The Effect of Formal Banking on Agricultural and Industrial Growth: Dynamic Evidence from a Regression Discontinuity Analysis in India

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Abstract

This paper addresses how real economic growth can be affected by policy driven formal banking expansion. Burgess and Pande (2005) estimated large reductions of poverty in India following the pattern of bank branch expansion under Social Banking. Utilizing a previously unstudied reform to branching policy in India, I use a regression discontinuity design at the geographically fine district level to identify the exogenous expansion of banking services due to the reform, demonstrating a cumulative effect of the policy from 2005 to 2011 on private credit to agriculture, manufacturing and personal loans. Accounting for the incentives generated by the reform and the unique banking environment, I address how the reform delivered results despite concerns raised over policy driven expansion in other work. Importantly, I conclude that the expanded banking services led to significant effects in agriculture and manufacturing. Specifically, I find a positive effect on productivity and output for major Indian crops including cotton and wheat, and for an index of crop yields for important revenue crops. From manufacturing, I find 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 growth by analyzing the amount of light emitted into space at night measured through remote sensing as a proxy for economic growth. Areas with expanding banking services experienced higher rates of growth in the years following the reform.

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1 Introduction

Access to credit offers many potential benefits. Credit facilitates consumption smoothing, allows a farmer or entrepreneur to invest in better inputs to increase the returns to their endeavors, and may otherwise contribute to the escape of poverty for the poor. Similarly, savings instruments can help individuals acquire assets that require greater lumps of funds than they may otherwise be able to accrue and meet their financial obligations. At the aggregate level, a properly functioning financial sector is expected to contribute to higher growth rates. However, many individuals lack access to credit due to information asymmetries and the high costs associated with managing loans for small and often low returning projects pursued by poor individuals. In communities lacking formal banking services, money lenders and family sometimes fill this gap but at high interest rates on loans and low returns on savings.

While increasing the reach of accessible credit and savings instruments to the under served portions of society may be a worthy goal, the mechanics of achieving that remain elusive. For the reasons mentioned above, the market is unlikely to address the gap on its own. Microfinance may still play an important role in delivering credit to individuals traditionally excluded by formal banking, though recent controversy and studies showing lower long term effects than expected suggest alternative methods deserve consideration. Governments have previously pursued expanding financial access through subsidizing government owned banks, regulating the expansion patterns of bank branching and setting lending quotas by economic and demographic sectors. The effectiveness of such interventions in delivering financial services and encouraging growth has been contested. The controversy behind such supply side interventions continues partially due to the difficulty of cleanly evaluating the effect of banking on economic outcomes.

Identifying the effect of banking on specific economic channels of growth is difficult because banks tend to concentrate in profitable areas that are also likely to experience higher economic growth and poverty alleviation. 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.

In this paper I address empirically how real effects in agriculture and industrial activities can be facilitated through policy driven bank branch expansion. Utilizing a previously unstudied policy reform to branching policy in India, I identify the exogenous expansion of banking services confirming that policy driven branch openings do generate additional local bank business and do not sit idle. However, there are no guarantees that such credit would be lent out efficiently or in ways that lead to growth. If the additional credit indeed spurs growth, then one should expect to find observable effects in two of India's fundamental industrial sectors, agriculture and manufacturing. Importantly, I conclude that the expanded banking services led to observable changes in agricultural output and productivity across a variety of major crops and considering an index of yields from financially important crops in India. I also find that manufacturing plants 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 growth by analyzing the amount of light emitted into space at night measured through remote sensing as a proxy for economic growth and show areas with expanding banking services experienced higher rates of growth following the reform.

I overcome the endogeneity concern by exploiting the details in the 2005 policy reform of bank branch licensing regulation dictating which districts offered additional incentives to banks opening branches within their borders. The reform generated an arbitrary cutoff leading to districts on one side to receive a higher probability of branch openings and not the other. Using a regression discontinuity (RD) design, I trace the effect of the reform on banking and economic outcome measures, showing no discontinuity prior to the reform, then a growing discontinuity over the post-reform years. The combination of the timing of effects around the reform, and separately establishing that districts do not systematically differ in their baseline traits, such as population and rainfall, near the threshold for the RD, allows for the clean identification of the effect banking outcomes exert on economic activity. I draw on several data sources to establish bank branch, credit and deposit outcomes annually at the district level. I am able to further disaggregate credit by bank group, population group and industrial sector as discussed in greater detail in the Data section of this paper. The banking analysis primarily focuses on the response by the private sector. Though smaller than the public sector, private bank branches contribute a non-trivial share of the overall discontinuity in operating branches at the threshold and shows strong corresponding responses in credit and deposit behavior. District level data on crop production and area cultivated are taken from the collection of State Reports to the Ministry of Agriculture. Rainfall and "nightlights" data are from remote sensing satellites. Finally, manufacturing data are available at the state level in the Annual Survey of Industries (ASI). 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, and perform a difference in differences analysis to estimate the effect on manufacturing. While not as ideal as the RD analysis, this methodology captures the spirit of the RD in many ways and uses the ASI at the level for which the sample was constructed.

1.1 Related Literature

There exists a long literature on the effect of financial institutions and their structure on economic growth. Jayaratne and Strahan (1996) show the deregulation of bank branching in the United States led to greater economic growth which they attribute to higher quality bank lending. Rajan and Zingales (1998) find evidence that stronger financial systems generate faster growth in industries that rely heavily on external financing leading to overall accelerated economic growth. Theoretical arguments for the impact of credit access on poverty alleviation and faster economic development are made in Banerjee and Newman (1993) in which credit effects occupation choice. In this paper, I propose that credit access can lead to different adoptions in technology, such as the use of higher quality agricultural inputs, new crop selection or higher rates of capital. Early empirical papers examining micro data on savings instruments and local credit markets show savings and credit, often through informal instruments such as investments in bullocks (Rosenzweig and Wolpin, 1993) and social networks (Townsend, 1994), are also important for short term welfare gains through consumption smoothing and insuring against risk.

