consider a single market with two periods and two types of borrowers, safe and risky. In the first period, a policy reform that will encourage entry in a (potentially unknown) set of markets beginning in the second period is announced. In the second period the reform is in effect. As in Stiglitz and Weiss (1981), each borrower has a potential project that requires a loan (normalized to size one for all borrowers) and yields the same expected return across borrowers. The borrower is assumed to have the same potential project in each period. Assume that the return from a failed project is zero, so that $P_s(R_s^A)R_s^A = P_r(R_r^A)R_r^A$, where R_i^A is the return from a successful (denoted A) project for type $i \in \{safe\,(s), risky\,(r)\}$ and$P_i(R_i^A)$ is the probability of success for type i. Thus, safe types have projects with lower returns conditional on success but succeed with greater probability $P_s(R_s^A) > P_r(R_r^A)$. If banks operate in the market, they can offer a standard debt contract with fixed repayment. Assume $R_i^A > (1 + r_i) > 0$ and that borrowers face limited liability, such that when a project is successful the borrower pays back the principle on the loan plus interest at rate r_i, but that in case of failure no payment

[6] The reforms to the composition of the priority sector studied in Banerjee and Duflo (2014) occurred in 1998 and 2000, prior to my analysis.

is made and both borrower and bank receive zero. Borrowers face an outside option that provides utility equal to μ. Both borrowers and banks discount the future at rate δ and are risk neutral. While borrowers know their own type, banks only know the distribution of types and the parameters defining the projects. Banks prefer to lend to the safe types due to limited liability but cannot distinguish between types in the general framework. Depending on the set of parameters just described and the share of safe and risky types in the population, banks may choose to ration credit in response to adverse selection, or the market may collapse entirely (Stiglitz and Weiss, 1981).

To capture the dynamic effect of the policy reform, consider the two following modifications: 1) Banks possess a screening technology that reveals a potential borrower's type with certainty and costs amount s. 2) There exists a downward sloping demand curve among safe types. A wide set of assumptions can satisfy this condition, for example, if personal costs of marketing the successful project differs between borrowers then demand for loans will decrease in r_s. To simplify the analysis, assume parameters are such that banks always choose to screen borrowers and never find it profitable to lend to the risky types. Further, the banks pass the cost of screening on to the borrower. As long as borrowers must repay the full amount of the loan conditional on a successful project, and borrowers cannot accept contracts with the potential for negative consumption, the expected default rate from safe types will remain unaffected and banks will know the demand conditional on the interest rate offered with certainty.[7] This assumption greatly simplifies the game as it allows the borrower's decision process to be considered separately for each period since current negative expected returns cannot be offset by more favorable expected lending conditions in the future.

Assume banks are symmetric and profit maximizers, each facing an exogenous marginal cost of funds, including administrative costs from lending, equal to $(1 + \rho)$, and cannot discriminate in the interest rate it offers to repeat versus first time borrowers. Since banks observe the parameters on the population defining the distribution of safe types, they know the slope of the demand curve, though do not know any particular borrower's value of the loan. Without the threat of entry, a monopolist serving the market in the first period maximizes profits by serving the same set of borrowers in each period, increasing the interest rate in the second period to capture the additional surplus the borrowers receive from not paying the screening cost again (a sketch of the proof is given in the appendix). Knowing this, the monopolist may work backwards from the second period to determine the profit maximizing interest rates in each period. In contrast, when two banks serve a market, they compete in prices in both periods. If both enter the market in the same period, then each offers the zero profit interest rate and split the market.

[7] A contract with potential negative consumption would arise when limited liability protects the borrower against a failed project, but not from a successful project for a borrower whose high marketing costs leaves them less from the project than the fixed payment owed to the bank.

However, if one bank acts as an incumbent, then it may choose to alter its behavior when anticipating the potential of entry. The screening cost, which may be construed as the cost to the borrower of filling out paper work or the effort of establishing a relationship with a loan officer, operates as a switching cost for the borrower.[8] Borrowers will go to whichever bank results in them keeping the highest expected return from their project. For first time borrowers this is simply the bank offering the lowest interest rate. Repeat borrowers must compare their expected payoff from the incumbent's 2nd period interest rate to that of the entrant plus the screening fee required to switch. The resulting equilibrium is intuitive: in the second period, under cutting leads the entrant to offer the zero profit interest rate and the incumbent offers an interest rate making its set of first period borrowers indifferent between switching to the entrant and staying. Since the set of first period borrowers is entirely determined by the first period interest rate, the second period interest rate is a function of the first period interest rate and the screening cost. Knowing this, the incumbent chooses the first period interest rate that maximizes profits over both periods. The threat of entry will result in the monopolist offering lower first period interest rates to secure a larger base of customers from which to earn positive profits in the second period. The set of parameters will determine how willing the incumbent is to trade off first period profits for those in the second period. The entrant will serve the remainder of the market that demands loans at the zero profit condition. Thus, credit will initially expand with the announcement of the policy reform and again upon realized entry.

3.1 Entry

The effects on entry must be primarily driven through changes to the structure of fixed costs of entry as the reform did not otherwise target local market conditions. Consider multiple markets described by the framework above. Markets are differentiated by their set of parameters already discussed plus overall market size. Suppose banks each draw market specific fixed costs of entry for every market. Abstracting from the strategic considerations of entry, assume banks act myopically such that they expect to act as a monopolist if entering a market unbanked in the first period or as a duopolist when entering banked markets. Under these assumptions, expected profits for each market is known to a bank and entry will occur for all markets j satisfying $E[\pi_B^j] - F_j > 0$. Markets with low profit potential or high fixed entry costs will fail to attract banks.

Consider a rule that ties permission for entry in some high profit potential markets to entry in lower profit ones. Banks facing binding constraints will now open into markets where $E[\pi_B^{UB1}] - F_{UB1} < 0$ if these losses may be offset by the profit gains from the rich market, $E[\pi_B^j] + E[\pi_B^{UB1}] - F_j - F_{UB1} > 0$. This condition will be more easily satisfied in policy eligible

[8] Klemperer (1987) lays the groundwork for considering the effect of switching costs.

districts with higher expected profits that faced unfortunately high fixed entry costs. Once entered, however, these markets may produce high levels of banking activity. In contrast, the set of markets originally served without the reform may contract if the lowest profit earning locations cannot offset the losses from policy eligible markets. Finally, the joint positive profits will be hardest to satisfy for policy eligible districts that face the lowest profit potential and highest fixed costs of entry. The reform will be unlikely to produce positive banking results for such markets.

3.2 Predictions

The above framework suggests three main predictions of bank responses to the policy reform. First, the amount of credit will expand in districts where increased entry under the reform is expected to occur. This will result from banks attempting to secure market shares in these districts so as to lock borrowers in through switching costs prior to the intensive entry under the reform. Second, branch entry will increase in under banked districts with high profit potential that was offset by high fixed costs to entry which become subsidized due to the reform. Further, entry may be most profitable in locations where banks open as an entrant, with lower fixed costs making up for stronger competition for borrowers. Thus, both entry as monopolists and as competitors is possible. Finally, this framework characterizes behavior under profit maximization. Banks following other objective functions, as public sector banks may do, would be less likely to generate these responses. Comparing the behavior of private sector and public sector banks will provide a qualitative test of predictions from the framework.

4 Empirical Methodology

Identifying the effect of bank branching on banking and real economic outcomes can be frustrated by classic endogeneity concerns outlined in previous work Burgess and Pande (2005), in which selection bias can overpower estimates, even changing their signs. The unique policy aspects of the 2005 branching reform create an environment facilitating the identification of banking effects on agricultural and industrial outcomes. I am able to circumvent endogeneity concerns and separately identify the banking effects from other simultaneously operating reforms by employing a regression discontinuity design that yields transparent estimates and identification founded on assumptions that are at least partially testable. First I identify and quantify the expansion of banking services in response to the policy. Next I focus on the effects of banking in agriculture, which appears to be an initial motivation for the reform and the largest employment activity in India. Then I turn to the effect of banking on manufacturing enterprises, which appeared to gain from the realized expansion of bank branches. After establishing a response in these two areas, I provide evidence of a positive effect on overall growth using light emitted at night as a proxy.

4.1 Regression Discontinuity

The method employed by the RBI for identifying districts as under banked in the 2005 branching policy reform, based on simple district and national averages of population per branch, yields a clear quasi-natural experiment exploitable by regression discontinuity techniques. Under banked districts were identified using two inputs. First, the national population of India, taken from the Population Census conducted in 2001, was divided by the total number of scheduled commercial bank branches operating in the country in 2005-2006 to obtain a "national average of population per branch." Then an analogous value was calculated for each district and compared to this national average. Those districts with a calculated value higher than the national value were designated under banked. Figure 4 shows district under banked status from the 2006 list of under banked districts plotted against district population per branch. According to the rule, districts to the right of the cutoff should be assigned to under banked status, as is broadly confirmed in the graph.[9] A map of the districts in India with their corresponding district averages is presented in the upper panel of figure 5.[10]

The above algorithm induces a cutoff at the value of the national average, treating district population per branch as the "forcing variable." The policy generates an arbitrary difference in districts falling on the "under banked" side of the cutoff, which offer an additional value to banks opening branches within their borders: such openings count toward their requirement for "serving common persons" to gain permissions for branches in rich markets. Districts falling on the other side of the threshold do not offer this benefit, though being otherwise similar, which will be tested formally. Thus, the policy effects the probability that the districts will receive additional branches through its manipulation of bank incentives. This estimation strategy will be valid if the distribution of potential outcomes is continuous at the cutoff(Lee, 2008). A lack of perfect manipulation of the running variable so as to change a district's treatment status, and the continuity of other factors that may affect the outcomes of interest with respect to district population per branch near the cutoff will suggest this assumption is satisfied. I verify that both of these stipulations hold below.

Figure 6 presents visual results from the McCrary test for manipulation of the running variable around the threshold McCrary (2008). The distribution of districts along the running variable is shown to be smooth around the threshold. The discontinuity estimate in the log difference in height is 6.6 with a standard error of 22, thus I fail to reject the null hypothesis of continuity. The figure also highlights another ideal trait of this environment; the

[9] Six districts do not follow the assignment rule, with four of them remaining in the sample used in estimation (see the section on constructing the forcing variable in the Data Appendix for details).

[10] The districts with greater deficits of branches per person, denoted by darker colors, matches closely with the areas identified as being more broadly under served by the map from the Vyas Committee issued in 2004.

cutoff is located near the peak of the density, meaning most districts fall close to the cutoff, suggesting the generalization of the effect for most districts may be reasonable. The lack of manipulation around the cutoff, beyond passing the McCrary test, is extremely defensible on intuitive grounds. Even if banks and districts were able to perfectly anticipate the criteria for assigning under banked status, their ability to manipulate assignment would be limited. The population level in the current equation was taken in 2001, four years prior to the policy. Thus, agents attempting to influence district status could only do so through altering the number of operating branches within district boundaries, which results from the collective branching decisions of all banks and conditional on RBI permissions, making manipulability extremely unlikely.

Figure 7 presents a series of plots of district baseline characteristics, with dots reporting local averages for districts falling within 200 persons per branch non-overlapping bins. A local linear regression of the data is shown with flexible slope on either side of the cutoff. While the figures constitute a visual RD testing for continuity at the cutoff centered at zero, they also summarize broader trends in branching at the time of the policy reform. Districts left of the cutoff enjoyed more branches per person by definition. These districts also tended to be places with higher populations living in large cities, exhibited higher literacy rates, had lower populations of scheduled caste and tribe persons and had a lower percentage of main workers engaged in agriculture. Each of these characteristics appears to be smooth at the cutoff, suggesting proper randomization of districts around the cutoff. The continuity is tested formally by performing RD analysis with the baseline characteristics as the dependent variable. The tests fail to reject the null hypothesis of continuity at the threshold, with reduced form results presented in table 1.

4.1.1 Technical Details of RD

The identification of local average treatment effects through regression discontinuity analysis is now well established in the literature (Black, 1999; Angrist and Lavy, 1999; Van der Klaauw, 2002; Lee et al., 2004), with the theoretical work on identification in Hahn et al. (2001) and the origins of the method in Thistlethwaite and Campbell (1960). To reduce bias from including observations far away from the cutoff where the identification does not hold, I use local linear regressions, dropping observations outside a set bandwidth of the cutoff (Hahn et al., 2001; Lee and Lemieux, 2010). I restrict all analysis to local linear and local 2nd degree polynomial regressions as recommended in (Gelman and Imbens, 2014). I set the bandwidth at 3.5 thousand persons per branch for all regressions, which falls within the range of optimal bandwidths selected for individual years by the Imbens and Kalyanaraman (2011) method.[11] I fix the bandwidth to provide transparency for tracing the evolution of the policy effect across

[11] Results are robust to different bandwidth selections, and 2nd degree polynomials typically perform better with wider bandwidths than linear specifications as in the example from Lee and Lemieux (2010).

years, as this fixes the set of included districts across regressions. In Figure 5 the lower left map indicates districts included in the local linear regressions. The districts are spread out geographically across most of the country, with under banked districts typically not far from banked counterparts. The map in the lower right panel identifies districts close to the cutoff on either side. Again, districts are distributed geographically and tend not to bunch by under banked status.

For each year, I first estimate the local linear regression of the reduced form equation,

$$y_i \quad = \alpha + D_i\tau + f(PopPerBranch - Cutoff) + \delta X_i + \epsilon_i \tag{1}$$

using a uniform kernel. y_i denotes a banking or economic outcome of interest in district i, such as the number of operating bank branches or crop yield. $D_i = 1[PopPerBranch_i - Cutoff \geq 0]$ is an indicator for satisfying the rule for assignment to under banked status, $PopPerBranch_i$ is the population per branch for district i, $f(\cdot)$ is a flexible functional form, X_i is a set of controls, τ is the coefficient of interest measuring the discontinuity at the threshold, and ϵ_i is an idiosyncratic error. In all regressions, I include the pre-random assignment value of the dependent variable from 2001 to improve precision and reduce sampling variability (Imbens and Lemieux, 2008; Lee and Lemieux, 2010). In addition, I include the 2001 district population and its square to further improve precision. The described method constitutes the reduced form estimate, with the probability of under banked status instrumenting for actual assignment. These values are reported graphically.

I report the "fuzzy RD" results implementing the regression discontinuity using Calonico, Cattaneo and Titiunik's "rdrobust" package with a triangular kernel. I use the fuzzy RD with banking outcomes because the rule I use to assign under banked status does not perfectly match the list.[12] When considering agricultural and other economic outcomes, their most interesting relationship is to realized banking behavior, rather than district assignment to under banked status. For these outcomes, in addition to the reduced form that presents the general effects of receiving under banked status, I estimate the effects with the fuzzy RD instrumenting for banking outcomes. That estimate will inform the effect of the specific banking outcome on the outcome of interest. However, that effect should be treated with caution as reform status will effect several dimensions of banking outcomes. To implement the fuzzy RD analysis I first "residualize" the data, regressing y_i on the set of controls X_i from equation 4.1.1, then estimating equation 4.1.1 replacing the left hand side variable with the residuals obtained from the first regression and dropping the controls from the specification (Lee and Lemieux, 2010). Conventional estimates of the RD are reported, as are bias-corrected

[12] I fail to match 6 out of 572 districts to their realized under banked status from the 2006 list. See the data appendix for details.

estimates and the robust standard errors from Calonico et al. (2014). I will focus on the conventional estimates in discussing results.

4.1.2 Dynamic Strategy

The identification of the policy effect on banking outcomes is bolstered by the ability to regularly estimate the effect of the reform through time, both before and following its implementation. In the pre-reform period, no discontinuity should exist at the cutoff. In the post-reform period, the effect of the policy should be expected to grow according to the timing set in place by the rules of the reform and its revelation. To demonstrate the timing of the reform effects, I estimate equation (4.1.1) separately by year for banking outcomes, agricultural outcomes and outcomes measured through remote sensing including rainfall and nighttime light emitted into space. Given that the set of under banked districts remained essentially unchanged in the reform period considered, this captures the short and medium term effects as they emerge.

4.2 Effects observed in Manufacturing

To examine the effect of increased financial access on the manufacturing sector, I use ASI data available at the state level. The level of aggregation prevents conducting the regression discontinuity just described. Instead, I follow a difference in differences approach, utilizing the institutional knowledge of the reforms to construct sets of treatment and control states.

I select the set of "under banked treatment states" in the following way. Using population census data at the district level, I construct the shares of state population in under banked districts. For the population of each state in under banked districts, I calculate the share of that population belonging to districts falling within a close bandwidth of the national average of population per branch, generally within 4 thousand persons per branch. Those states with large shares of their population in under banked districts close to the threshold are selected as the treatment group. I then construct a control group using a comparable procedure from districts with banked status. "Banked States" include Haryana, Uttarakhand, Punjab, Mizoram, Daman and Dimiu, Karnataka, Puducherry, and "Under Banked States" include Rajasthan, Tripura, Jharkhand, Orissa, Dadra and Nagar Haveli.