Burgess and Pande (2005) serves as the seminal empirical paper on the effect of formal banking on poverty alleviation. They study an earlier period than this paper, the years following the 1969 nationalization of India's 14 largest private commercial banks through the first few years following the end of the Social Banking period in 1990. During 1977-1990, the RBI required banks to open 4 branches in unbanked areas for each single branch opened in previously banked ones. Recognizing the likely endogeneity between an area's profit potential and inherent ability to reduce poverty, Pande and Burgess exploit trend breaks in geographic branch expansion driven by the policy reforms and show these inversely correlate with measures of poverty. They suggest the policy driven expansion of banking services induced a 14-17% decline in the incidence of poverty, accounting for about 50% of the overall decline of the period studied.

In a 2006 comment, Panagariya notes potential issues with the Pande and Burgess identification strategy. Reviewing the policies governing the expansion of branches and banking in India, Panagariya argues a similar policy tying unbanked openings to banked ones had been in effect as early as 1962, becoming increasingly demanding in terms of unbanked openings up to 1977. The aggregation of the analysis to the state level in Pande and Burgess creates additional concerns. Kochar (2011) points to the Integrated Rural Development Program (IRDP), an important anti-poverty program providing subsidized credit to the poor, that ran parallel to branch expansion with the target populations of both policies being highly correlated. The co-implementation of the two programs at the state level of aggregation could confound the estimated effect of either. Kochar pursues a district level analysis in the state of Uttar Pradesh for years 1983-1993 concentrating on distribution effects between wealthy and poor households and between castes, exploiting differences in the two policies at that level. She finds increases in per capita expenditure for wealthier and land owning households, with minimal effects on poor ones. She also found small effects from priority sector requirements on agriculture. Although my data do not report outcomes for various levels of wealth, by focusing on credit extended in semi-urban areas, I observe suggestive evidence that priority sector regulations do have an important effect on the geographic distribution of loans. Although personal loans and deposits expand in the first years of the reform around the cutoff in semi-urban areas, it is not until a tightening of priority sector regulations in 2008 that agriculture and manufacturing experience similar growth.

The policy implications of Pande and Burgess, the extensiveness of its reference, and the concerns raised by its critique leave the effect of formal banking on economic outcomes open ended and important. The literature highlights the importance of timing and geography in attempting to utilize banking policy reforms to identify an unbiased effect. The analysis in this paper addresses the timing of reforms in a direct and transparent manner by tracing the evolving policy response through time with separate annual estimations, rather than relying on pre- and post-reform comparisons. The analysis also differs from the previous literature by leveraging an entirely distinct and previously unstudied set of reforms beginning in 2005. The expansion and anti-poverty reforms studied from the earlier period were discontinued shortly after 1990 (Burgess and Pande 2005, Kochar 2011). The period 2000-2012 drastically differs from the Social Banking period in several other ways, with the requirements on interest rates, the holding of government securities by banks, and high cash reserve ratios having been deregulated. Perhaps most importantly, the emergence of a new set of private banks, on which I will focus, introduces the opportunity to draw comparisons between the policy response of private and public (government owned) banks.

La Porta, Silanes and Shleifer (2002) show that a higher incidence of government ownership in banking is correlated with slower growth looking across countries. Cole (2009) analyzes the 1980 privatization of 8 commercial banks in India to study the effect of bank ownership on bank behavior and delivery of development oriented policy objectives, finding private banks were generally as responsive as public banks. I will not be able to directly compare the policy response of private and public banks because the two bank types may respond to the policy reform by serving different markets as each pursues differing objective functions. Banerjee and Duflo (2008) provide evidence of credit constraints in India using credit records from a single nationalized bank and a temporary provision of subsidized credit to certain eligible firms between 1998 and 2000. They observe that the firms receiving additional credit do not substitute away from their other forms of financing but instead expand their level of production. In independently developed work, Krishnan, Nandy and Puri (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 manufacturers experiencing the fullest extent of those reforms. Further, they identify the greatest efficiency gains came from the expansion of credit to small, financially constrained firms, following a mixture of regression discontinuity analysis and panel regression methods. In this paper, I similarly find effects on manufacturing and the use of capital in response to the expanding availability of credit. The two papers suggest that empirical findings in development contexts may be generalizable and have important implications for the developing segments of developed economies.

In the next section I describe the important aspects of India's banking system and the policy reforms to the branch licensing policies utilized for analysis. In section (3) I review the regression discontinuity framework and describe how I translate its principles for analyzing the manufacturing sector with difference in differences. In section (4) I describe the data used in analysis. Then in section (5) I first establish a clear response in branching behavior to the policy reforms, then identify corresponding responses in aggregate private sector credit, and break these down to responses by credit to agriculture, industrial activity (and separately for manufacturing) and personal loans. I then show how corresponding effects can be observed in agricultural output and productivity for several crops. The cash crops I analyze increased output and productivity with the increased exposure to banking services, while the food crop, maize, showed no response. I then present the results from the nightlights data as a proxy for overall economic growth and conclude the results section with the analysis on manufacturing. Section (6) 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.[1]

The reform in 2005 changed the regulatory environment in two fundamental ways. First,

[1]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.

the reform effectively tied new branch licenses for highly sought markets to branch entry in markets designated as under banked. Specficially, 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-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 (MC) Branch Authorisation Policy, 2005).[2] 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 Report, 2009; Kochar, 2011), banks under the current reform could choose between under banked districts for entry and also determine the extent 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

[2]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.

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.

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 shares of bank invensements, 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. Among others, 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, reproduced in the left panel of figure LABEL, identifying areas under served 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, and the official list of under banked districts released in 2005 is based on the district average population per branch relative to the national average. 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.[3] After 2010, certain states were made ineligible for under banked status, reducing the number of

[3] 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.

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 5, 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 receive licenses in a disaggregated manor. The historgram of branch license dates for a large private sector bank is shown figure 7.[4] 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 effectivley 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 districts' under banked status. Licenses for branches in high profit potential centers in banked districts were used

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

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.

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. The reforms to the composition of the priority sector studied in Banerjee and Duflo (2008) occurred in 1998 and 2000, prior to my analysis. In 2007, new guidelines were adopted for the priority sector, reducing the set of loan categories eligible for priority status. The reformed guidelines concentrate lending in direct and indirect agricultural endeavors and limit 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 NABARD funds at "punishment" rates. Banks typically come very close to meeting the requirement, overshooting slightly in some years and falling short in others.

3 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. When locations that experience high growth potential are also profitable for banks, attracting more branches and banking activity, simple OLS estimates lead to an overestimation of the effect of banking on outcomes. During periods of regulation, banks are compelled by policy to open branches in poorly served areas that also happen to exhibit slow growth, leading to branches being associated with negative development outcomes.

The unique policy aspects of the 2005 branching reform create an environment facilitating the clear 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 testable assumptions. 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 emplyment activity in India. Then I turn to the effect on 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.

3.1 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 in two steps. 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 3 shows district under banked status from the 2006 list of under banked districts plotted again district population per branch centered on the national average. According to the rule, districts to the right of the cutoff should be assigned to under banked status, as is confirmed in the graph.[5] A map of the districts in India with their corresponding district averages is presented in the right panel of figure (4). Note that 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.

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 in centers 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, though otherwise similar - which will be tested formally - do not offer this benefit. 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 there is a lack of perfect manipulation of the running variable so as to change a district's treatment status, and if the other factors that may affect

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

the outcomes of interest are continuous with respect to district population per branch near the cutoff. I verify both of these stipulations hold below.

Figure (5) presents visual results from the McCrary test for manipulation of the running variable around the threshold (McCrary 2007). 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 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. Even if banks and districts were able to anticipate the criteria for assigning under banked status, their ability to manipulate assignement would be limited. The population level in the current equation was taken in 2001, four years prior to the policy. Thus, districts attempting to influence their status could only do so through altering the number of operating branches within their boundaries, which results from the collection of branching decisions made by all banks and conditional on RBI permissions, making manipulability extremely unlikely.

Figure (6) presents the mean values for baseline characteristics for districts falling within 200 persons per branch 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 emitted some light from a higher percentage of district area. None of these characteristics appear to be discontinuous around the cutoff however, suggesting proper randomization of districts around the cutoff. The continuity is tested formally by performing RD analysis on a full set of baseline characteristic with each as the dependent variable. The tests fail to reject the null hypothesis of continuity at the threshold, with results presented in table 1.

3.1.1 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 Thistlewaite and Campbell (1960). To reduce bias from including observations far away from the cutoff where the identification does not hold, I use local lnear regressions, dropping observations outside a set bandwidth of the cutoff (Fan and Gijbels, 1996; Hahn, et al 2001; Lee and Lemieux, 2010). I restrict all analysis to local linear and local

2nd degree polynomial regressions as recommended in Imbens and Gelman (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 (2012) method.[6] I fix the bandwidth to provide transparency for tracing the evolution of the policy effect across years, as this fixes the set of districts included across regressions.

Specifically, for each year I estimate the local linear regression,

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

using a uniform kernel, where y_i denotes a banking or economic outcome of interest, such as the number of operating bank branches or crop yield, in district i, $D_i = 1[PopPerBranch_i - Cutoff \geq 0]$ 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, 2007; Lee and Lemieux 2010). In addition, I include the 2001 district population per branch in regressions on banking outcomes to further improve precision.

Additionally, I report the results from implementing the regression discontinuity using Calonico, Cattaneo and Titiunik's "rdrobust" program with a triangular kernel, considered the present state of the art. To implement this analysis I "residualize" the data, in which I estimate equation 3.1.1 using residuals obtained from first regressing y_i on the set of controls X_i and dropping the controls from the specification (Lee and Lemieux). Conventional estimates as obtained from equation 3.1.1 are estimated, as are bias-corrected estimates and the robust standard errors from Calonico, Cattaneo and Titiunik (2014).

3.1.2 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 and revelation of information. To clearly demonstrate the timing of the reform effects, I estimate equation (3.1.1) separately from 2001 - 2012 on banking outcomes and the subsequent effects on agriculture and industry. Given that the set of under banked districts remained essentially unchanged from 2005-2010, the short and medium term effects

[6]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).

should clearly emerge.

3.2 Effects observed in Manufacturing

In the final piece of analysis, I look for observable effects of the reform in manufacturing firms. The data on manufacturing are available at the state level, preventing an analysis by regression discontinuity as described above. Instead, I follow a simple 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 using the banked district 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 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-district differences between the districts receiving under banked status and those not. Although this identification strategy is not ideal, the careful selection of the treatment and control districts should help in eliminating potential threats and I will take the estimate as suggestive of the effect from the policy reform on manufacturing.

4 Data

The primary data on banking are from data sets maintained by the RBI. The Master Office File that 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.

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. The time dimension will help with disentangling some effects from changes to bank composition within bank groups in districts, but many interesting questions require data at finer levels than currently available. The analysis in this paper will largely rely on deposit aggregates separated by bank groups.