For each treatment and control group pairing, I estimate the following,

$$\begin{aligned} y_{it} = \quad & \alpha + \xi post06_t * treat_i + \varphi post06_t + \psi treat_i \\ & + \beta_1 year_t * state_i + \beta_2 year_t + \beta_3 state_i + \beta_4 X_{it} + \omega_{it} \end{aligned} \tag{2}$$

where $post06_t$ indicates financial years 2006 and later, $treat_i$ indicates that the state belongs to the treatment group, and the remaining terms indicate controls for state fixed effects and state specific time trends, as well as a matrix of additional controls in X_{it} with an idiosyncratic error ω_{it}. The coefficient of interest will be on the interaction term $post06_t * treat_i$, which will give the difference of within-state differences between the states receiving under banked status and those not. In addition to controlling for post 2006 and treated state individual effects, the regressions include the logged number of manufacturing units in the firm and the logged number of employees in the enterprise to control for enterprise size. Plant age and its square are also included as controls as these may influence the firms' access to credit and capital markets. Although this identification strategy is not as ideal as the RD, the careful selection of the treatment and control states should help in eliminating potential threats and I will take the estimate as suggestive of the effect from the policy reform on manufacturing.

5 Data

The primary data on banking are from data sets maintained by the RBI. The Master Office File (MOF) provides a detailed record of bank branch locations and characteristics, from which detailed branch network information by bank may be constructed. I have also matched most branches to approximate geocoded locations based on postal codes (PIN) and center names. In the present analysis, the MOF is used to construct the running variable and national average based on population per branch at the district and national levels respectively. The Basic Statistical Returns 1, 2 and 7 provide time series data on credit and deposits at various levels of aggregation. The empirical methods and analysis pursued in this work is greatly determined by the level of data availability. Although branch location data are available in detail through time by bank, much of the credit and deposits data are only available annually as aggregates to bank group level by district. Thus, although it is possible to observe which banks are operating within a district, assigning a certain number of accounts or amount of credit from any particular branch is impossible. Fortunately, the policy reform applied at the district level, allowing analysis directly at the level of the reform. Utilizing the time dimension further helps to disentangle some effects of the reform from changes to bank group classifications.

The availability of credit limits, amounts and accounts by the intended geographic utilization of loans constitutes a strength of the data used in this analysis. The use of Call Reports from banks do not typically allow for this level of geographic precision of where loans are actually directed. This feature strengthens the arguments that loans reported in certain areas are not financing projects in neighboring districts.

To conduct the analysis on agriculture, I develop a new data set by processing and combining separate annually available data from the Ministry of Agriculture, Directorate of Economics and Statistics on crop production statistics and crop farm harvest prices. By matching district production levels to farm harvest prices by crop, I am able to construct an index of crop yields similar to that in Jayachandran (2006) for crop years 2002 - 2008. The use of an index circumvents certain concerns arising from differences in crop suitability across districts.

Data on manufacturing enterprises are from the Annual Survey of Industries, reported annually for registered firms. Measures from enterprises with fewer than 100 employees are taken from a 20% sample of firms representative at the state level. The ASI data used in this analysis does not report the district of the enterprise. As described in the empirical strategy section above, I adjust for the level of the data being broader than the level of the reform so as to best capture the spirit of the RD design.

District level data on several measures of interest, local GDP for example, are unavailable or available only sporadically. To overcome the lack of traditional measures, I consider data recorded from remote sensing on rainfall and the amount of light emitted at night from the TRMM satellite and DMSP-OLS Nighttime Lights Time Series, respectively. The nighttime light data are used to proxy for changes in local GDP, as prescribed in Henderson et al. (2012). See the Data Appendix for greater detail on all data used in the analysis.

6 Results

6.1 Banking

6.1.1 Bank Branches

The analysis focuses attention on the response from banks in the private sector. The notion that these banks introduce a new banking technology and the rapid expansion of their branch networks during this period makes them particularly likely to drive innovation and a transformation of the banking environment in affected districts. As profit maximizers, the theoretical framework suggests they are also the most likely to respond strongly to the reform around the cutoff. Responses from the public sector will be noted to provide contrast. To motivate the primary set of empirical results, I first consider a visual example for two years. Figure 9 presents the standard visual RD for operating private bank branches for the pre-reform year 2000 and the post-reform year 2012. The y-axis denotes the number of operating private bank branches per district, with dots reporting the local averages of districts falling within 200 persons per branch non-overlapping bins. The horizontal axis is the forcing variable of district population per branch centered on the national average and scaled to thousands of persons per branch. Considering the figure from year 2000, districts do not appear to vary systematically in their number of bank branches prior to the reform. In the post reform year, under banked districts show higher numbers of operating branches relative to banked branches just on the other side of the cutoff. The discontinuity of the number of branches estimated at the cutoff from either side yields the local average treatment effect of the reform on private branches. Next, I make the analysis more precise by presenting the annual results from estimating equation 4.1.1 with operating private branches as the dependent variable.

The ability to observe the number of branches across time, and the fact that the list of under banked districts did not change yearly, allows the effect of the reform to be identified not only by spatial variation between districts, but through time as the reform became implemented and branches were able to accumulate. The right panel of figure 10 plots the intercept points at the cutoff from annual local linear regressions from the banked and under banked sides of operating private sector branches in a district. Districts maintain the same value of the forcing variable across years so the set of districts remains unchanged.[13] The red dashed line provides the estimated intercept from approaching the threshold along the under banked side as in the classic RD graphical representation. The solid blue line reports the corresponding intercept approaching from the banked side. The vertical distance between the two, reported for each year, corresponds to the discontinuity at the cutoff estimated as τ in equation 4.1.1. A vertical red line between the two points indicates a positive discontinuity, with under banked districts exhibiting a higher value at the threshold than banked districts, with significance at least at the 10% level.[14] These figures not only present the average treatment effect, but place the level of the intercepts vertically so that overall growth and decline may be easily recognized.

The figure identifies important policy aspects. In the years leading up to the reform, there is little difference in the estimated number of branches from the banked and under banked districts at the cutoff. This in itself acts as a partial validation test of the randomization of districts around the cutoff. A strong response to the policy does not occur until after 2006, which was a likely possibility given the timing of the reform. Still, the small increase in the positive discontinuity in 2005 and 2006 is not inconsistent with some banks working to establish market share in under banked districts. The strongest effects in branches occur beginning in 2008 and are estimated precisely at the 5% and 1% confidence levels, which is consistent with banks waiting until mid 2006 to submit their first ABEP and opening their branches just before their licenses expire in mid 2007. Estimates are presented in table 4. The steadily growing discontinuity is consistent with a response from private banks to the branching policy.

In the figure on the left, I report the estimated effect on operating and granted licenses. The most important feature from this graph is the first statistically significant positive effect on licenses measured one year earlier than branches on January 1st, 2007. Turning to the estimation results from licenses and branches in table 4, the effect from licenses precedes a similar response in branches beginning in 2007 through 2010. The policy starting in 2010

[13] New districts since 2001 that claimed territory from more than one source district are dropped along with the source districts. In addition, Thane and Pune districts in Maharashtra are dropped, as is Varanasi district in Uttar Pradesh after 2002. See the Data Appendix for details.

[14] Thanks to Johannes Schmieder for help in clearly displaying the dynamic nature of the effect graphically. Note that these figures rely on estimation using a uniform kernel.

was amended such that banks could open in lower population centers without a prior license, resulting in licenses for such openings being issued on the day of branch entry, despite its presumed reporting in ABEPs.

The combined timing of the licenses and operating branches, as well as the pre-reform and post-reform pattern demonstrates the exogenous differential change in branch reach in districts belonging to under banked districts near the cutoff relative to the otherwise similar districts on the banked side. The cumulative average effect of the policy in 2012 is estimated at approximately 10 more private sector branches in under banked districts at the cutoff relative to the banked districts. The effect is a little less than 50% of the sample mean reported in the table for 2012 at 20 private sector branches in districts around the cutoff. The size of the private sector presence increased for the sample overall in this time from an average of 10 branches per district in 2006 to 20 in 2012.

6.1.2 Credit

The 2005 policy reform on branching permissions directly cites opening branches in under banked districts as a condition affecting total permissions to a bank. However, the other terms mentioned, offering no-frills accounts and meeting priority sector requirements, apply at the bank level rather than by district. Thus, there is little direct pressure from the reform on bank credit and deposit behavior, particularly around the threshold. Recall, however, that the theoretical framework predicted that banks would expand credit in under banked areas in anticipation of future competition.

Figure 11 shows the annual discontinuities in total district credit from private banks, analogous to the figure presented for operating branches discussed above. Similar to the early pre-reform years in private bank branches, the number of credit accounts in thousands shown in the left panel of the figure displays little difference between the banked and underbanked districts at the cutoff. However, consistent with the timing of the Vyas Committee commissioning and report, the number of credit accounts began increasing in under banked districts in 2004 and 2005. Underlying this change is also a change in the composition of banks in these districts, with fast growing branches opening in these districts as more inert banks were acquired by nationalised banks. This behavior is consistent with aggressively growing banks acting preemptively on the expectation of reforms by expanding in areas likely to be more heavily contested in the future. Turning to the estimates in table 5, the response from this preemption is estimated at 6,725 additional credit accounts in the under banked districts at the cutoff, which is 52% of the sample mean for districts around the cutoff. The discontinuity in accounts continues to grow over the next few years and is estimated precisely for all years except 2009 and 2011. The slight retraction of the discontinuity in 2008 may be explained by the exit of a private bank through acquisition by the public sector in 2007.[15] The decline in the discontinuity in 2009 may reflect the tightening of restrictions regarding specific cities eligible as under banked within districts based on their proximity to major metropolitan areas or being metropolitan themselves. Unlike the branches data, credit cannot be broken out by bank within a district to form a clearer picture as to the exact channels driving the aggregate responses. The last two years again show increased expansion in credit accounts consistent with the growth in branches in these years.

The results from outstanding credit amounts in millions of rupees show qualitatively consistent results. The amounts data are measured with less precision, which may result from many large investment projects being lumpy in nature, leading annual district levels to fluctuate more than the number of accounts. [16]

As noted by RBI Deputy Governor Mohan in a 2006 speech regarding financial inclusion, the expansion of retail credit after 2003 accounted for a major source of increased lending (Mohan, 2006). Breaking credit out by personal loans, figure 12, confirms that the response in the growth of personal loans in under banked districts near the cutoff relative to banked districts was significant. The initial jump in personal loan accounts in 2004 corresponds with the changing composition of banks as aggressive private banks slowly expanded their branch presence in under banked districts. Also at this time, the interest rates on consumption loans were liberalized, allowing interest rates to dip below the bank's self reported cost of funds plus profit margin. Personal loan amounts largely mirror the expansion of accounts, though the tightening after 2008 may correspond to a change in priority sector lending requirements making the requirement more stringent.

An implication of the theoretical framework behind the hypothesis of a preemptive response in credit by profit maximizers is that public sector banks, which follow less clear objective functions, are unlikely to show the same pre-reform response as private sector banks. Figure 13 and the corresponding table 7 confirm a lack of response prior to the policy implementation around the cutoff, as well as a muted response during the reform years as well. These results are consistent with the incentives generated by the reform operating most strongly on private sector banks aiming to grow in reform years.

6.2 Agriculture

Agriculture constitutes the primary economic activity for the majority of Indians. The 2001 Population Census reports that over 56% of India's workers were engaged in agricultural or related activities at the time of the census which, due to the exclusion of marginal workers, likely provides a lower bound. Given that concern over the availability of credit in rural areas

[15] Bharat Overseas Bank was acquired by Indian Overseas Bank that already held a 30% interest in the bank.

[16] The large dip in credit to banked districts in 2008 appears to be driven by outliers, as changes in districts affected by the above mentioned merger in the previous year do not show strong responses in credit amounts.

led to the commissioning of the Vyas Committee that catalyzed a reform to rural branching and presumably the broader policy reform in 2005, early policy effects concentrated in agriculture could be expected. The analysis below indeed shows an early response in increased agricultural lending that wanes as the details of the reform become known, and increases again with greater emphasis placed on rural and semi-urban markets by later refinements to the reform. Attention is then turned to the effect of expanded banking services on agricultural performance.

6.2.1 Credit to Agriculture

Figure 14 shows the reduced form RD in the district percentage change in credit amount to direct and indirect agricultural activity in rural and semi-urban areas from their 2001 levels.[17] A positive and statistically significant response in under banked districts is first detected for credit to direct agricultural activities in 2005, the year following the Vyas Committee Report. The effect continues into 2006 after which it diminishes for a few years until emerging again in 2009. The greater relative expansion of credit in under banked districts at the cutoff is significant in magnitude as well, exceeding the sample means in 2005 and 2006, and remaining above 50% of the sample mean in the later years. The analogous effect estimated for lending to indirect agricultural activities is imprecisely estimated until 2009 after which the discontinuity is positive, statistically significant, and large in magnitude exceeding the sample mean. Results are reported in table 8.

The early expansion of credit beginning in 2005 is consistent with the timing of the Vyas Committee and emphasis placed on agricultural lending by policy makers, as well as with the incentives of private banks to increase lending to secure their market share of profitable loans in anticipation of increased competition. The decrease after 2006 may be attributable to banks learning that the branching policy reform was less directly tied to agricultural lending than initially anticipated. Alternatively, a subsidized credit program to farmers exclusively through public sector banks initiated around that time may have drawn away demand for private loans, washing out the private bank effect in direct agricultural credit.[18] The growth in agricultural lending after 2008 in under banked districts has several potential explanations. New branches opening as a result of the policy are growing in strength during these years. A refinement to the branching policy in 2008 made metropolitan areas ineligible for under banked status in 2008, creating greater incentive to move into lower populated areas. The adoption of a new branching policy in 2010 that placed greater emphasis on rural and semi-urban branch entry in all districts with a bonus for under banked areas also explains the faster growth

[17] The percentage change is approximated using the difference in logs of credit amounts from the 2001 reported levels.

[18] The Credit Subvention Scheme operated through NABARD and exclusively distributed through government sector banks was initiated in 2006-2007.

in the sample mean relative to the discontinuity for direct agricultural lending in 2010 and 2011. Alternatively, a reform to priority sector lending in 2007 also placed greater emphasis on agricultural lending. Required investment in the Rural Development Infrastructure Fund for failing to meet priority sector quotas, first coming due in the 2009 financial year, was accounted as indirect agricultural lending by banks. Finally, the categorization of loans by the RBI was revised in 2008, making direct comparisons by sector pre- and post- 2008 less accurate. Without finer data on loans, disentangling the exact causes is likely not possible.

Rainfall Annual rainfall is undoubtedly an important input for agricultural performance in India. Figure 15 presents estimated discontinuities in the district averaged percentage deviations of rainfall measures from their mean levels across the points of measure within a district. Since rainfall is random and unaffected by the policy reform at the cutoff or anywhere else, this analysis also serves as a falsification test of the RD design. As anticipated, rainfall does not show significant discontinuities at the cutoff. This suggests the response from credit and agricultural performance is not discontinuously effected by exogenous productivity shocks around the cutoff in the years considered.

Crops Figure 16 shows the reduced form regression discontinuity analysis for yield and output for two major crops in India, cotton and wheat. I present discontinuity analysis for crop yield (tonnes per hectare of cultivated land) and output (tonnes). Each specification controls for the district averaged percentage deviations of rainfall, district population and its square, and the 2001 pre-randomization value of the dependent variable. The analysis for the output is the most striking for cotton, while the effect on yield is greater for wheat. The response from these individual crop statistics suggests the branching policy reform positively impacted output and/or productivity. However, considering crops individually, and absent price data for the crop output, makes interpreting the results difficult. Not every district produces each crop, or is well suited for every type of agriculture. Farmers may be moving in or out of crops based on their prices. Yields may decrease if farmers enter high paying crop markets with plots of land poorly conditioned for those crops. Alternatively, yields may rise if farmers invest more in productive and profitable crops. Thus, a measure better incorporating the incentives faced by the farmer is needed.

To address these concerns, I compute an index of crop yields similar to that used in Jayachandran (2006). The index is constructed as a weighted average of crop yields for rice, wheat, jowar and groundnut, using crop revenue shares for the district as weights (see Data Appendix for details). I am able to construct the measure for the July-June years 2001-2002 to 2007-2008 from data on crop prices and production statistics collected at the district level. The price data for crops is available for a slightly smaller set of districts and generally restricted to crops for which the particular district produces in greater volumes. The index carries the added benefit, however, that a wider set of districts in India produce at least one of the crops in volume, meaning the set of districts through time will change less than considering output from a single crop. The results from the reduced form RD analysis are shown in the top panel of table 11. The estimates show positive discontinuities after 2005, though are estimated imprecisely except in 2008.

To estimate the effect of banking activity on average crop yield, I estimate a fuzzy RD of the crop yield index on total private sector credit accounts, instrumenting for credit accounts with the discontinuity. In the bottom panel, I present the fuzzy RD results for the pre-reform and post-reform periods. No effect is estimated in the pre-reform period. In the post reform period, I estimate an average effect of 0.03 with 10% significance, which may be interpreted as every thousand private bank accounts increases the crop yield by an average of 3%. This is a little less than the average effect of a positive rainfall shock, for rainfall above the 80th percentile for that district, on crop yield estimated in Jayachandran (2006).