Similarly, the data on agriculture and manufacturing are available annually at the district and state levels respectively. To conduct the analysis on agriculture, I developed a new data set from separate data available from the Ministry of Agriculture, Directorate of Economics and Statistics. By matching district production levels to data on farm harvest prices by crop, I am able to construct an index of crop yields similar to that in Jayachandran (2011) for 2002 - 2008.

The Annual Survey of Industries provides yearly data on the manufacturing sector available at the state level.

Support data include the Populations Census of India, 2001 and remote sensing data for rainfall and the amount of light emitted at night from the TRMM satellite and DMSP-OLS Nighttime Lights Time Series, respectively. See the Data Appendix for greater detail on all data used in the analysis.

5 Results

The incentives generated by the policy reform suggest two sources of effects from the banking sector. In direct response to the regulations placed on branching following the policy implementation, under banked districts near the cutoff should exhibit higher numbers of operating branches on average than their otherwise similar counterparts from the banked side. In anticipation of increased future entry in under banked districts, banks may choose to strengthen their presence there to secure their market shares in the most profitable areas. This may take the form of expanding branches or increasing the amount of credit to lock in customers prior to entry by competitors. On the other hand, most districts on either side of the cutoff would seem to be less profitable than alternative markets far from the cutoff on the banked side, and thus may not generate much new branch entry before the reform. Due to the timing of the reform discussed in detail in section 3.2, banks could effectively delay opening their intervention driven branches until mid 2007. The question of which effect dominated in branching is empirical and answered below. The effect on credit should be less ambiguous, with incumbents in most districts expanding credit to lock in customers who face switching costs in establishing relationships with new loan officers and moving accounts to other banks.

5.1 Banking

5.1.1 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 shows mean values of operating private bank branches for districts falling within 200 persons per branch bins. The horizontal axis is the forcing variable of district population per district at the bin center, with the national average adjusted to be zero. 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 3.1.1 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.[7] 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 3.1.1. 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.[8] These figures not only present the average treatment effect, but place the level

[7] 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, and Varanasi district in Uttar Pradesh are dropped. See the Data Appendix for details.

[8] Thanks to Johannes Schmieder for help in clearly displaying the dynamic nature of the effect graphically.

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 from 2008 on 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. 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 at that time was amended such that banks could open in lower population centers without a prior license, resulting in licenses for such openings being issued on day of branch entry, despite its 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 accumulative average effect of the policy in 2012 is estimated at roughly 8.39 more private sector branches in under banked districts at the cutoff relative to the banked districts. The effect is a little more than 40% 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.

5.1.2 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. Under one extreme, that

Note that these figures rely on estimation using a uniform kernel.

policy driven opened branches perform no actual banking business beyond mandatory staffing and hours of operation, no discontinuity in credit would be observed around the threshold at any time even with the entry of new branches. Alternatively, if the new private branches create new business or steal market shares from government or foreign sectors, then the discontinuity in credit should mirror that in the branches. As a third potential outcome, if banks anticipate the potential for future intensified competition in districts around the threshold, they may preemptively expand their business there to deter entry or secure their market share.

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 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 5,650 additional credit accounts in the under banked districts at the cutoff, which is 44% of the sample mean for districts around the cutoff. Though the discontinuity in accounts continues to grow over the next few years and is estimated precisely, the slowed growth in 2008 may be explained by the exit of a private bank through acquisition by the public sector in 2007[9]. 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 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, which would make annual district levels fluctuate more than the number of accounts. [10]

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

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

[10]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.

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 its corresponding table 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.

5.2 Agriculture

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. Policy makers placed a major emphasis on agricultural lending in the years leading up to the reform. In this section credit earmarked for agriculture and low population centers is considered, followed by the effect on agricultural outcomes.

5.2.1 Credit

Private credit lent for direct use in agriculture in rural areas shows a positive discontinuity in 2004-2006. The discontinuity emerges again after 2008 when priority sector regulations placed a greater emphasis on direct lending to agriculture.

In considering semi-urban lending to agriculture, the expansion follows that from branches more closely. This would be consistent with private banks opening branches in semi-urban areas more than in rural ones.

Both effects suggest agriculture benefited from the expanded banking services generated by the reform. See tables 8 - 15.

Rainfall As a further test of baseline characteristics I estimate the annual discontinuities for two measures of rainfall at the cutoff. Since rainfall is random and unaffected by the policy reform at the cutoff or anywhere else, this analysis also serves as a falsification test to show that nothing is mechanically producing the estimated discontinuities. Figure (16) presents estimated discontinuities in the averaged percentage deviations of rainfall measures from their mean levels across the points of measure within a district. As anticipated, rainfall does not show significant discontinuities at the cutoff. This suggests the response from credit is not pushed by shocks to productivity around the cutoff in the years considered.

Crops Figure (17) shows the 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 log rainfall. The analysis for the output is the most striking for cotton, while the percentage change in yield shows greater effects for wheat. Considering crops individually, and absent price data for the crop output, makes interpreting the results difficult. 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.

To address these concerns, I compute an index of crop yields similar to that used in Jayachandran (2011). 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 index carries the added benefit that most districts in India produce at least one of the crops, meaning the set of districts through time will change less than considering output from a single crop. The results from the RD analysis are shown in figure 18 and table 12. The estimates show positive discontinuities after 2005, though estimated imprecisely. Still, given the low power due to a small sample of available agricultural data the lack of significance is not surprising. the estimated discontinuities are consistent with improved yield for the set of most revenue important crops for the districts. Further, the index consists primarily of high nutrition value crops that are staples of the diet. An investment in these "safe" crops as credit expands is consistent with a Stiglitz and Weiss (1981) framework in which banks prefer to lend to safer borrowers. Future work will include expanding the data set to other years and filling in gaps of agricultural data as they are updated by the government.

5.3 Industrial Activities

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

Credit to Manufacturing and Processing In assessing the effect of the policy on manufacturing and processing (manufacturing), I first look to the broader loan category of industrial activity, which includes construction, electricity and gas production, manufacturing and mining. I then confirm the bulk of these loans are directed toward manufacturing activities, which are considered to be an important engine for economic growth in developing economies. The second row of figures in figure (14) presents the discontinuities for accounts in the left panel and amounts in the right panel to industrial activities. In both figures only a small and insignificant discontinuity is estimated prior to 2007. Starting in 2008 a significant effect is estimated at the 10% level for the number of accounts. The discontinuities actually exceed the sample mean for the years 2008-2009, though the extreme discontinuity in 2008 suggests a potential issue with outliers or miscoding of industrial sector in that single year. A similar spike in credit amount to industrial activity is not observed in 2008. Large discontinuities in credit to under banked districts for industrial activity is estimated for 2009-2011 and is statistically significant at the 10% level.

Turning to the industrial measures, credit to construction from semi-urban branches shows a similar growth pattern to direct agriculture, with a positive discontinuity first emerging in 2006 and slowly growing until it estimated with statistical significance at the 5% level in 2008 at 82% additional average growth in under banked districts at the cutoff from 2001 levels over banked districts. The sample mean for 2008 was measured at 107% average growth. As in other analysis, 2008 likely experiences data issues resulting from miscoded outliers. Similar, though smaller estimates are attained in 2009-2011. The discontinuity in the percentage change of private credit to manufacturing is estimated at close to zero until 2008 at which point the discontinuity jumps to 122% with a sample average mean of only 46% and is precisely estimated at the 5% confidence level. The estimates in 2009-2011 are similar though only 2009 and 2010 are estimated precisely with 10% confidence.

5.3.1 Evidence from the ASI

In table15 I present the results from difference in differences analysis using data from the ASI. The analysis uses years 1999-2010, excluding financial year 2006 which straddles the reform. In column (1) and (2) I estimate the effect on logged assets excluding land and inventory, and including them, respectively. The average treatment effect is imprecisely estimated around 16 and 17% for both. The effect on logged working capital, in column (3), is estimated at 0.244 though imprecisely. The effect on the amount of outstanding loans held by the firm is estimated to increase 27% with statistical significance at the 5% level. Total investment by increase by 21.3%, though just falls short of statistical significance at the 10% level. The capital labor ratio is estimated to increase by 3.7 in response to the policy and is estimated at the 5% 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 cutoff. In each regression I control 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. Further, the increase in the capital labor ratio is consistent with previously credit constrained firms making investments in productive assets 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.

Perhaps of some interest is the sign pattern on the age of the plant which enters as a control. The plant age appears to be negatively correlated with the logged assets and the measures of the capital labor ratio, but positively correlated with the financial variables, working capital, outstanding loans and total investment. This is an interesting relationship to explore further, as the results may hint that older firms are more able to secure credit but are not using that credit for installing capital. This analysis cannot speak directly to this question but points to an area for future research.

5.4 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 interpreting very low levels of light - any errors or idiosyncrasies generated by these processes get are 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 then compares these changes to other changes in estimating the discontinuity at the threshold. Figure (21) graphically reports the discontinuities estimated with a 2nd degree polynomial. 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 (16). 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.

The growing discontinuity in light emitted between banked and under banked districts at the threshold in the first years following the reform is consistent with increased economic growth induced by the exogenous expansion of the banking sector in under banked districts in response to the 2005 policy reform. The continued expansion of the effect through 2012 is consistent with the effect of banking having a sustaining effect on economic growth, at least in the run of 6 years. The switch to a new satellite in 2010 likely explains at least part of the drastic jump in percentage change levels in the last 3 years. Future work will investigate this outcome further by extending the series to earlier years with data available from other satellites and limiting the scope of analysis within districts to areas within a set radius of locations ever served by operating branches.

5.5 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 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 17 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."[11]

6 Conclusions

In this paper I follow a regression discontinuity design to cleanly estimate the effect of an exogenous expansion in formal banking on outcomes in agriculture and manufacturing, precipitating in positive differential growth for treated districts as estimated by greater percentage growth in average district light emitted at night. The unique geography and timing of the policy reform facilitates identifying its causal effect on banking services and economic outcomes as other policies operated at the bank and national levels rather than by district, and with different timing. The analysis identifies plausible channels for banking to induce economic growth, first demonstrating an expansion of credit to agriculture and manufacturing due to the branching reform, then finding corresponding effects in agricultural productivity in major cash crops and a change in investments and the use of capital in manufacturing firms. These findings help resolve a controversy in the literature as to the source of growth associated with banking presence.

One noteworthy result from the analysis is the apparent effect of competition in delivering and amplifying the expansion of credit in under banked districts. The focus of the analysis with respect to credit is primarily on the response from the private sector at the threshold. The competition effect appears in the discrepancy between actual branch expansion and credit expansion each in response to the policy. Although the number of operating branches grew

[11] 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.

in under banked districts with a lag, likely due to the timing of applications, licensing and opening for branches, credit responded immediately. The immediate and even preemptive expansion of personal loans suggests incumbents may have been reacting to anticipated future entry by expanding and securing its market share using the loans to cultivate customer loyalty and exploit switching costs. Without the effect from competition, the discontinuity in credit should have mirrored the expansion of branches.