6.3 Industrial Activities

Though the initial drive of the policy reform may have been to increase financial inclusion in low population areas and increase the credit flow to agriculture, many of the populated centers of under banked districts benefited from increased branch entry. This section investigates to what extent manufacturing enterprises benefited from the expanded bank presence by receiving loans and being able to invest in productive assets.

Credit to Manufacturing and Processing Figure 17 presents the reduced form RD effect for the percentage change in credit amount to manufacturing and processing. The effect after 2007 resembles the expansion of bank branches, with a steadily growing positive effect in under banked districts. Turning to the fuzzy RD results, the estimates are all quite imprecisely estimated. This may be due to the lumpiness with which capital is acquired in manufacturing, with large projects arriving infrequently per district but constituting a large share of credit. Multi-plant manufacturing enterprises may also have been able to secure funds for plants in unbranched areas through their headquarters. As such, large manufacturing investments may be less reliant on local branch access. While less response in credit appears to be earmarked for manufacturing, it is possible that credit lent as personal loans, that shows a strong response to the reform, may end up funding capital investments or freeing up other resources that then get invested in enterprises. To investigate this possibility, the next section examines input decisions from registered manufacturing firms.

6.3.1 Evidence from the ASI

In table 13 I present the results from difference in differences analysis using data from the ASI. The analysis uses years 1999-2010. In column (1) I estimate the effect on logged assets excluding land and inventory. The average treatment effect is positive but imprecisely estimated at a value of 17%. The effect on logged working capital, in column (2), is estimated at 0.264 with significance at the 10% level. The effect on the amount of outstanding loans held by the firm is estimated to increase 24% with statistical significance at the 10% level. Total investment increased by 19.7%, with statistical significance at the 10% level. The capital labor ratio is estimated to increase by 3.4 in response to the policy and is also estimated with precision at the 10% significance level. The sample mean for the under banked states sample was 10.88 post reform, making this a sizable effect. The estimates are quite robust to considering other ranges of years around the reform. In each regression I control for the rural status of the enterprise, the age of the plant as measured by years since opening, the number of total enterprises in the firm to which the enterprise belongs, the logged number of employees at the enterprise to control for size, and state fixed effects with state specific time trends. I exclude industry fixed effects as new NIC codes were adopted in 2008, potentially making some industry codings inconsistent through the time series. In practice, the inclusion of 3 digit NIC codes has little effect on the estimates.

The significant increase in loans carried by enterprises from under banked districts in the post reform years would indicate that the increased banking activity is finding its way to the industrial sector. The increases in working capital as well as total investments suggests firms are expanding the use of productive inputs with the expansion of credit. Further, the increase in the capital labor ratio is consistent with previously credit constrained firms making investments in capital as those constraints are relaxed with the inflow of new formal credit. These adjustments to the productive technologies of the firm are likely to result in changes in efficiency. If credit rationing resulted in the misallocation of credit, the expansion of credit may produce large impacts if it helps correct inefficient dispersions of marginal products of capital across firms.

6.4 Economic Growth and Light emitted at Night

The final analysis following the RD design examines discontinuities in changes of the emission of light into space at night. Henderson et al. (2012) established that so called "nightlights" provide a reliable proxy for economic growth under certain caveats. Important among these is the prescription to compare changes in light through time for one area to those in another, rather than comparing levels of light only across places or levels of light only across time. There are several reasons for this: the time series is composed of readings taken by different satellites in different blocks of years. The instruments between satellites vary, and their precision changes with age. The raw data are also processed in ways undisclosed to researches and vary across years. Part of this processing includes decisions on interpreting very low levels of light. Thus, any errors or idiosyncrasies generated by these processes get accentuated by differences in the degree of urbanization across locations.

This analysis accounts for these concerns by estimating the discontinuity in the difference of logged average district light since 2004. Thus, the dependent variable can be interpreted as the approximate percentage change in average light emitted in a location from its level in 2004. The RD compares these changes in estimating the discontinuity at the threshold. Figure 18 graphically reports the discontinuities estimated with a 2nd degree polynomial, which better captures the underlying data. Since the level of light is reported from measurements taken during the calendar year, 2005 is the first year with months under the enacted reform. Estimates are presented in Table (14). A slight negative discontinuity is estimated in the first year and is a small fraction of the average percentage change in light for districts in the sample. The discontinuity is small and positive again in 2006 though the average change in districts was negative overall. A positive jump in the discontinuity to 9.4% appears in 2007 and is estimated significantly at the 1% level, with the average change in light for districts in the sample increasing as well to 11.4%. A similar response is found in 2008 with 2009 showing low levels of light emitted in general for the sample around the threshold and a smaller discontinuity. The last three years show similar discontinuities in light to 2007 and 2008, with 2011 estimated with precision at the 10% confidence level.

To estimate the effect of expanding branch presence on the change in the amount of light emitted in districts at night, I perform a fuzzy RD of the change in light on private bank branches for the pre-reform period, which in this case is only 2005, and the post reform period constituting years 2006-2012 pooled together controlling for year fixed effects in addition to district population and its square. I run the estimation using local linear regressions because these better fit the bank branching data and offer a strong first stage. The pre-reform effect reported in the lower panel is negative and small, consistent with the reduced form estimate for 2005. The conventional estimate reported in the post reform column is estimated positive, but small and insignificant. However, the bias-corrected measure which accounts for a local quadratic estimate with a wider bandwidth, better capturing the quadratic relationship in the night light data, yields a positive and significant coefficient. This estimate is significant at the 1% level and has a value of 0.012. The coefficient may be interpreted as the average effect of each bank branch from the reform period is to increase nighttime light by 1.2%. Taking the estimated elasticity of nighttime light to GDP from Henderson et al. (2012) of 0.3, this implies that each bank branch raises local GDP by approximately 0.36%. The average increase in bank branches in the post reform period is estimated at approximately 5, implying the total effect was an average increase of local GDP in the districts by 1.79%.

6.5 Robust to NREGA

A competing explanation for the change in the spatial allocation of bank branches, increased banking activity, and subsequent responses in economic outcomes is the introduction of the Mahatma Gandhi National Rural Employment Guarantee Act (NREGA) that closely coincided in time with the branching policy reform. The act constitutes a public works program aimed at relieving poverty in rural areas by providing 100 days of guaranteed work to individuals from rural areas. The implementation of NREGA occurred in three stages, with 200 districts selected to begin the program in the fiscal year April 2006 through March 2007, with 130 new districts introduced in 2007-8 and the remaining 263 districts introduced in 2008-9. Zimmermann (2012) and Klonner and Oldiges (2014) analyze the effect of NREGA and provide background on the program. Of particular importance to the current analysis, NREGA benefits were distributed through bank accounts. One may conclude that this would increase the demand for formal banking, potentially increasing both the geographic reach and level of banking services. While likely true, to confound the current results there must also be a discontinuous break in the implementation of the program and disbursement of benefits at the "under banked" cutoff used for the regression discontinuity.

Districts were assigned to the various roll-out phases based on a composite index on district "backwardness" from the National Planning Commission (2003). In table 15 I test whether a discontinuity in phase assignment can be detected at the cutoff. A significant discontinuity would suggest a correlation with the NREGA program. The test fails to reject the null hypothesis of continuity at the cutoff for all three phases. Thus, NREGA phase assignment and therefore likely its benefits as well, would be unexpected to differ at the cutoff. In analysis not shown, I perform a visual RD of the district composite index at the under banked cutoff. No discontinuity is observable at the cutoff. Further, the general notion that persons per branch is generally increasing with worsening district conditions is confirmed by the trend of the index on "backwardness."[19]

7 Conclusions

Greater access to formal financial markets through policy driven branch expansion can relax credit constraints, allowing productive firms to invest at their optimal rates and households to smooth consumption across time. However, due to information asymmetries, possibly misaligned incentives within bank hierarchies and high costs to serving certain areas, expanding branch networks need not necessarily result in greater credit access or economic growth.

[19]Out of concern that the omitted districts are disproportionately from one side of the cutoff or the other, I repeat the McCrary test only including districts missing the composite index value. I fail to reject the null hypothesis of continuity in the density of districts at the cutoff with the discontinuity estimate in the log difference in height at -31 and a standard error of 38.

Identifying the effect of formal bank access also proves challenging due to classic endogeneity concerns of branch location choice. This paper utilizes exogenous variation in formal banking access generated by a recent and previously unstudied branching policy reform in India from 2005. Using a regression discontinuity design based on the assignment rule of districts to under banked status, the analysis demonstrates an expansion of banking services consistent with the timing and incentives of the reform. Agricultural productivity and the capital intensity of manufacturing are shown to increase in areas receiving higher credit due to the reform. I estimate that an increase of 1,000 private bank credit accounts in a district raises average crop yield by 3%. This effect is a little less than half of the effect Jayachandran (2006) measures on crop yield from positive rainfall shocks. Manufacturing enterprises in areas with increased access to banking exhibited higher growth in total investments, working capital and capital labor ratios. Finally, I confirm the aggregate effect on local GDP growth by showing that areas with expanding banking services experienced higher rates of growth in nighttime light intensity in the years following the reform. The estimates imply that each additional private bank branch led to a 0.36% increase in local GDP.

Overall, these findings offer strong causal evidence that the expansion of the financial systems facilitate growth in productive activities important for driving economic development. They further confirm the potential effectiveness of policy reforms in producing this expansion. The evidence suggests that the competition anticipated to be generated by the reform led profit maximizing banks to increase the quantity of credit ahead of additional branch entry to secure market shares in profitable areas. This effect from competition enhanced the response to the reform, beyond what could be expected from branch entry alone. Importantly, the expansion of credit does not seem to have been restricted to urban areas which is a common concern in developing areas. Rural and semi-urban markets in underserved areas also exhibited increases of credit from private banks. Though caution must be used in examining the credit data at disaggregated levels, the timing and effects in rural areas are consistent with banks responding to priority sector requirements by lending to target groups through their newly opened branches. This would suggest the importance of harmonizing incentives across policies to effectively meet policy objectives. Future work should examine the effects of interactions between the policy interventions.

The results of this analysis suggests that private sector banks respond strongly to the incentives generated by regulations. Areas targeted by the policy reform demonstrated a variety of benefits. While this speaks to the effects of financial development, little can be said in terms of overall policy evaluation. Resources were redistributed across districts due to the reform. Without measures for the opportunity costs of these resources, a full welfare analysis is beyond the scope of this paper. The introduction of bank or branch level data on credit, as well as farmer level data of characteristics, borrowing, inputs and crop selection would allow for a closer examination of these potential costs, give greater insights as to the specific mechanisms driving productivity gains and provide a basis for a more complete welfare analysis. Future work should also concentrate on a deeper understanding of the interactions between private sector, public sector and informal lenders in facilitating financial development.

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8 Figures

Figure 1: Banking Sector Structure in India

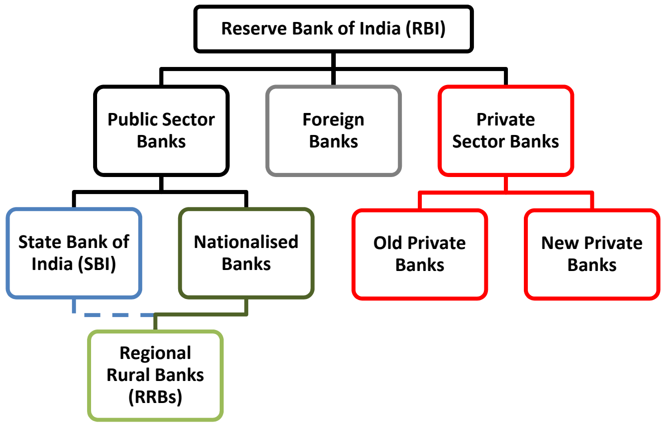


Figure 2: Policy Time Line for Bank Branching and Related Reforms

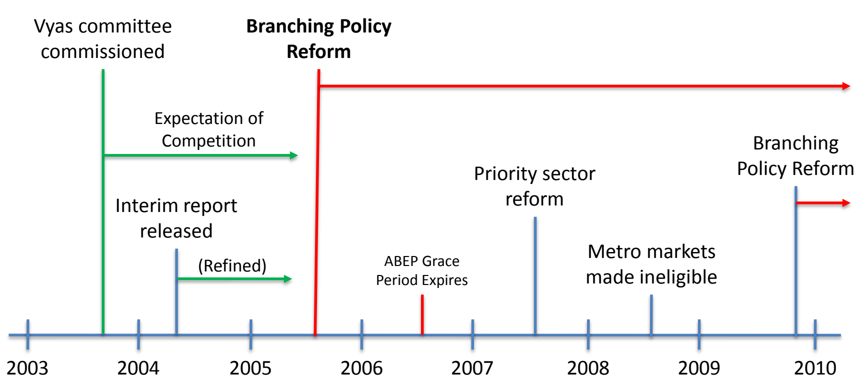
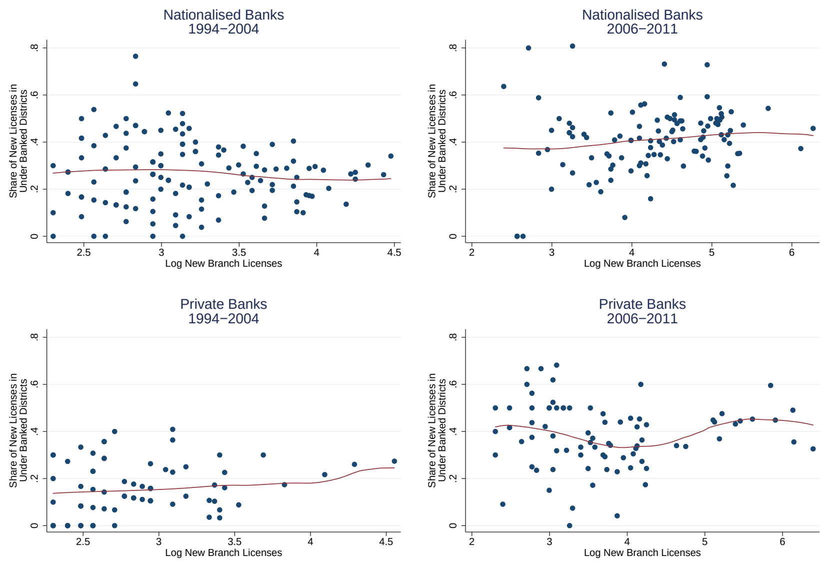
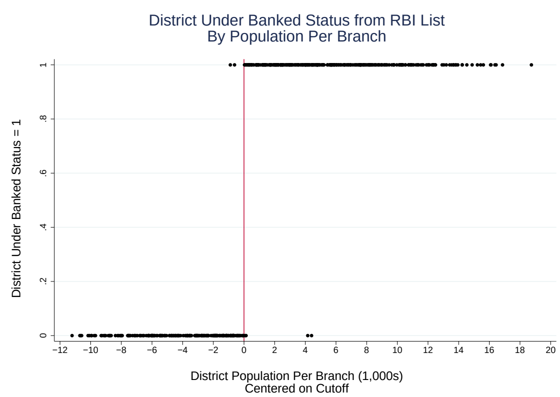


Figure 3: Bank-year Specific Shares of New Licenses Issued to the Bank in Districts on the 2006 List of Under Banked Districts



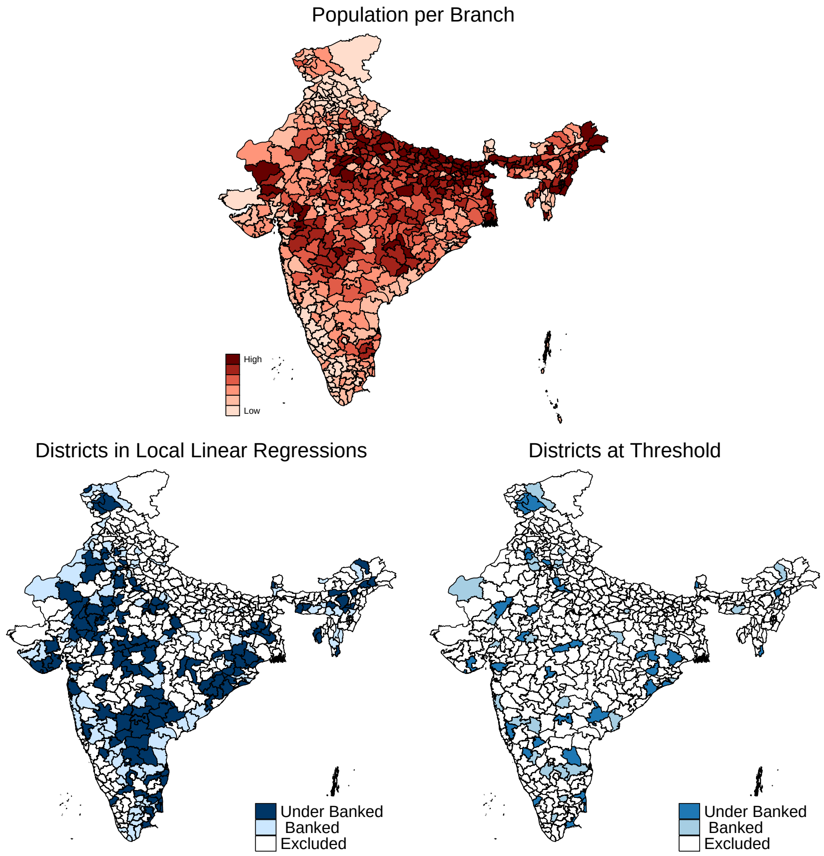
Note: Each observation is the percentage of new licenses for general and specialized branches issued during a calendar year for each bank-year pair in the respective Nationalised and Private bank groups. The value is plotted against the log of total new licenses issued to the bank in that year.