A second important finding comes from focusing on branches serving low population areas. Some evidence suggests that the combination of the branching policy with revisions to the priority sector policies in 2008 resulted in channeling more credit to agriculture and industrial activities in under banked districts. This even growth likely followed the expanding number of branches serving these markets. A corresponding pattern of growth in credit to agriculture and manufacturing in these areas is not observed, with a discontinuity appearing instead suddenly after 2008 in some circumstances and remaining stable thereafter. The timing of this effect corresponds with a revision to priority sector lending requirements that placed greater emphasis on lending to agricultural activities after 2008. The pattern suggests banks responded to the priority sector reform by expanding their credit to agriculture in locations they had opened semi-urban branches. Thus, both the branching policy and the priority sector lending regulation resulted in the directing of credit to semi-urban agricultural and manufacturing endeavors. This result suggests the importance of the two policies operating together and being set in a coordinated manner.

Collectively, the results demonstrate that formal banking can exert real impacts on the economy, realized in this case through efficiency gains in agriculture and the higher investments and capital utilization in manufacturing, all leading to faster growth immediately following the reforms. The method by which these results were delivered relied on leveraging the incentives of private sector banks by tying permissions for branches in profitable areas to branch openings in under served ones. The private banks responded with openings close to the threshold that likely presented the greatest earning potential, and increased banking services as they competed for market shares in these areas. The subsequent refinements in the policy and the revision to priority sector lending redirected these efforts to other markets. Thus, the harmonizing of regulations and private incentives to effectively deliver development oriented goals will be essential for regulators dealing with private firms. Although public sector banks faced the same policies, more analysis is required to better understand its responses in credit and deposits around the cutoff. Future work will also focus on the efficient timing of reforms to manage incentives and to best direct patterns of geographic expansion to reach under served segments of society.

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Part I

Data Appendix

7 Districts

The majority of analysis in this paper is conducted at the administrative district level. Districts constitute the administrative level directly below the state government (and union territory). Data sets at the district level rarely provide numerical identifiers and typically refer to an internal system when available that does 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 are also relatively common practices 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 auxilliary 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.[12] District websites, newspapers and other internet based resources were used to help map alternative spellings to numerical codes.

[12]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 attributable to their proximity to

8 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 (i.e. General Banking, Specialized Banking, ATM). "Brick and mortar" branches are used in the analysis, meaning branches classified at being general banking or specialized banking. Not Administratively Independent Offices (NAIO) 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 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.

Constructing the forcing variable In constructing the forcing variable and national average I follow the APPBO procedure [13] 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 Report, 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.[14] Out of 572 districts only 6 fail to match their official status. Due to redistricting and the level of aggre-

Mumbai. Thane is on the under banked list while Pune is not, though the RBI ammended the policy to 2008 to make centers within 100km of Mumbai ineligible for under banked status, effectively removing the Thane's status. Varanasi district in Uttar Pradesh is also dropped 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 located right at the cutoff on the banked side. Thus, even though the majority of branches that moved and continued operating under the nationalised public sector bank due to the merger belonged to under banked districts, the dramatic reclassification of 20 branches as public sector banks result in a sudden drop at the banked intercept in 2003 that does not accurately represent 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.

[13] 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.

[14] 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.

gation 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.

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.

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. Values 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 designated 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.

9 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.

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 prominant 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 convertions 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 relativley 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 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 and Bollard, Klenow and Sharma (2012) 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, Klenow and Sharma (2012).

11 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.

Part II

Tables and Figures

Figure 1: Policy Timeline

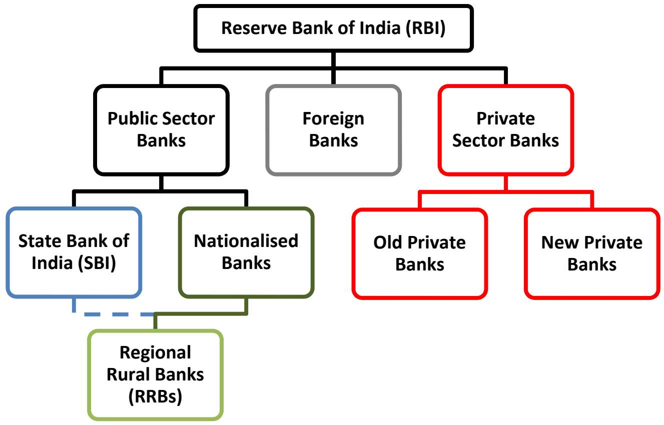


Figure 2: Policy Timeline

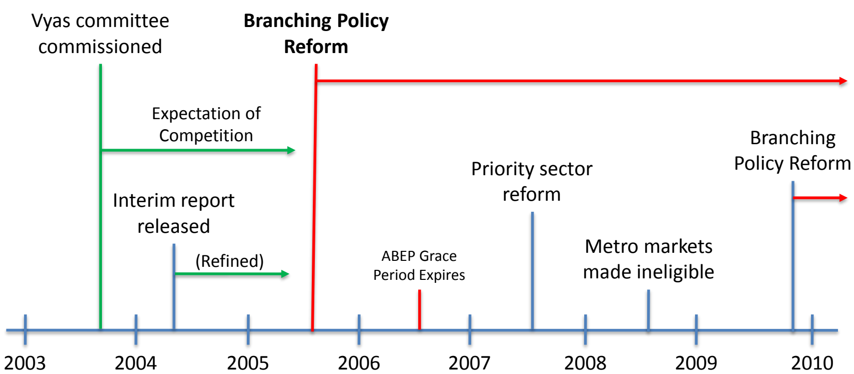


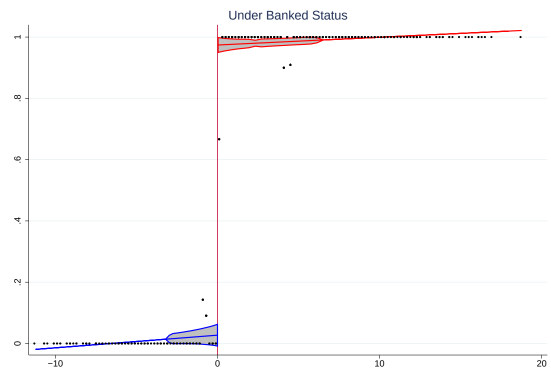
Table 1: Continuity tests for Baseline Values at the Cutoff

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	Population	City_Pop	Sched_Caste_Tribe_Pop	Pct_Literate	Pct_Dist_Dark	Area_Proxy	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

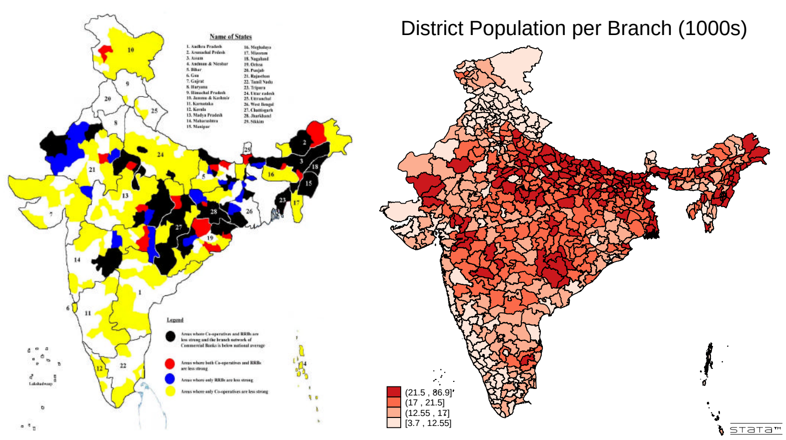
Note: Regression discontinuity estimated using local linear regressions.

Figure 3: Under Banked Status by District Population Per Branch



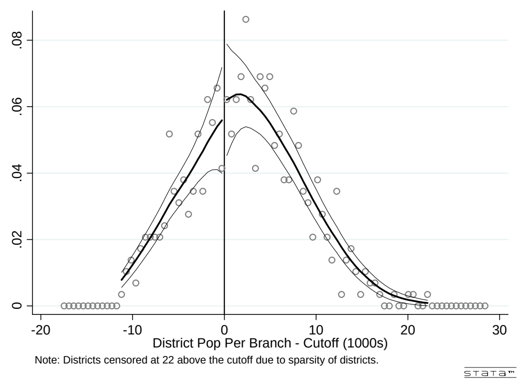
The average assignment value to under banked status for districts falling within bins of 200 persons per branch is shown on the vertical axis (under banked status takes a value of one if on the 2006 under banked list of districts, zero otherwise). The forcing variable, district population per branch centered on the national average, is on the x-axis scaled to thousands of persons per branch.

Figure 4: Maps of Under Served Areas by Formal Banking



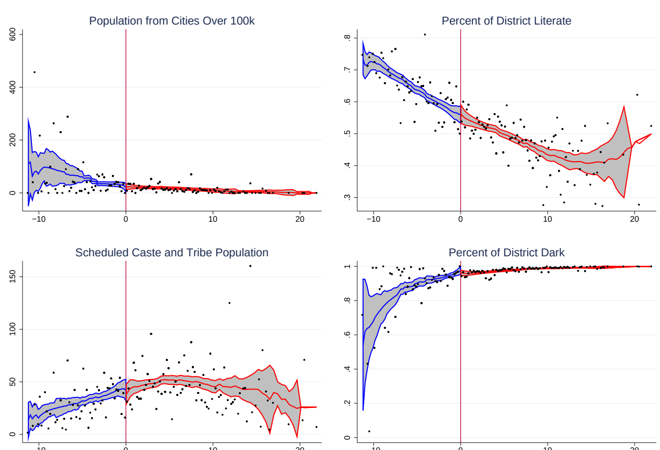
Left: Map reproduced from Vyas Committee Report (Vyas Committee, 2004). Yellow areas indicate sparse coverage of cooperative bankes while darker colors indicate less coverage by scheduled commercial banks including RRBs; Right: District population per branch. Darker colors indicate higher population per density.

Figure 5: Visual McCrary Test



The discontinuity estimate in the log difference in height is 6.6 with a standard error of 22: Fail to Reject the null hypothesis of continuity.

Figure 6: Continuity Around the Threshold



Note: The figure presents the mean values for baseline characteristics for districts falling within 200 persons per branch bins as the y-value. The horizontal axis is the forcing variable of district population per district centered on the national average, such that districts from the under banked list fall to the right of the cutoff, which is set to be zero and indicated by the vertical line. A local linear regression of the data is shown allowing for different slopes on either side of the cutoff.

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.

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.

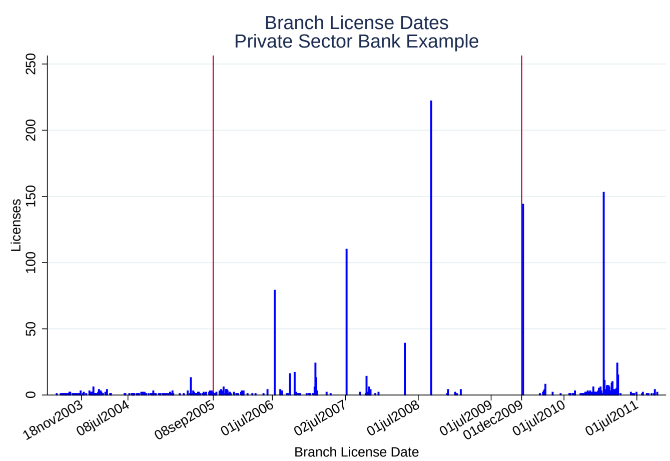
Table 3: Summary Statistics Continued...

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.