Figure 4: RD Visual First Stage: Under Banked Status by District Population Per Branch



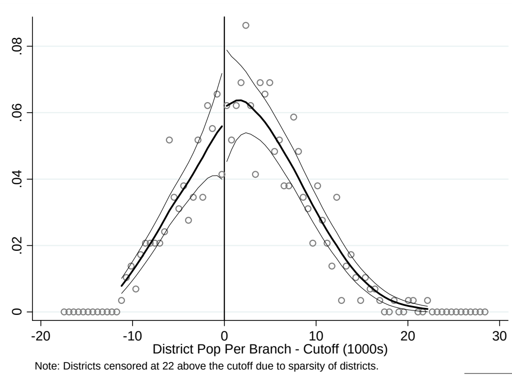
Note: The dots report the under banked status of a district, taking a value equal to one if the district appeared on the list of under banked districts in the 2006 RBI MC on Branching Authorisation Policy, and zero otherwise. The forcing variable, district population per branch centered on the national average, is on the x-axis scaled to thousands of persons per branch. Values to the right of the cutoff are predicted to have under banked status. 368 districts of 572 have under banked status, with 6 incorrect predictions based on the rule.

Figure 5: Maps of Under Served Areas by Formal Banking



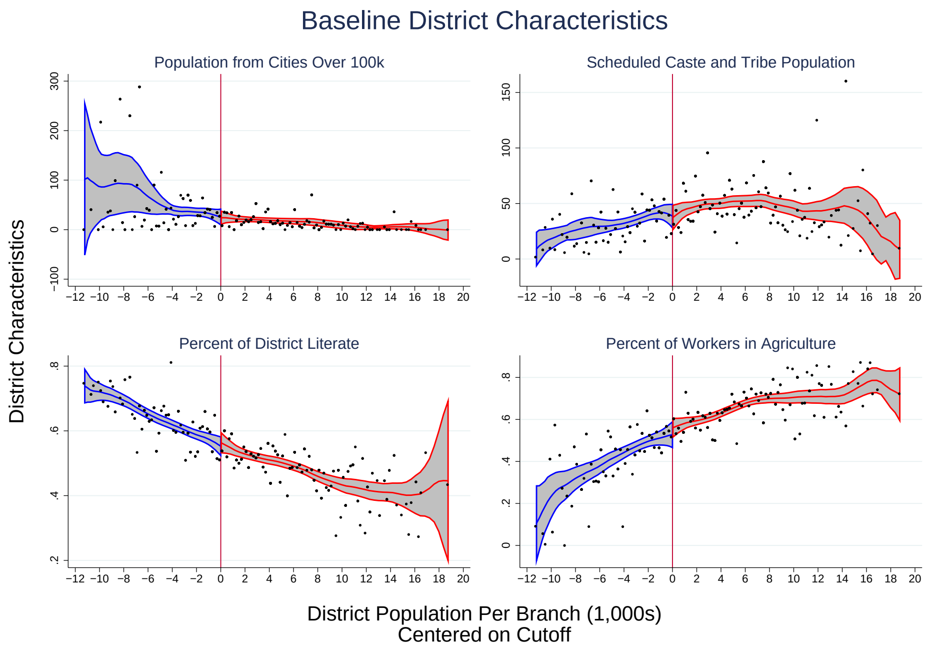
Upper: District population per branch. Lower Left: Including only districts used in local linear regressions. Lower Right: Including only those districts within 1,000 persons per branch of the cutoff.

Figure 6: Visual McCrary Test



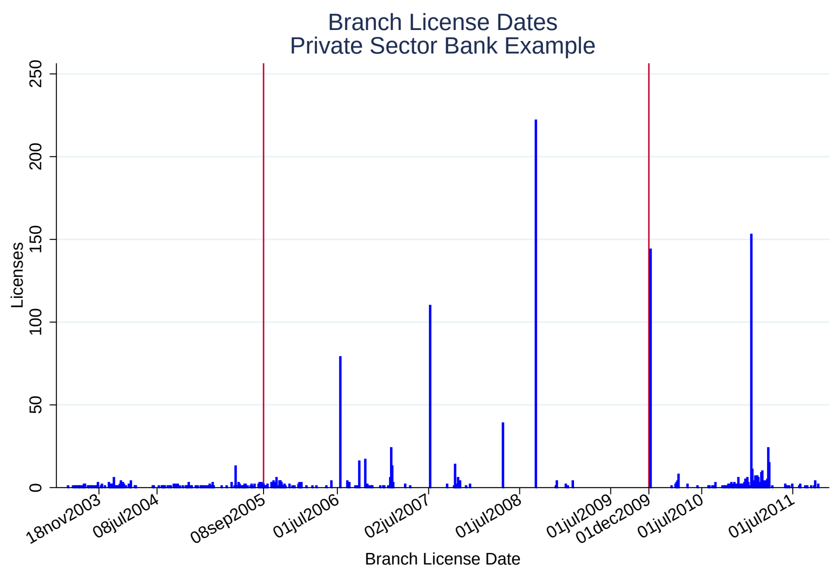
The graph plots a density of districts along the forcing variable, district population per branch, centered on the cutoff. The discontinuity estimate in the log difference in height is 6.6 with a standard error of 22. I fail to reject the null hypothesis of continuity at the cutoff, suggesting a lack of manipulation.

Figure 7: Continuity Around the Threshold



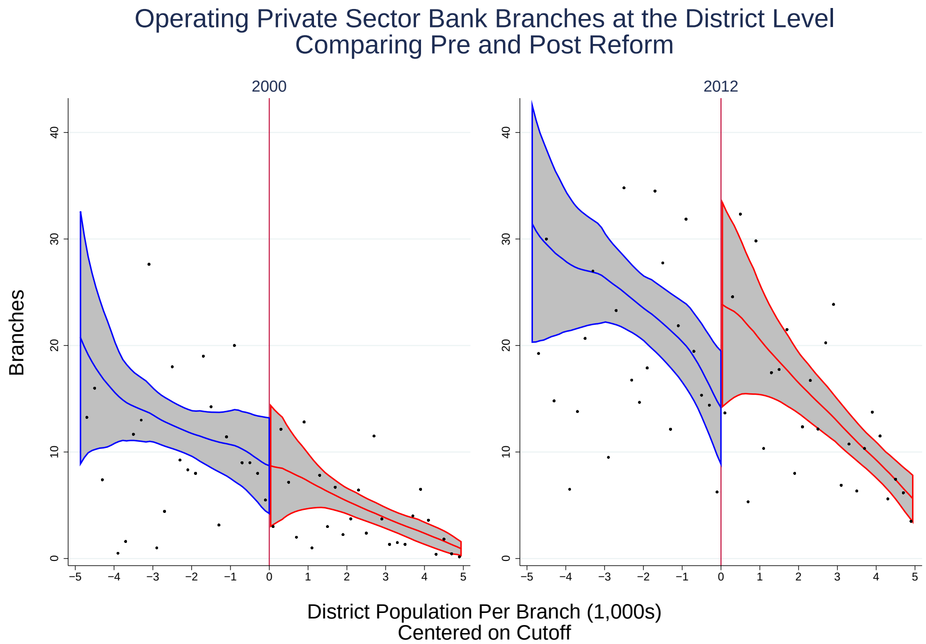
Note: The figure presents baseline district characteristics taken from the 2001 Population Census of India, with dots reporting local averages for districts falling within non-overlapping 200 persons per branch bins. The horizontal axis is the forcing variable of district population per branch centered on the cutoff. Districts predicted to have under banked status fall to the right of the cutoff. The estimated y-value from a local linear regression of bandwidth 3.5 thousand persons per branch is shown at each x-value, allowing for different slopes on either side of the cutoff, with 5% confidence intervals.

Figure 8: Histogram of Branch Licenses Showing ABEPs for a Large Private Sector Bank



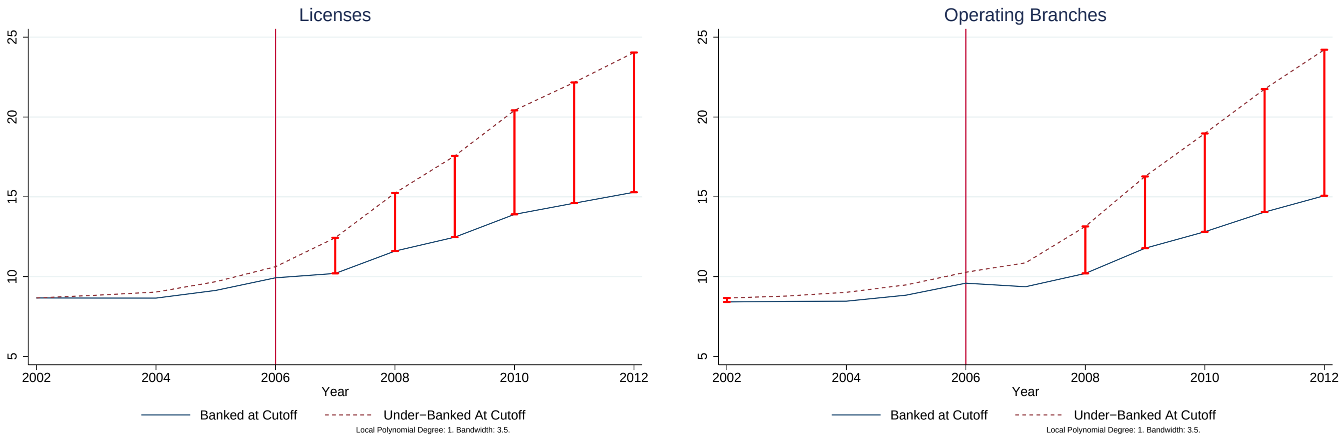
Note: Branch license dates are from the MOF. Bin widths are set to 4 days. Though annual branch expansion plans (ABEP) may not be observed directly, the large spikes in branch licenses set approximately a year apart after 2005 are consistent with licenses issued through ABEPs. The dates of Master Circular releases are shown, with vertical red lines at the 2005 policy reform and the subsequent reform in December 2009. Branches acquired through mergers and acquisitions are excluded.

Figure 9: Visual RD: Operating Private Bank Branches



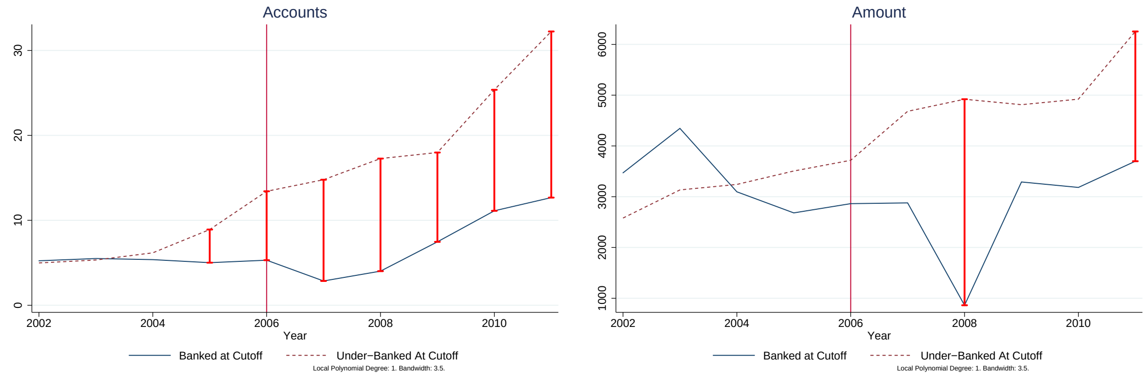
Note: Each plot presents the number of operating private sector bank branches within a district, in respective years, with dots reporting local averages for districts falling within non-overlapping 200 persons per branch bins. The horizontal axis is the forcing variable of district population per branch centered on cutoff and scaled to thousands of persons per district. The estimated y-value from local linear regressions, with a 3.5 thousand persons per district bandwidth and triangular kernel, at each x-value along with 5% confidence intervals is shown, allowing for different slopes on either side of the cutoff. The year 2000 in the left plot shows a pre-reform example of branches around the cutoff. The figure on the right shows the cumulative effect of the policy on operating branches since its implementation in 2005. Local averages greater than 40 are not shown in the plots, but were included in local linear regressions. Local averages greater than 40 did not occur close to the cutoff.

Figure 10: Discontinuity from Reduced Form: Operating Private Bank Branches



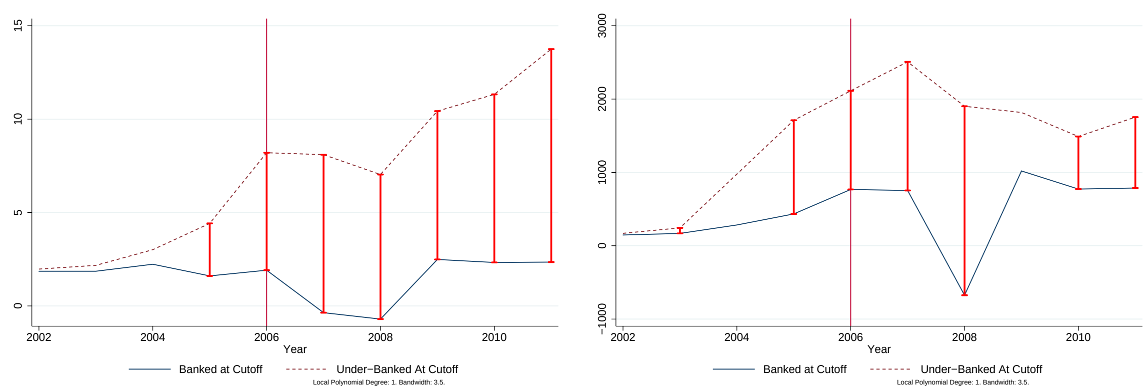
Note: Estimated using local linear regressions with controls for district population and its square, and the pre-randomization 2001 value of the dependent variable. Bandwidths are set 3.5 thousand persons per branch and estimated using a uniform kernel. The figure plots the estimated intercepts at the cutoff from the estimation of the RD equation repeated annually. The red dashed line provides the estimated intercept from approaching the threshold along the under banked side. The solid blue line reports the corresponding intercept approaching from the banked side. The distance between the two, reported for each year, shows the estimated discontinuity at the threshold. A vertical red line between the two points indicates a positive discontinuity with under banked districts exhibiting a higher value at the threshold than banked districts, with significance at least at the 10% level. A vertical dashed green line indicates a negative discontinuity estimated at least at the 10% level. The thin vertical red line at 2006 represents the first estimation made after the reform implementation.

Figure 11: Discontinuity from Reduced Form: Private Banks Aggregate Credit



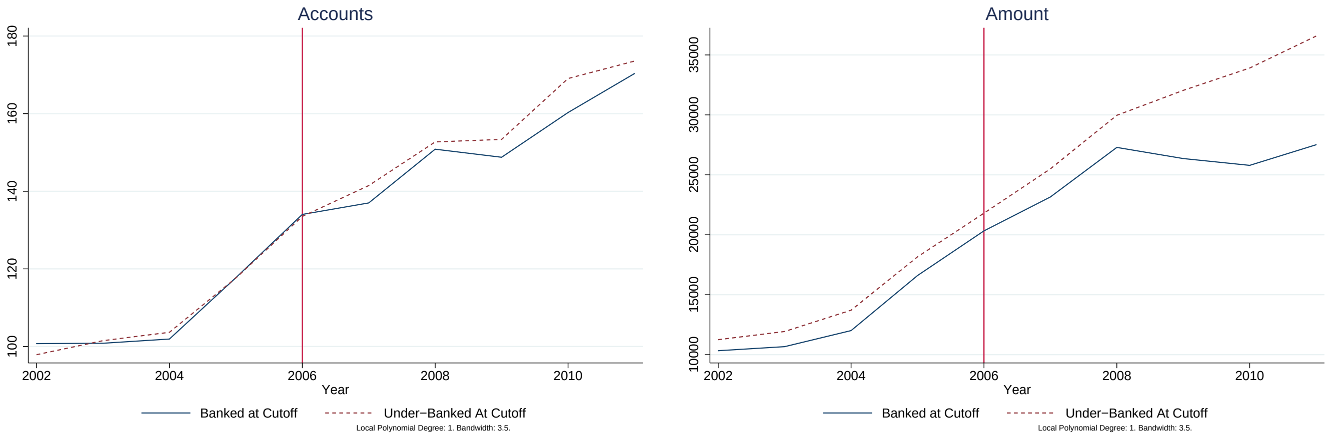
Note: Accounts reported in thousands. Amounts reported in millions of rupees. Estimated using local linear regressions with controls for district population and its square, and the pre-randomization 2001 value of the dependent variable. Bandwidths are set 3.5 thousand persons per branch and estimated using a uniform kernel. See notes from Table 10 for graph description.

Figure 12: Discontinuity from Reduced Form: Private Credit to Personal Loans



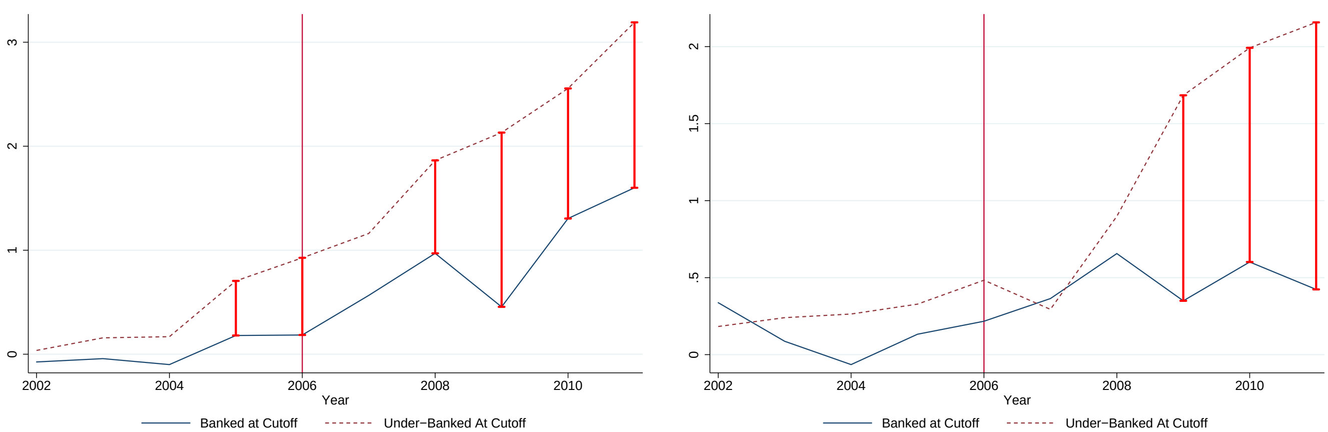
Note: Accounts reported in thousands. Amounts reported in millions of rupees. Estimated using local linear regressions with controls for district population and its square, and the pre-randomization 2001 value of the dependent variable. Bandwidths are set 3.5 thousand persons per branch and estimated using a uniform kernel. See notes from Table 10 for graph description.

Figure 13: Discontinuity from Reduced Form: Credit from Public Sector Banks



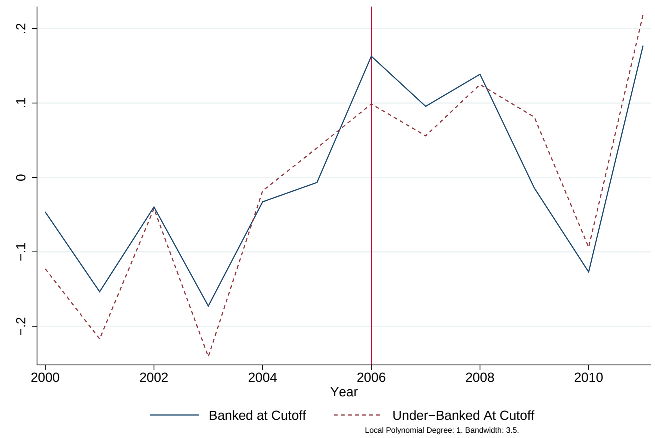
Note: Accounts reported in thousands. Amounts reported in millions of rupees. Estimated using local linear regressions with controls for district population and its square, and the pre-randomization 2001 value of the dependent variable. Bandwidths are set 3.5 thousand persons per branch and estimated using a uniform kernel. See notes from Table 10 for graph description. Public sector banks include State Bank of India and Associated Banks, Nationalised Banks, IDBI and Regional Rural Banks.

Figure 14: Discontinuity from Reduced Form: Percentage Change in Private Credit Amount to Agriculture in Rural and Semi-Urban Areas



(Left) Direct Agriculture, (Right) Indirect Agriculture. Note: Percentage change is approximated using difference in logs relative the value reported in 2001. Estimated using local linear regressions with controls for district population and its square. Bandwidths are set 3.5 thousand persons per branch and estimated using a uniform kernel.

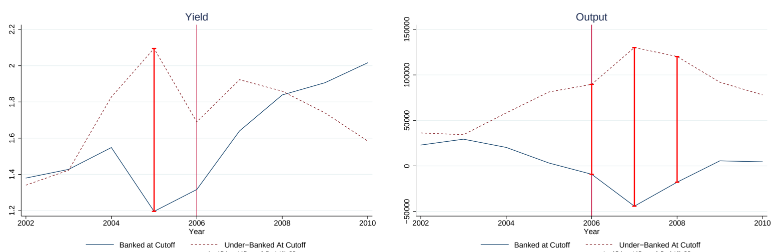
Figure 15: Discontinuity from Reduced Form: Rainfall



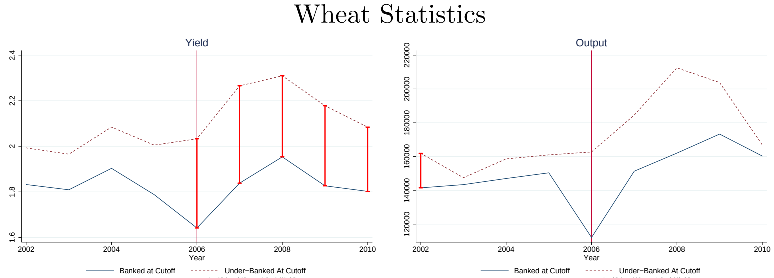
Note: District Average Percentage Deviation from Mean. Estimated using local linear regressions. Bandwidths are set 3.5 thousand persons per branch and estimated using a uniform kernel. See notes from Table 10 for graph description.

Figure 16: Discontinuity from Reduced Form: Individual Crops

Cotton Statistics

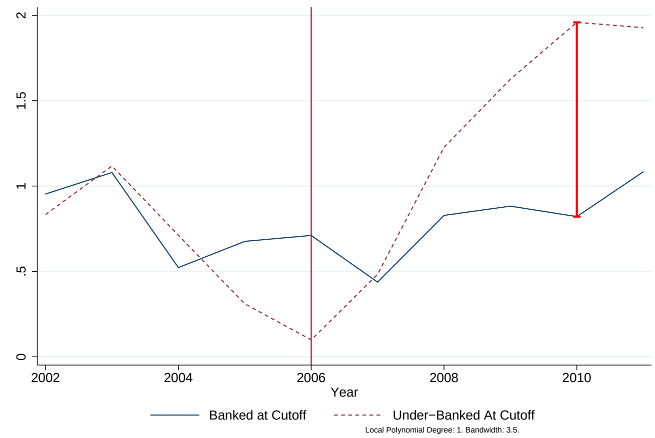


Wheat Statistics



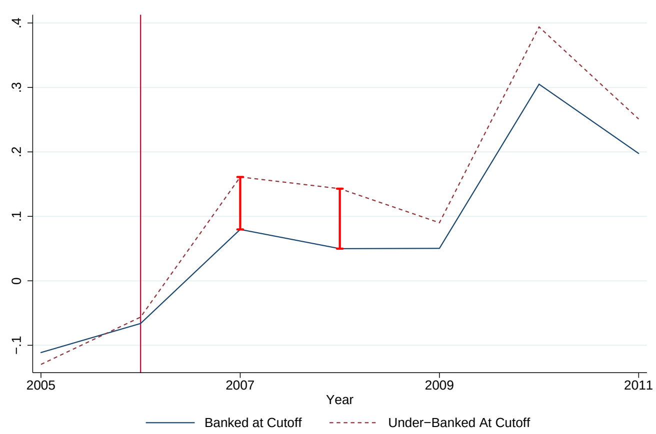
Note: Yield [Tonnes/Hectare] (Left), Output [Tonnes] (Right). Cotton output measured in bales rather than tonnes.

Figure 17: Discontinuity From Reduced Form: Percentage Change in Private Credit Amount to Manufacturing and Processing from 2001 Level



Note: Percentage change is approximated using difference in logs relative the value reported in 2001. Estimated using local linear regressions with controls for district population and its square. Bandwidths are set 3.5 thousand persons per branch and estimated using a uniform kernel.

Figure 18: Discontinuity from Reduced Form: Difference in Log Mean District Light from 2004 Level



Note: Estimated using local quadratic regressions with controls for district population and its square. Bandwidths are set to 3.5 thousand persons per branch and estimated using a triangular uniform.

9 Tables

Table 1: Continuity tests for Baseline Values at the Cutoff

VARIABLES	(1) Population	(2) City_Pop	(3) Sched_Caste_Tribe_Pop	(4) Pct_Literate	(5) Pct_Dist_Dark	(6) Area_Proxy	(7) PrivBranches2000
Conventional	0.839	-1.344	-1.436	0.0114	-0.00894	-2,485	0.192
	[35.38]	[13.61]	[8.483]	[0.0219]	[0.0169]	[2,697]	[3.026]
Bias-corrected	16.01	2.353	0.265	0.0187	-0.0101	-3,386	0.567
	[35.38]	[13.61]	[8.483]	[0.0219]	[0.0169]	[2,697]	[3.026]
Robust	16.01	2.353	0.265	0.0187	-0.0101	-3,386	0.567
	[42.75]	[16.30]	[9.840]	[0.0261]	[0.0210]	[3,323]	[3.527]
Bandwidth	3.500	3.500	3.500	3.500	3.500	3.500	3.500
N_Banked	95	95	95	95	95	95	95
N_UBanked	122	122	122	122	122	122	122
DepMean	176.7	28.56	45.24	0.553	0.949	8150	7.198

Standard errors in brackets

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

Note: Estimated using local linear regressions with no controls. Bandwidths are set 3.5 thousand persons per branch and estimated using a triangular kernel.

Table 2: Summary Statistics

Banking

	Banked, Pre-reform			Banked, Post-reform			Under Banked, Pre-reform			Under Banked, Post-Reform		
	N	Mean	Std. Dev.	N	Mean	Std. Dev.	N	Mean	Std. Dev.	N	Mean	Std. Dev.
Branches												
SBI	610	28.618	23.095	732	33.238	27.971	900	21.35	16.381	1080	24.595	19.693
Nationalised	610	69.805	62.759	732	80.634	73.984	900	45.444	44.86	1080	51.54	50.432
RRB	610	21.523	21.684	732	23.001	22.171	900	28.221	22.147	1080	29.207	22.946
Foreign	610	0.121	0.624	732	0.243	1	900	0.018	0.199	1080	0.112	0.457
Old Private	610	11.807	16.582	732	11.628	15.295	900	4.198	9.298	1080	4.589	10.001
New Private	610	2.428	4.6	732	7.25	10.687	900	0.794	2.372	1080	4.049	6.154
Public Banks	610	120.154	87.587	732	137.926	105.531	900	95.064	66.491	1080	106.006	76.429
Private Banks	610	14.234	18.58	732	18.878	20.755	900	4.992	10.375	1080	8.638	13.96
Credit Amount												
SBI	610	5293.635	5980.068	732	11037.746	12248.838	900	3285.651	5986.45	1080	6507.465	8548.992
Nationalised	610	10236.988	13154.392	732	22228.233	33180.444	900	4602.575	5692.052	1080	9362.257	12494.337
RRB	610	870.748	1198.64	732	1738.277	2270.793	900	950.135	1134.78	1080	1869.281	2256.909
Foreign	610	201.344	727.787	732	487.36	1620.559	900	50.173	293.389	1080	191.788	1414.19
Private	610	3813.913	7071.325	732	7637.427	12055.826	900	1354.922	3542.466	1080	2437.963	5464.27
Credit Accounts												
SBI	610	30945.372	31517.419	732	47639.104	50181.875	900	24107.006	24218.304	1080	38046.444	39105.763
Nationalised	610	60582.561	60584.955	732	89278.02	97041.327	900	37963.999	38526.215	1080	55938.739	58976.202
RRB	610	22255.538	33920.327	732	30088.209	47295.116	900	28251.067	34646.607	1080	36354.233	48093.88
Foreign	610	134.425	772.631	732	319.858	1656.413	900	51.02	564.603	1080	119.098	874.722
Private	610	9792.657	14751.414	732	25507.242	35027.737	900	3214.418	7356.894	1080	9889.303	22363.595
Deposit Amount												
SBI	607	9599.797	10660.293	732	16412.707	20661.421	892	6104.533	6197.594	1078	10180.87	10886.087
Nationalised	607	20027.738	26126.927	732	33469.464	51159.493	892	9745.183	12975.665	1078	15306.32	20677.413
RRB	607	1340.932	1519.9	732	2212.508	2520.006	892	1807.669	1792.853	1078	2828.679	2818.4
Foreign	607	181.203	1207.168	732	611.752	4849.064	892	20.185	243.413	1078	65.089	603.547
Private	607	4695.24	8722.103	732	8973.14	17799.643	892	1371.376	2938.947	1078	2798.099	5257.67
Deposit Accounts												
SBI	607	203.438	178.676	732	298.246	276.023	892	147.726	130.511	1078	232.131	228.963
Nationalised	607	502.83	502.301	732	683.751	696.657	892	294.637	342.959	1078	410.485	464.146
RRB	607	76.55	101.221	732	118.76	157.796	892	100.515	109.819	1078	157.422	174.789
Foreign	607	0.98	6.606	732	2.268	14.987	892	0.188	2.342	1078	0.396	2.834
Private	607	91.003	124.465	732	136.977	184.145	892	30.155	63.394	1078	50.568	93.778

Source: RBI Master Office File, BSR 1 and BSR 2 years 2001-2011. Sample includes years 2001-2011 for districts falling within 5 thousand persons per branch of the national average. Each year includes 122 banked districts and 180 under banked districts, from a total of 572 districts considered. Amounts are reported in Rupees million adjusted to 2011q4 prices; Accounts are reported in thousands.

Table 3: Summary Statistics Continued...

Agriculture

	Banked, Pre-reform			Banked, Post-reform			Under Banked, Pre-reform			Under Banked, Post-reform		
	N	Mean	Std. Dev.	N	Mean	Std. Dev.	N	Mean	Std. Dev.	N	Mean	Std. Dev.
Cotton												
Area	403	32,656	53,321	349	31,406	56,677	619	31,351	64,876	471	37,076	75,472
Output	403	59,959	127,462	349	100,347	229,598	619	41,581	89,199	471	86,119	203,562
Productivity	403	1.61	0.98	349	2.12	1.38	619	1.35	0.84	471	1.55	1.28
Maize												
Area	560	11,945	20,923	470	15,124	28,518	968	16,400	32,962	761	16,688	36,426
Output	560	27,988	57,175	470	48,069	103,819	968	28,449	64,162	761	34,070	87,053
Productivity	560	1.87	1.19	470	2.38	2.24	968	1.49	0.84	761	1.76	1.35
Onion												
Area	431	1,527	3,714	342	2,036	5,455	743	1,074	2,489	510	1,485	4,019
Output	431	13,885	29,608	342	17,539	36,355	743	14,587	51,185	510	24,189	99,249
Productivity	431	11.71	7.93	342	12.03	8.58	743	11.34	7.48	510	11.38	7.92
Potato												
Area	351	2,028	4,026	303	2,303	6,024	674	3,014	9,512	587	3,694	12,041
Output	351	28,503	44,128	303	27,843	43,051	674	67,058	248,196	587	71,627	286,377
Productivity	351	13.75	7.51	303	12.93	7.79	674	12.64	7.55	587	11.76	8.19
Rice												
Area	667	64,626	82,739	544	67,299	85,705	1017	88,839	104,258	784	100,968	120,405
Output	667	173,077	285,059	544	194,407	303,283	1017	160,160	221,919	784	197,829	266,243
Productivity	667	2.30	1.01	544	2.51	1.10	1017	1.61	0.87	784	1.81	0.94
Sesamum												
Area	573	3,245	6,935	460	2,790	4,742	908	4,826	11,359	749	5,919	15,535
Output	573	1,220	3,198	460	1,119	2,212	908	1,805	5,529	749	2,032	6,103
Productivity	573	0.35	0.23	460	0.38	0.25	908	0.32	0.22	749	0.35	0.24
Sugarcane												
Area	523	12,161	23,096	419	11,554	22,413	907	8,554	25,972	711	8,866	27,790
Output	523	955,008	1,797,426	419	902,855	1,738,094	907	590,206	1,786,733	711	588,924	1,878,506
Productivity	523	70.26	35.51	419	67.35	39.47	907	53.13	26.72	711	55.86	30.25
Tobacco												
Area	166	7,958	16,242	176	8,267	17,829	258	454	1,647	213	620	2,082
Output	166	9,853	22,353	176	10,113	20,766	258	663	2,233	213	1,128	3,622
Productivity	166	1.54	1.53	176	1.53	1.61	258	1.63	1.88	213	1.71	1.57
Wheat												
Area	437	60,088	81,807	349	64,550	81,240	923	49,803	65,451	689	52,869	67,471
Output	437	204,344	353,065	349	225,183	353,261	923	126,363	200,516	689	147,671	224,604
Productivity	437	2.21	1.25	349	2.38	1.27	923	1.78	0.97	689	1.93	1.02

Source: Rainfall data from TRMM satellite, crop data from State Agricultural Reports. Sample includes years 2000-2010 for districts falling within 5 thousand persons per branch of the national average. Observations are crop-years; the number of districts varies by crop as not every crop is grown in all districts. 302 of 572 districts are eligible for sample. Area is reported in Hectares square, output in tonnes, and productivity is output divided by area. Cotton reported in bales instead of tonnes.

Annual Survey of Industries

	Banked, Pre-reform			Banked, Post-reform			Under Banked, Pre-reform			Under Banked, Post-reform		
	N	Mean	Std. Dev.	N	Mean	Std. Dev.	N	Mean	Std. Dev.	N	Mean	Std. Dev.
Log Total Employees	42702	3.786	1.403	40252	3.954	1.436	21133	3.567	1.345	17976	3.72	1.403
Log Number of units	42824	0.04	0.193	40575	0.041	0.203	21216	0.021	0.15	18123	0.025	0.159
Plant Age	42248	16.002	13.986	39268	15.204	13.878	20864	14.97	14.197	17562	14.664	14.332
Log Capital (No Land or Inventory)	42339	14.911	2.876	39707	15.151	3.392	21030	14.576	2.952	17886	14.995	3.135
Log Net Assets	42352	15.679	2.883	39772	15.76	3.294	21040	15.354	2.929	17902	15.602	3.024
Log Working Capital	35823	15.306	3.024	34057	15.259	3.689	18262	15.015	3.105	15818	15.287	3.154
Log Loans	34828	14.869	4.037	32543	14.962	4.199	16258	14.874	4.084	13795	15.062	4.035
Log Total Investment	39950	14.688	3.2	37858	14.943	3.829	20517	14.248	3.298	17468	14.649	3.619
Capital Labor Ratio	42221	6.644	47.52	39543	11.121	237.379	20971	8.133	38.898	17800	10.879	105.471
Log Capital Labor Ratio	42202	0.774	1.535	39535	0.875	1.516	20958	0.89	1.662	17798	1.003	1.645

Source: Annual Survey of Industries, Unit level data 1999-2010. Sample is restricted to plants reporting being open and reporting a valid urban or rural status. Captital Labor Ratio constructed as average of opening and closing Net Assets divided by the total wage bill plus benefits. States and UTs selected by their share of population being concentrated on one side of the threshold or the other. "Banked States" include Haryana, Uttarakhand, Punjab, Mizoram, Daman and Dimiu, Karnataka, Puducherry, and "Under Banked States" include Rajasthan, Tripura, Jharkhand, Orissa, Dadra and Nagar Haveli.

Table 4: Fuzzy RD: Private Bank Branches

Licenses

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
VARIABLES	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Conventional	-0.0469	0.246	0.414	0.533	0.657	2.198*	3.785**	5.691**	7.313**	8.510***	9.665***
	[0.182]	[0.323]	[0.533]	[0.693]	[0.911]	[1.212]	[1.668]	[2.267]	[2.869]	[3.267]	[3.545]
Bias-corrected	-0.0888	0.318	0.869	0.936	1.067	2.628**	4.153**	6.265***	7.748***	8.910***	10.12***
	[0.182]	[0.323]	[0.533]	[0.693]	[0.911]	[1.212]	[1.668]	[2.267]	[2.869]	[3.267]	[3.545]
Robust	-0.0888	0.318	0.869	0.936	1.067	2.628*	4.153**	6.265**	7.748**	8.910**	10.12**
	[0.215]	[0.379]	[0.643]	[0.831]	[1.075]	[1.423]	[1.939]	[2.638]	[3.342]	[3.796]	[4.123]
Bandwidth	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500
N_Banked	95	94	94	94	94	94	94	94	94	94	94
N_UBanked	122	122	122	122	122	122	122	122	122	122	122
DepMean	8.714	8.917	9.241	9.847	10.62	11.92	13.83	15.31	17.13	18.47	19.99

Standard errors in brackets

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

Operating Branches

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
VARIABLES	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Conventional	0.155	0.320	0.538	0.579	0.629	1.128	3.017**	4.512**	6.630***	8.680***	9.991***
	[0.159]	[0.329]	[0.561]	[0.669]	[0.902]	[1.070]	[1.445]	[1.962]	[2.541]	[3.184]	[3.610]
Bias-corrected	0.133	0.355	0.990*	0.958	1.032	1.298	3.463**	4.770**	6.919***	9.097***	10.41***
	[0.159]	[0.329]	[0.561]	[0.669]	[0.902]	[1.070]	[1.445]	[1.962]	[2.541]	[3.184]	[3.610]
Robust	0.133	0.355	0.990	0.958	1.032	1.298	3.463**	4.770**	6.919**	9.097**	10.41**
	[0.186]	[0.383]	[0.668]	[0.801]	[1.069]	[1.250]	[1.674]	[2.288]	[2.961]	[3.705]	[4.197]
Bandwidth	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500
N_Banked	95	94	94	94	94	94	94	94	94	94	94
N_UBanked	122	122	122	122	122	122	122	122	122	122	122
DepMean	8.636	8.801	9.125	9.597	10.34	10.87	12.25	14.42	16.19	17.91	20.00

Standard errors in brackets

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

Note: Estimated using local linear regressions with controls for district population and its square, and the pre-randomization 2001 value of the dependent variable. Bandwidths are set 3.5 thousand persons per branch and estimated using a triangular kernel. Under banked status is instrumented for with predicted under banked assignment. Licenses are considered in operation if they are granted for a branch currently operating or pending opening.

Table 5: Fuzzy RD: Private Banks Aggregate Credit

Private Sector Credit Accounts

VARIABLES	(1) 2002	(2) 2003	(3) 2004	(4) 2005	(5) 2006	(6) 2007	(7) 2008	(8) 2009	(9) 2010	(10) 2011
Conventional	-0.264	0.119	1.147	3.678*	6.725*	10.42***	10.01*	7.781	11.74*	16.96
	[0.606]	[0.857]	[1.270]	[1.993]	[4.039]	[3.698]	[5.461]	[4.872]	[7.009]	[10.95]
Bias-corrected	-0.281	0.523	1.871	4.199**	8.192**	12.14***	11.90**	9.321*	13.44*	18.26*
	[0.606]	[0.857]	[1.270]	[1.993]	[4.039]	[3.698]	[5.461]	[4.872]	[7.009]	[10.95]
Robust	-0.281	0.523	1.871	4.199*	8.192*	12.14***	11.90*	9.321	13.44	18.26
	[0.707]	[1.023]	[1.489]	[2.371]	[4.741]	[4.549]	[6.439]	[5.692]	[8.198]	[12.73]
Bandwidth	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500
N_Banked	95	94	94	94	94	94	94	94	94	94
N_UBanked	122	122	121	122	122	122	122	122	122	122
DepMean	5.067	5.484	6.470	8.800	12.83	13.77	16.78	17.78	22.82	25.80

Standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Private Sector Credit Amounts

VARIABLES	(1) 2002	(2) 2003	(3) 2004	(4) 2005	(5) 2006	(6) 2007	(7) 2008	(8) 2009	(9) 2010	(10) 2011
Conventional	-550.7	-867.3	-159.9	994.4	1,060	1,664	3,504	1,451	1,461	2,194
	[1,547]	[2,026]	[1,947]	[1,342]	[1,682]	[2,156]	[2,529]	[1,475]	[1,363]	[1,646]
Bias-corrected	-182.5	-359.5	294.2	1,813	1,893	2,523	4,854*	2,703*	2,314*	3,044*
	[1,547]	[2,026]	[1,947]	[1,342]	[1,682]	[2,156]	[2,529]	[1,475]	[1,363]	[1,646]
Robust	-182.5	-359.5	294.2	1,813	1,893	2,523	4,854	2,703	2,314	3,044
	[1,760]	[2,326]	[2,221]	[1,598]	[2,072]	[2,623]	[3,314]	[1,879]	[1,679]	[2,054]
Bandwidth	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500
N_Banked	95	94	94	94	94	94	94	94	94	94
N_UBanked	122	122	121	122	122	122	122	122	122	122
DepMean	2641	3223	2943	3466	3922	4920	5934	5362	4932	5990

Standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Note: Accounts reported in thousands. Amounts reported in millions of rupees. Estimated using local linear regressions with controls for district population and its square, and the pre-randomization 2001 value of the dependent variable. Bandwidths are set 3.5 thousand persons per branch and estimated using a triangular kernel. Under banked status is instrumented for with predicted under banked assignment.

Table 6: Fuzzy RD: Private Credit to Personal Loans

Accounts in Personal Loans

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
VARIABLES	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Conventional	0.147	0.460	1.109	2.898**	6.498**	8.159***	6.706**	6.957**	8.658***	10.89*
	[0.240]	[0.447]	[0.816]	[1.216]	[2.647]	[2.455]	[2.732]	[3.124]	[3.047]	[5.652]
Bias-corrected	0.205	0.658	1.473*	3.127**	7.307***	9.538***	7.775***	7.839**	9.870***	11.98**
	[0.240]	[0.447]	[0.816]	[1.216]	[2.647]	[2.455]	[2.732]	[3.124]	[3.047]	[5.652]
Robust	0.205	0.658	1.473	3.127**	7.307**	9.538***	7.775**	7.839**	9.870***	11.98*
	[0.285]	[0.518]	[0.945]	[1.486]	[3.140]	[3.179]	[3.359]	[3.707]	[3.614]	[6.562]
Bandwidth	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500
N_Banked	95	94	94	94	94	94	94	94	94	94
N_UBanked	122	122	121	122	122	122	122	122	122	122
DepMean	1.885	1.910	2.686	3.681	6.138	6.313	6.471	9.120	9.056	9.707

Standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Amount to Personal Loans

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
VARIABLES	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Conventional	22.11	75.08	663.6	1,382**	1,605**	1,927**	2,409	628.1	692.1	878.2*
	[20.50]	[51.87]	[480.0]	[657.6]	[753.1]	[887.3]	[1,533]	[626.7]	[425.4]	[485.3]
Bias-corrected	33.25	103.3**	759.6	1,499**	1,846**	2,179**	3,008**	687.7	807.5*	925.9*
	[20.50]	[51.87]	[480.0]	[657.6]	[753.1]	[887.3]	[1,533]	[626.7]	[425.4]	[485.3]
Robust	33.25	103.3*	759.6	1,499**	1,846**	2,179**	3,008	687.7	807.5	925.9*
	[23.46]	[60.87]	[497.4]	[763.0]	[901.2]	[1,065]	[2,151]	[735.6]	[493.8]	[556.7]
Bandwidth	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500
N_Banked	95	94	94	94	94	94	94	94	94	94
N_UBanked	122	122	121	122	122	122	122	122	122	122
DepMean	151.8	199.6	644.3	1003	1384	1658	1983	1609	1200	1280

Standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Note: Accounts reported in thousands. Amounts reported in millions of rupees. Estimated using local linear regressions with controls for district population and its square, and the pre-randomization 2001 value of the dependent variable. Bandwidths are set 3.5 thousand persons per branch and estimated using a triangular kernel. Under banked status is instrumented for with predicted under banked assignment.

Table 7: RD from Reduced Form: Credit from Public Sector Banks

Public Sector Credit Accounts

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
VARIABLES	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Conventional	-3.827	-0.621	0.269	-1.419	-1.086	4.170	-0.156	2.630	4.258	-1.188
	[3.191]	[4.109]	[5.598]	[7.397]	[10.56]	[10.96]	[11.23]	[12.24]	[15.05]	[15.09]
Bias-Corrected	-3.866	-0.196	1.956	1.412	1.662	8.924	2.854	7.809	8.348	2.285
	[3.191]	[4.109]	[5.598]	[7.397]	[10.56]	[10.96]	[11.23]	[12.24]	[15.05]	[15.09]
Robust	-3.866	-0.196	1.956	1.412	1.662	8.924	2.854	7.809	8.348	2.285
	[3.814]	[5.045]	[6.903]	[9.092]	[12.92]	[13.43]	[13.69]	[14.88]	[17.98]	[18.26]
Bandwidth	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500
N_Banked	94	94	94	94	94	94	93	94	94	94
N_UBanked	122	122	122	122	122	122	122	122	122	122
DepMean	99.43	102.5	105.6	120.6	132.4	141.5	151.7	154.2	167.2	177.1

Standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Public Sector Credit Amounts

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
VARIABLES	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Conventional	585.4	791.0	795.6	252.2	-669.7	27.51	-849.1	2,754	2,948	3,923
	[528.0]	[774.0]	[982.6]	[2,482]	[3,326]	[3,029]	[4,649]	[3,457]	[3,487]	[3,949]
Bias-Corrected	531.9	1,086	1,073	639.5	-421.5	865.7	322.0	4,478	4,171	5,329
	[528.0]	[774.0]	[982.6]	[2,482]	[3,326]	[3,029]	[4,649]	[3,457]	[3,487]	[3,949]
Robust	531.9	1,086	1,073	639.5	-421.5	865.7	322.0	4,478	4,171	5,329
	[599.5]	[1,058]	[1,343]	[2,974]	[3,959]	[3,546]	[5,400]	[4,124]	[4,329]	[4,995]
Bandwidth	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500
N_Banked	94	94	94	94	94	94	93	94	94	94
N_UBanked	122	122	122	122	122	122	122	122	122	122
DepMean	10544	11953	13493	17693	21386	23326	27547	29581	31372	34125

Standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Note: Accounts reported in thousands. Amounts reported in millions of rupees. Estimated using local linear regressions with controls for district population and its square, and the pre-randomization 2001 value of the dependent variable. Bandwidths are set 3.5 thousand persons per branch and estimated using a triangular kernel. Public sector banks include State Bank of India and Associated Banks, Nationalised Banks, IDBI and Regional Rural Banks.

Table 8: Fuzzy RD: Percentage Change in Private Credit Amount to Rural and Semi-Urban Areas

Direct to Agriculture

VARIABLES	(1) 2002	(2) 2003	(3) 2004	(4) 2005	(5) 2006	(6) 2007	(7) 2008	(8) 2009	(9) 2010	(10) 2011
Conventional	0.0681	0.141	0.216	0.699**	1.033**	0.734	0.945	1.795***	1.407**	1.731***
	[0.108]	[0.166]	[0.209]	[0.343]	[0.418]	[0.534]	[0.666]	[0.679]	[0.686]	[0.659]
Bias-corrected	0.120	0.266	0.301	0.917***	1.284***	0.899*	1.236*	2.104***	1.719**	1.918***
	[0.108]	[0.166]	[0.209]	[0.343]	[0.418]	[0.534]	[0.666]	[0.679]	[0.686]	[0.659]
Robust	0.120	0.266	0.301	0.917**	1.284**	0.899	1.236	2.104**	1.719**	1.918**
	[0.131]	[0.198]	[0.243]	[0.409]	[0.507]	[0.668]	[0.812]	[0.829]	[0.842]	[0.805]
Bandwidth	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500
N_Banked	95	94	94	94	94	94	94	94	94	94
N_UBanked	122	122	121	122	122	122	122	122	122	122
DepMean	-0.0700	0.0481	0.164	0.433	0.550	0.964	1.478	1.419	1.953	2.376

Standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Indirect to Agriculture

VARIABLES	(1) 2002	(2) 2003	(3) 2004	(4) 2005	(5) 2006	(6) 2007	(7) 2008	(8) 2009	(9) 2010	(10) 2011
Conventional	-0.00565	0.333	0.534	0.519	0.614	-0.0643	0.292	1.637**	1.713***	2.207***
	[0.257]	[0.350]	[0.423]	[0.572]	[0.505]	[0.617]	[0.689]	[0.705]	[0.556]	[0.595]
Bias-corrected	0.0720	0.449	0.670	0.703	0.866*	0.0355	0.357	1.997***	2.075***	2.507***
	[0.257]	[0.350]	[0.423]	[0.572]	[0.505]	[0.617]	[0.689]	[0.705]	[0.556]	[0.595]
Robust	0.0720	0.449	0.670	0.703	0.866	0.0355	0.357	1.997**	2.075***	2.507***
	[0.290]	[0.424]	[0.511]	[0.685]	[0.606]	[0.742]	[0.844]	[0.846]	[0.666]	[0.711]
Bandwidth	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500
N_Banked	95	94	94	94	94	94	94	94	94	94
N_UBanked	122	122	121	122	122	122	122	122	122	122
DepMean	0.317	0.199	0.188	0.237	0.257	0.453	0.963	1.039	1.313	1.133

Standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Note: Percentage change is approximated using difference in logs relative the value reported in 2001. Estimated using local linear regressions with controls for district population and its square. Bandwidths are set 3.5 thousand persons per branch and estimated using a triangular kernel.

Table 9: Reduced Form RD: Rainfall

Averaged Percentage Deviation from the Mean

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
VARIABLES	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Conventional	-0.0405	-0.0212	-0.0237	-0.0396	-0.00818	0.00883	-0.0638	-0.0373	0.0247	0.0520	0.0633	0.00992
	[0.0796]	[0.0595]	[0.0448]	[0.0444]	[0.0720]	[0.0514]	[0.0707]	[0.0761]	[0.0928]	[0.0707]	[0.0694]	[0.0760]
Bias-corrected	-0.0498	-0.0128	-0.0278	-0.0354	-0.0147	0.00278	-0.0874	-0.0580	0.0359	0.0720	0.0644	0.0131
	[0.0796]	[0.0595]	[0.0448]	[0.0444]	[0.0720]	[0.0514]	[0.0707]	[0.0761]	[0.0928]	[0.0707]	[0.0694]	[0.0760]
Robust	-0.0498	-0.0128	-0.0278	-0.0354	-0.0147	0.00278	-0.0874	-0.0580	0.0359	0.0720	0.0644	0.0131
	[0.0973]	[0.0738]	[0.0532]	[0.0531]	[0.0876]	[0.0624]	[0.0849]	[0.0923]	[0.115]	[0.0872]	[0.0864]	[0.0922]
Bandwidth	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500
N_Banked	95	95	95	94	94	94	94	94	94	94	94	94
N_UBanked	120	120	120	120	119	120	120	120	120	120	120	120
DepMean	-0.0500	-0.154	-0.0411	-0.208	-0.0298	0.0111	0.0970	0.0506	0.110	0.0545	-0.127	0.174

Standard errors in brackets

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

Note: Estimated using local linear regressions with no controls. Bandwidths are set 3.5 thousand persons per branch and estimated using a triangular kernel.

Table 10: RD Results: Individual Crops

Cotton Yield

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
VARIABLES	2002	2003	2004	2005	2006	2007	2008	2009	2010
Conventional	-0.0596	0.192	0.314	0.900	0.444	0.387	0.144	-0.124	-0.380
	[0.205]	[0.358]	[0.521]	[0.681]	[0.563]	[0.632]	[0.649]	[0.676]	[0.595]
Bias-corrected	-0.0693	0.193	0.479	1.165*	0.524	0.596	0.368	-0.128	-0.369
	[0.205]	[0.358]	[0.521]	[0.681]	[0.563]	[0.632]	[0.649]	[0.676]	[0.595]
Robust	-0.0693	0.193	0.479	1.165	0.524	0.596	0.368	-0.128	-0.369
	[0.258]	[0.444]	[0.665]	[0.829]	[0.730]	[0.767]	[0.812]	[0.849]	[0.734]
Bandwidth	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500
N_Banked	55	54	53	37	55	46	51	54	53
N_UBanked	83	83	83	52	72	54	68	69	63
DepMean	1.291	1.327	1.739	1.910	1.771	2.007	1.861	1.757	1.805

Standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Cotton Output (Bales)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
VARIABLES	2002	2003	2004	2005	2006	2007	2008	2009	2010
Conventional	15,129	710.2	40,656	62,240	101,178*	176,076**	148,302*	98,366	79,421
	[12,529]	[13,759]	[34,687]	[41,323]	[54,006]	[86,326]	[81,145]	[65,372]	[58,139]
Bias-corrected	15,837	-6,044	53,965	82,530**	113,763**	216,181**	173,677**	110,198*	87,096
	[12,529]	[13,759]	[34,687]	[41,323]	[54,006]	[86,326]	[81,145]	[65,372]	[58,139]
Robust	15,837	-6,044	53,965	82,530	113,763	216,181**	173,677*	110,198	87,096
	[17,640]	[17,434]	[49,786]	[56,638]	[71,802]	[107,247]	[103,780]	[85,300]	[75,475]
Bandwidth	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500
N_Banked	55	54	53	37	55	46	51	54	53
N_UBanked	83	83	83	52	72	54	68	69	63
DepMean	44580	38189	64526	115579	97665	132027	111801	108616	115830

Standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Wheat Yield

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
VARIABLES	2002	2003	2004	2005	2006	2007	2008	2009	2010
Conventional	0.125	0.124	0.0764	0.173	0.479	0.431	0.459*	0.402	0.313
	[0.143]	[0.167]	[0.166]	[0.158]	[0.426]	[0.291]	[0.240]	[0.260]	[0.216]
Bias-corrected	0.149	0.116	0.126	0.221	0.643	0.546*	0.629***	0.542**	0.369*
	[0.143]	[0.167]	[0.166]	[0.158]	[0.426]	[0.291]	[0.240]	[0.260]	[0.216]
Robust	0.149	0.116	0.126	0.221	0.643	0.546	0.629**	0.542*	0.369
	[0.161]	[0.193]	[0.204]	[0.188]	[0.541]	[0.355]	[0.290]	[0.322]	[0.263]
Bandwidth	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500
N_Banked	58	57	58	59	53	49	55	53	49
N_UBanked	93	88	88	92	88	64	80	87	69
DepMean	2.001	1.944	2.070	1.921	1.969	2.211	2.172	2.212	2.207

Standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Wheat Output (Tonnes)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
VARIABLES	2002	2003	2004	2005	2006	2007	2008	2009	2010
Conventional	13,076	2,897	4,849	6,177	63,023	15,449	49,503	26,082	-10,164
	[11,915]	[10,099]	[18,090]	[20,159]	[56,729]	[30,231]	[39,057]	[36,240]	[27,953]
Bias-corrected	14,898	-1,283	5,066	4,761	79,457	12,576	52,895	27,974	-17,642
	[11,915]	[10,099]	[18,090]	[20,159]	[56,729]	[30,231]	[39,057]	[36,240]	[27,953]
Robust	14,898	-1,283	5,066	4,761	79,457	12,576	52,895	27,974	-17,642
	[14,158]	[12,315]	[21,197]	[22,151]	[73,073]	[36,954]	[46,181]	[46,379]	[35,750]
Bandwidth	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500
N_Banked	58	57	58	59	53	49	55	53	49
N_UBanked	93	88	88	92	88	64	80	87	69
DepMean	161445	146242	162996	151854	158668	196304	191220	204942	194492

Standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Note: Cotton output measured in bales rather than tonnes. Estimated using local linear regressions with controls for district population and its square, and the pre-randomization 2001 value of the dependent variable. Bandwidths are set 3.5 thousand persons per branch and estimated using a triangular kernel.

Table 11: RD Results: Crop Yield Index

Reduced Form Separately for Each Year

VARIABLES	(1) 2003	(2) 2004	(3) 2005	(4) 2006	(5) 2007	(6) 2008
Conventional	0.0113	-0.114	0.120	0.380	0.187	0.284*
	[0.101]	[0.146]	[0.132]	[0.268]	[0.157]	[0.170]
Bias-corrected	-0.00324	-0.123	0.117	0.492*	0.226	0.337**
	[0.101]	[0.146]	[0.132]	[0.268]	[0.157]	[0.170]
Robust	-0.00324	-0.123	0.117	0.492	0.226	0.337
	[0.120]	[0.173]	[0.155]	[0.358]	[0.198]	[0.213]
Bandwidth	3.500	3.500	3.500	3.500	3.500	3.500
N_Banked	47	44	38	47	44	45
N_UBanked	74	72	67	74	60	72
DepMean	-0.115	-0.0303	0.0340	0.0133	-0.0710	-0.0449

Standard errors in brackets

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

Fuzzy RD Instrumenting for Private Bank Credit Accounts, Pre-reform and Post-Reform

VARIABLES	(1) preref	(2) postref
Conventional	-0.0786	0.0290*
	[0.214]	[0.0154]
Bias-corrected	-0.109	0.0362**
	[0.214]	[0.0154]
Robust	-0.109	0.0362*
	[0.247]	[0.0193]
Bandwidth	3.500	3.500
N_Banked	91	174
N_UBanked	146	273
DepMean	-0.0731	-0.0168

Standard errors in brackets

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

Note: Index of crop yield using weighted averages of the crops rice, wheat, jowar and groundnut. Weighted by crop revenue share. Estimated using local linear regressions with controls for district average rainfall percentage deviation from the mean, district population and its mean and the pre-randomization 2002 value of the dependent variable. Bandwidths are set at 3.5 thousand persons per branch and estimated using a triangular kernel. Pre-reform years are considered 2003-2004 and post-reform is 2005-2008.

Table 12: Fuzzy RD: Percentage Change in Private Credit Amount to Manufacturing and Processing from 2001 Level

VARIABLES	(1) 2002	(2) 2003	(3) 2004	(4) 2005	(5) 2006	(6) 2007	(7) 2008	(8) 2009	(9) 2010	(10) 2011
Conventional	-0.141	0.0501	0.0285	-0.367	-0.756	-0.114	0.543	0.985	1.402**	0.913
	[0.528]	[0.614]	[0.533]	[0.488]	[0.624]	[0.590]	[0.631]	[0.610]	[0.655]	[0.686]
Bias-corrected	-0.151	0.139	0.0544	-0.328	-0.860	-0.232	0.703	1.395**	1.824***	1.214*
	[0.528]	[0.614]	[0.533]	[0.488]	[0.624]	[0.590]	[0.631]	[0.610]	[0.655]	[0.686]
Robust	-0.151	0.139	0.0544	-0.328	-0.860	-0.232	0.703	1.395*	1.824**	1.214
	[0.640]	[0.752]	[0.657]	[0.614]	[0.766]	[0.706]	[0.758]	[0.740]	[0.794]	[0.825]
Bandwidth	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500
N_Banked	95	94	94	94	94	94	94	94	94	94
N_UBanked	122	122	121	122	122	122	122	122	122	122
DepMean	0.934	1.098	0.678	0.763	0.553	0.694	1.117	1.231	1.287	1.410

Standard errors in brackets

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

Note: Percentage change is approximated using difference in logs relative the value reported in 2001. Estimated using local linear regressions with controls for district population and its square. Bandwidths are set 3.5 thousand persons per branch and estimated using a triangular kernel.

Table 13: Diff n Diff: States Selected around Under Banked Threshold, 1999-2010

VARIABLES	(1) Ln_Net_Assets	(2) Ln_Working_Capital	(3) Ln_Loans	(4) Ln_Tot_Investment	(5) Cap_Labor_Ratio
TreatXPost2006	0.171	0.264*	0.235*	0.197*	3.426*
	[0.142]	[0.136]	[0.116]	[0.106]	[1.724]
Observations	118,236	101,566	95,269	113,296	118,128
R-squared	0.270	0.195	0.082	0.200	0.012
State FEs	Yes	Yes	Yes	Yes	Yes
State Trend	Yes	Yes	Yes	Yes	Yes

Robust standard errors in brackets

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

Standard Errors Clustered at State level

Note: Banked States include Haryana, Uttarakhand, Punjab, Mizoram, Daman and Dimiu, Karnataka and Puducherry. Under Banked States include Rajasthan, Tripura, Jharkhand, Orissa and Dadra and Nagar Haveli. All regressions control for post 2006 and treated state individual effects, logged number of units in firm and the logged number of employees in the enterprise, plant age and its square, a year trend, state specific year trends and state fixed effects.

Table 14: Difference in Log Mean District Light from 2004

Discontinuity from Reduced Form Estimated Annually

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	2005	2006	2007	2008	2009	2010	2011
Conventional	-0.0258	0.00485	0.0942***	0.0916***	0.0346	0.0972	0.0810*
	[0.0193]	[0.0272]	[0.0297]	[0.0322]	[0.0707]	[0.0605]	[0.0492]
Bias-corrected	-0.0297	0.00720	0.108***	0.104***	0.0426	0.119**	0.105**
	[0.0193]	[0.0272]	[0.0297]	[0.0322]	[0.0707]	[0.0605]	[0.0492]
Robust	-0.0297	0.00720	0.108***	0.104***	0.0426	0.119*	0.105**
	[0.0210]	[0.0300]	[0.0319]	[0.0353]	[0.0773]	[0.0663]	[0.0531]
Bandwidth	3.500	3.500	3.500	3.500	3.500	3.500	3.500
N_Banked	94	94	94	94	94	94	94
N_UBanked	122	122	122	122	122	122	122
DepMean	-0.139	-0.0808	0.114	0.0722	0.0259	0.355	0.219

Standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Fuzzy RD Instrumenting for Private Bank Branches, Pre-reform and Post-Reform

	(1)	(2)
VARIABLES	preref	postref
Conventional	-0.0156	0.00482
	[0.100]	[0.00413]
Bias-corrected	-0.0111	0.0119***
	[0.100]	[0.00413]
Robust	-0.0111	0.0119**
	[0.117]	[0.00491]
Bandwidth	3.500	3.500
N_Banked	94	658
N_UBanked	122	854
DepMean	-0.139	0.143

Standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Note: Reduced form estimated using local quadratic regressions with controls for district population and its square. Bandwidths are set to 3.5 thousand persons per branch and estimated using a triangular kernel. The fuzzy regression discontinuity is estimated using local linear regressions. The number of operating private bank branches is instrumented with predicted under banked assignment. Controls include district population and its square. Pre-reform year is 2005 using 2004 as the base year for the approximate percentage change. Post-reform years are 2006-2012.

Table 15: NREGA Discontinuity in District Phase Assignment

	(1)	(2)	(3)
VARIABLES	Phase_1	Phase_2	Phase_3
Conventional	-0.0648	0.0145	0.0503
	[0.119]	[0.0909]	[0.135]
Bias-Corrected	-0.121	0.0710	0.0497
	[0.119]	[0.0909]	[0.135]
Robust	-0.121	0.0710	0.0497
	[0.139]	[0.109]	[0.160]
Bandwidth	3.500	3.500	3.500
N_Banked	93	93	93
N_UBanked	121	121	121
DepMean	0.285	0.201	0.514

Standard errors in brackets
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Note: Reduced form estimated using local quadratic regressions with controls for district population and its square. Bandwidths are set to 3.5 thousand persons per branch and estimated using a triangular kernel. NREGA was rolled out in 3 phases between 2006 and 2009 based on some measure of expected program need by district.

10 Data Appendix

10.1 Districts

The majority of analysis in this paper is conducted at the administrative district level in India. Districts constitute the administrative level directly below the state government (and union territory). Data sets at the district level rarely provide numerical identifiers. When available, these identifiers typically do not easily map to other data sets. Further, the anglicized spelling of district names is often inconsistent across and even within data sets. Renaming and redistricting also occur relatively frequently in India. As such, each data set required the assignment of a numerical identifier before conducting analysis. To ensure consistent measures in the data across time, I adjust all data to their 2001 district boundaries from the Population Census. I first assign each district its 2001 state and district numerical codes from the 2001 Population Census, or an auxiliary district code if the district was formed post 2001. Then using the atlas provided in the 2011 Population Census, I map new districts back to their source districts in 2001. Although super-districts, created when newly formed districts drew land from more than one source district, are identified, they are dropped from the analysis.[20] District websites, newspapers and other internet based resources were used to help map alternative spellings to numerical codes.

10.2 Banking

Branches and Licenses Data on the number of operating branches and licenses are from the Master Office File (MOF) accessed from the RBI website in spring 2012. Opening and closing dates (when applicable) are provided for each bank, as well as information regarding branch location and type of business conducted at the branch (e.g. General Banking, Specialized Banking, ATM). "Brick and mortar" branches are used in the analysis, meaning branches

[20]New districts since 2001 that claimed territory from more than one source district are dropped along with the source districts due to issues with the aggregation. In addition, Thane and Pune districts in Maharashtra are dropped. These districts are located close to Mumbai but are not technically classified as belonging to the greater Mumbai area. They constitute outliers as they achieve rapid growth more likely to be attributable to their proximity to Mumbai. Thane is on the under banked list while Pune is not, though the RBI amended the policy to 2008 to make centers within 100km of Mumbai ineligible for under banked status, effectively removing Thane's status. Varanasi district in Uttar Pradesh is also dropped after 2002 due to the 2002 merger of the private sector Banaras State Bank with Bank of Baroda which is a nationalised bank. Banaras State Bank primarily operated in Uttar Pradesh with the bulk of its branches in districts designated as under banked. However, 20 branches operated in Varanasi which happens to be located right at the cutoff on the banked side. The vast majority of branches affected by the merger belonged to districts designated as under banked. However, the reclassification of 20 branches to public sector bank status just on the banked side of the cutoff results in a sudden drop in the banked intercept in 2003 for private banks. Since most of these branches continued to operate under the public sector, the drop-off creates an exaggerated representation of the policy effect, which does not accurately represent the change to the banking environment. While these branches could be "added back" using the detailed data from the MOF, the same cannot be done for the aggregated data on credit.

classified at being general banking or specialized banking. Not Administratively Independent Offices such as extension counters and ATMs are excluded from analysis. The number of operating branches for each year is calculated as the number of branches with an opening date prior to January 1st of that year and a closing date afterward or missing. Operating branches by subsets of bank group classification are calculated similarly. Licenses are considered to be operating if issued before January 1st of a given year with a branch close date afterward or missing. Thus, licenses can be in "operation" even if branch opening occurs at a later date. After the December 2009 reform granting blanket permissions to open in low population centers, the incidence of unreported license dates for branches in such centers increased. The assumption is made that these constitute branches exercising the blanket permission, such that the effective license date is taken to be the date of branch opening.[21]

Constructing the forcing variable In constructing the forcing variable and national average I follow the APPBO procedure [22] described for identifying deficit districts during the policies of the 1980s and also that for identifying under banked states in the RBI Report of the Group to Review Branch Authorisation Policy (RBI, 2009). I take the number of operating branches on September 7th, 2005, the day prior to the 2005 Master Circular issue date that implemented the branching policy reform. Following the rule that Under Banked Status = 1(district population per branch ¿ national average) yields nearly an exact match to the official 2006 list of under banked districts in the 2006 master circular.[23] Out of 572 districts only 6 fail to match their official status. Due to redistricting and the level of aggregation of credit and deposits data, I aggregate all districts bifurcating since 2001 back to their 2001 boundaries. In cases that new districts form from two or more source districts, these are aggregated into a single super district, resulting in 572 districts. Of these, I denote 202 districts as banked (with 204 on the official list) and 370 under banked (368 officially). After dropping super districts from the sample, 4 misassigned districts remain. Replicating the analysis taking the number of operating branches on January 1st, 2006 yields similar results.

[21] A similar pattern for license dates from branches in urban centers in the Northeast region that had a special exception for blanket permissions for urban centers, and only in that region, provides additional support for this assumption.

[22] The Average Population Per Bank Office was constructed using the district population from the most recent population census, in this case that from 2001, and dividing that by the number of bank offices in that district. I restrict the set of offices to those conducting general and specialized bank business which may depart from the actual algorithm used by the RBI. The national average to which the value is compared is the total population of India divided by the number of bank offices.

[23] A list of under banked districts was issued with the 2005 master circular. A slightly revised list was reissued with the 2006 master circular and remained unchanged through 2009, after which the districts of some states were dropped. The national average computed using September 7th, 2005 as the policy date was 14,915 persons per branch in India.

Credit The Basic Statistical Returns 1 (BSR1) provides information on credit accounts, credit limits and credit outstanding by scheduled commercial banks including RRBs (last accessed spring 2014). The data are reported annually by banks with values as of March 31st for that year. Credit captured by BSR1 relates to gross bank credit such as term loans, cash credit, overdrafts, etc. Detailed descriptions are provided by the RBI. The financial year 200X-200Y is reported as 200Y in the paper and is reported with consistent notation across analyzed data. Values are delineated by bank group and population group at the district level (e.g. number of credit accounts with Nationalised Banks, by semi-urban areas in Rangareddy). Locations, such as semi-urban Rangareddy, represent the area of credit utilization for loans exceeding 2 lakh Rs. for which detailed account information is collected. Loans of lesser amounts are reported with less information, and the RBI assumes they are utilized in the same area as which the loan was sanctioned. Credit amounts are further delineated by utilization purpose, coined "occupation," and include : agriculture, industry, professional and other services, personal, trade, transport operators, finance and all other. These are broken down further for agriculture into "direct" and "indirect," for industry by "construction" "mining" "manufacturing and processing" and "electricity, gas and water" and trade by "retail" and "wholesale." Personal loans are also presented disaggregated, but the delineation between subgroups appears to be inconsistent through time so are always treated as aggregated personal loans in the analysis. A reclassification of loans to make occupations consistent with a 2004 update of industrial codes occurred in 2008. The reclassification should not have affected aggregate measures of account and amounts, though caution should be taken when attempting to draw comparisons at the occupation level before and after 2008.[24]

The BSR2 provides analogous information for deposits and is structured similarly (last accessed spring 2014). Values are reported for the number of deposit accounts and deposit amounts.

The BSR7 provides quarterly data on credit, deposits and reporting branches. Analysis on BSR7 is not included in this paper.

All credit and deposit limits and amounts are adjusted using the Consumer Price Index for Industrial Workers provided by India's Labour Bureau. I adjust all values to 2011, fourth quarter prices. Amounts are reported in Rupees.

Population Groups The RBI follows a specific assignment procedure for population groups. Based on the Population Census, locations with populations less than ten thousand are desig-

[24]Two districts exhibit measures of credit accounts and amounts that appear to reflect coding errors in the data. Mallapuram, Kerala is dropped in 2004 due to an unexplainable jump in the magnitude of credit unmatched in the district in any other years. Ghaziabad, Gujarat in 2008 displays even more erratic values for certain credit measures. These values are set to missing as the remaining appear unaffected. In both instances, private sector banks with a presence in the concerned district were acquired by the public sector. The reclassification of the bank to the public sector may have created underlying issues in the data reported in those places for those years.

nated rural, 10,000 - 100,000 semi-urban, 100,000 - 1 million urban and greater than 1 million metropolitan. Prior to 2005 locations were assigned status based on their 1991 Population Census values. The switch to the 2001 Population Census for reports in 2006 and later make strict comparisons between the sets of years complicated at the disaggregated population group level. The problem appears to be greater for the metropolitan and urban population groups, as fewer centers exist in these categories. The scope for problems appears smaller for rural and semi-urban classifications due to the high volume of centers in these categories. Still, the caveat should be kept in mind for analysis at the disaggregated level.

10.3 Agriculture

Crop output and area The data on crop output and area are reported in the Annual Crop Yields at District Level from the Crop Production Statistics. The production output in tonnes and area cultivated in square hectares are reported by crop at the district level either annually or by season, depending on the crop and state. Reported crops vary across districts, and the detail of information on variety and growing season also varies across states and years. I develop the data from a file made available from the Government of India for years 1998-1999 to 2010-2011 (years reported July-June). Extensive cleaning of district and crop names, as well as accounting for redistricting, is required to analyze the data as a panel. I match each district reported to their 2001 Population Census identification number or to a 2011 ID number constructed for this analysis when dealing with new districts since 2001. Analysis is restricted to years 2001-2010 which exhibit lower frequencies of missing data. Missings values after 2010 are reported to be due to unfiled state reports. Districts never reporting positive statistics for a crop over the sample period are dropped from analysis for that individual crop. In years a district reports a missing value for a crop that is reported in that district in other years, the value is interpreted as null and replaced with a zero value.

Crop prices The data on crop prices are from the Farm Harvest Prices of Principle Crops. States are responsible for reporting crop prices for a set of prominent crops each year. The prices are supposed to be collected during the peak harvest times of each crop and account for variations in quality. States vary in their reporting of crop prices by season and detail on variety. Further, states vary in reporting price for some crops by product (e.g. some report prices for sugarcane while others only report prices for raw sugar, cotton lint or whole cotton, etc.) Technical conversion factors for raw crops to agricultural outputs provided by the Statistic Division of the FAO are used where applicable to match prices to corresponding crop outputs. Prices are reported in Rupees per Quintal (an Indian quintal is 100 kg) and must be converted to Rupees per tonne for consistent units with the output data. I have developed the data from pdf reports available in separate sets by state for 2001-2002 to 2003-2004, 2004-

2005, 2005-2006, and 2006-2007 to 2007-2008. Efforts to process the remaining years of the data are under way. Extensive cleaning of district names, accounting for redistricting, and assignment to identification numbers was similarly required.

Crop yield index Annual crop yield is calculated as crop output in tonnes per hectare cultivated for that crop. To create the index of crop yields as in Jayachandran (2006), I match the crop prices data to the crop output and area data. Four of the top five revenue producing crops for India identified in Jayachandran (2006) are used in the index, rice, wheat, jowar and groundnut. Sugar is excluded due to concerns regarding the accuracy of conversions of sugarcane to raw sugar production in order to match the two data sets, and whether the reported prices for sugar capture actual prices faced by farmers after accounting for delay of payments bargaining. Crop yields are normalized to have mean values equal to one in each year for comparability across crops. Weighted averages of the log values of the four crop yields are taken for each district year, using the crop revenue share of the total crop revenue of the district from those four crops as weights. When matching the price and production data sets, season and variety matches are made when the detail of data from both sets allow. Otherwise, the mean of price data by district and crop are calculated (if price is broken out by variety or season) and matched to the production data for that crop-year. To increase the number of matches, when prices are missing for a crop at the district level, the weighted state average prices provided in the reports are used. Missing crop prices at the district level generally correspond to relatively low levels of output in the production data. The index is currently constructed for 2002-2008, with efforts to process the remaining years of data under way.

10.4 Industry

Annual Survey of Industries The Annual Survey of Industries (ASI) is a detailed survey of registered manufacturing firms in India conducted by the Central Statistical Organisation. The ASI is used extensively in economic research (Hsieh and Klenow, 2009; Bollard et al., 2013) to name just a few). I use fiscal years 2001-2010 in my analysis. In these years, all firms with greater than 100 workers were enumerated, as were all firms operating in the five less developed states/UTs (Manipur, Meghalaya, Nagaland, Tripura and Andaman & Nicobar Islands). The remainder of registered firms (those with greater than 10 workers, assuming compliance) were surveyed from samples representative at the State by NIC-2004 4 digit industry code. In addition to the values reported directly in the ASI, I construct the capital labor ratio as the average of the opening and closing values of assets net of depreciation divided by the sum of the firm's wage bill plus benefits, as in Hsieh and Klenow (2009). Due to the joint census-sampling methodology, I conduct my analysis at the state level in order to apply proper weighting for a representative sample of all registered firms. A thorough discussion of the ASI data can be found in Bollard et al. (2013).

10.5 Remote Sensing

DMSP-OLS Nightlights The Defense Meteorological Satellite Program (DMSP) maintains data sets with of night lights data, constituting a yearly average of the amount of light emitted into space at night for a roughly 1km square grid. Using satellite images, algorithms to control for reflection, cloud cover and other confounding factors assign a digital number between 0 and 63 for each cell that may be downloaded as a finely pixelated map of the Earth. Using the boundary outline of India's administrative districts in 2001, I construct the district average of the digital numbers in each district. I then calculate the percentage change of this average as the log of the district mean value minus the log district mean from 2004. Analyzing changes in growth across districts, as opposed to levels is important due to measurement error introduced through machine learning and the algorithms applied to eliminate glare light bleed. I have processed data from satellites F16 and F18, that cover calendar years 2004-2012. Efforts are under way to process the data from F15 that would extend the data set back to year 2000. A thorough discussion of the nightlights data is included in Henderson et al (2012).

TRMM Rainfall Data Rainfall strongly affects agricultural productivity. To the extent that rainfall varies annually across districts, conditioning on it will improve my precision for estimates related to agriculture. I use the publicly available data collected by the Tropical Rainfall Measuring Mission (TRMM) satellite jointly maintained by the National Aeronautics and Space Administration (NASA) and the Japan Aerospace and Exploration Agency (JAXA). Fetzer (2014) gives a detailed description of these data and their verification processes. These data are collected from a satellite orbiting approximately 250 miles above the Earth's surface that completes an orbit several times a day and is able to detect rainfall falling as lightly as 0.7 millimeters per hour. Daily rainfall measures are available from 1998-2012 on a 0.25 by 0.25 degree grid, making it the finest available spatial resolution for India to the best of my knowledge.

These data are likely favorable to those generated using ground rainfall gauges as the latter require local monitoring and maintenance, the quality of which may vary systematically with the prosperity of districts. Further, the spatial diffusion of gauges is not uniform across India, requiring different levels of interpolation between rain gauges that can introduce measurement error that may be difficult to account for and change in less transparent ways as the number and location of gauges vary across time.

11 Theoretical Framework Appendix

This section sketches out the theoretical framework for anticipated competition in the second period leading to increased levels of credit at the time of policy announcement in the first. Details of intermediate steps are omitted in the interest of space. The participation constraint for borrower i in each period is given by,

$$\begin{cases} E[\pi_i^1] = P_s(R_s^A)[R_s^A(1-\theta_i) - (1+r^1)] - s > \mu & \textit{Period}\,1 \\ E[\pi_i^2] = \{P_s(R_s^A)[R_s^A(1-\theta_i) - (1+r^2)] - s1(First\,Time\,Borrower) > \mu & \textit{Period}\,2 \end{cases} \tag{3}$$

where $\theta_i \sim uniform[0,1]$ is a privately known cost to the borrower that is constant across periods (as is being a safe type), r^t denotes the interest rate in period 1 or 2, and $1(First\,Time\,Borrower)$ is the indicator function for the borrower's first period of borrowing from the specific bank. Consider the borrower participation constraint from period t. The indifferent borrower with type θ_i facing interest rate r^t will satisfy

$$P_s(R_s^A)R_s^A(1-\theta_i) = P_s(R_s^A)(1+r^t)] + s1(First\,Time\,Borrower) + \mu \tag{4}$$

Rearranging terms, the indifferent borrower may be expressed as a function of the interest rate r^t,

$$\hat{\theta}_i(r^t) = 1 - \frac{P_s(R_s^A)(1+r^t) + s1(First\,Time\,Borrower) + \mu}{P_s(R_s^A)R_s^A} \tag{5}$$

such that all borrowers with $\theta_i < \hat{\theta}_i(r^t)$ will demand a loan with interest rate r^t. For a market of size M, total demand for loans at interest rate r^t will be $M\beta\hat{\theta}_i(r^t)$.

Assume banks are profit maximizers, face an exogenous marginal cost of funds plus administrative costs of lending equal to $(1+\rho)$, and cannot discriminate in the interest rate offered to repeat and first time borrowers. The bank's participation constraint from each period is,

$$E[\pi_B^t] = P_s(R_s^A)(1+r^t)\theta(r^t) > (1+\rho)\theta(r^t) \quad for\,t = 1,2 \tag{6}$$

In deciding the interest rate for each period, the incumbent bank will anticipate its outcome in the second period if facing entry and take that into consideration in setting its first period interest rate. Specifically, if a new bank enters the market in the second period, the incumbent will expect to compete in interest rates such that the entrant must offer his zero-profit condition interest rate and the incumbent will offer the interest rate making his first period borrowers that do not pay the screening fee if they stay indifferent between borrowing from him and the incumbent.

Sketch of Proof: *If the incumbent offers an interest rate higher than that making first period borrowers indifferent between borrowing from the incumbent while avoiding switching costs and borrowing from the entrant while incurring the switching costs, then the incumbent loses the entire market to the entrant. If the incumbent offered an interest rate lower than that value, then he loses profits from the locked in first period borrowers but gains no new borrowers since new borrowers must pay the screening fee regardless and the entrant's interest rate is strictly lower. If instead the entrant offered a price above the zero profit condition interest rate, then the incumbent would increase his rate to earn higher profits off of his first period borrowers. This, however, creates incentive for the entrant to lower his interest rate a small amount and capture the entire market. If the entrant instead lowers his interest rate he will serve the entire market at a loss.*

Taking the second period equilibrium into consideration, the incumbent knows his second period interest rate when facing entry will be $1 + r_2^I = \frac{1+\rho+s}{P_s(R_s^A)}$ by equating demand for the zero profit interest rate and demand for an interest rate when the switching cost need not be incurred. The incumbent will then maximize first period interest taking the second period predetermined interest rate into consideration as the first period interest rate will determine the demand faced in both periods. Thus, the incumbent's maximization problem is

$$\max_{r_1^I, r_2^I} P_s(R_s^A)(1 + r_1^I)\theta(r_1^I) + \delta P_s(R_s^A)(1 + r_2^I)\theta(r_2^I) - [(1 + \rho)\theta(r_1^I) + \delta(1 + \rho)\theta(r_2^I)] \tag{7}$$

Substituting in the value for r_2^I and setting demand equal in both periods reduces the problem to

$$\max_{r_1^I} P_s(R_s^A)(1 + r_1^I)\theta(r_1^I) + \delta P_s(R_s^A)\left(\frac{1 + \rho + s}{P_s(R_s^A)}\right)\theta(r_1^I) - (1 + \delta)(1 + \rho)\theta(r_1^I) \tag{8}$$

Taking the first order condition with respect to r_1^I, setting it equal to zero and solving for the optimal first period interest rate for the incumbent yields,

$$1 + r_1^{I*Entry} = \frac{1}{2P_s(R_s^A)}\{P_s(R_s^A)R_s^A - (1 + \delta)s - \mu + (1 + \rho)\} \tag{9}$$

Intuitively, the incumbent increases the interest rate with the expected payoff of the project to capture additional surplus as well as the cost of lending the funds and lowers the interest rate with the borrower's reservation utility. The incumbent lowers the interest rate as the switching cost increases, as this relaxes the constraint on the interest rate he offers in the second period, allowing for higher profits from each continuing first period borrower.

To determine the effect of anticipated competition on first period lending, consider an incumbent that does not expect entry in the second period. He will find it optimal to set interest rates so as to maximize total profit from both periods, increasing the interest rate in the second period to extract the additional surplus from the repeat borrowers no longer paying the screening cost. Since no other changes occur to the environment, the incumbent will maximize profits by serving the same set of borrowers in both periods, setting the second period interest rate so as to make the marginal borrower indifferent between accepting the loan and not. The maximization for the incumbent not expecting entry may be expressed as,

$$\max_{r_1^I} P_s(R_s^A)(1+r_1^I)\theta(r_1^I) + \delta P_s(R_s^A)(1+r_1^I+s)\theta(r_1^I) - (1+\delta)(1+\rho)\theta(r_1^I) \tag{10}$$

Taking the first order condition with respect to r_1^I, setting it equal to zero and solving for the optimal first period interest rate for the incumbent yields,

$$1+r_1^{I*NoEntry} = \frac{1}{2P_s(R_s^A)}\{P_s(R_s^A)R_s^A - (1+\frac{\delta P(R_s^A)}{(1+\delta)})s - \mu + (1+\rho)\} \tag{11}$$

Finally, since the interest rate determines the first period quantity of credit, anticipated competition will lead to an expansion of credit if $1+r_1^{I*Entry} < 1+r_1^{I*NoEntry}$. This inequality reduces to the simple expression, $\frac{P_s(R_s^A)}{1+\delta} < 1$ that must always be true. Hence, introducing the potential of future competition leads to an expansion of credit at the time announcement.