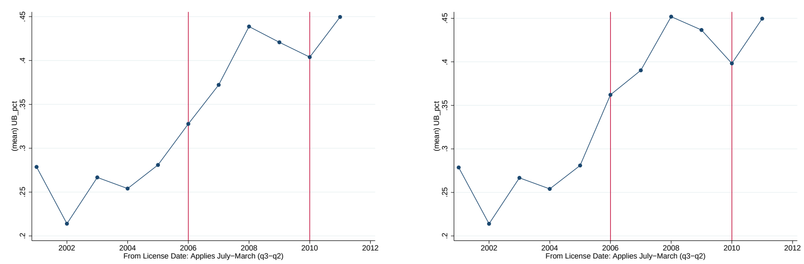
Figure 7: Histogram of Branch Licenses Showing ABEPs for a Large Private Sector Bank



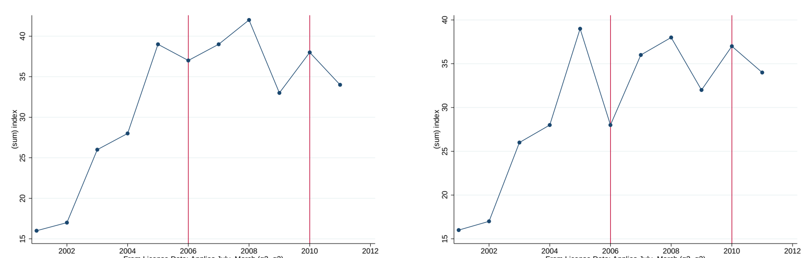
Branch license dates are from the MOF. Bin widths are set to 4 days. Though annual branch expansion plans may not be observed directly, the large spikes in branch licenses set approximately a year apart are consistent with annual branch expansion plans (ABEP). The dates of Master Circular releases are 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 8: Percentage of Licenses Issued to Under Banked Districts in a Policy Year

Percentage of Licenses Issued to Under Banked Districts in a Policy Year

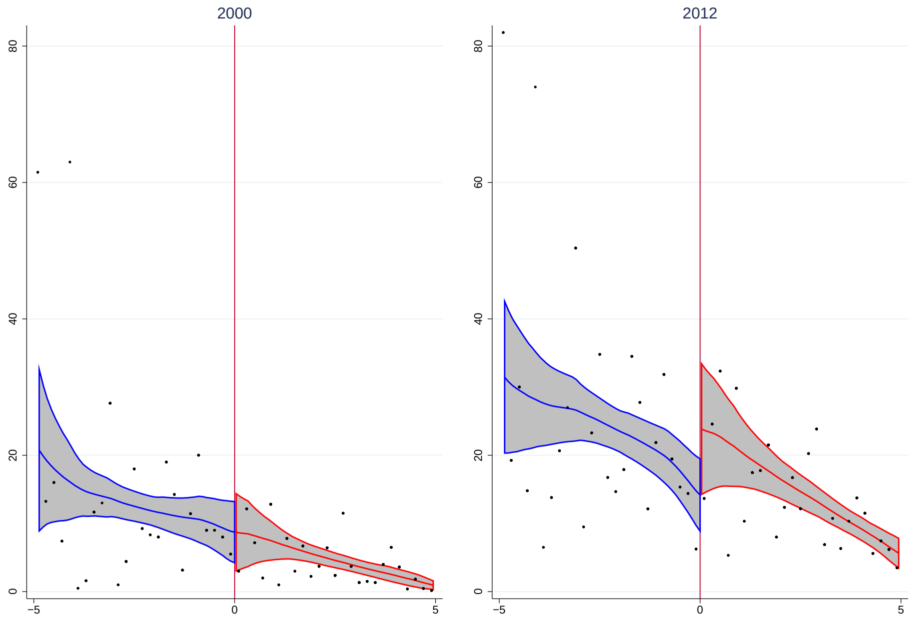


Number of Banks Licensing at Least 10 Branches



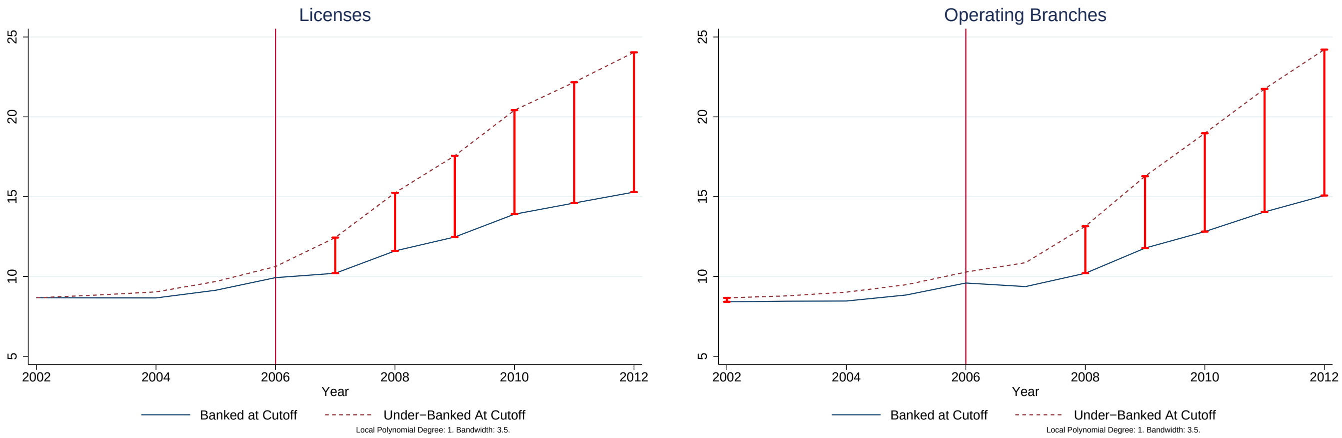
(Left) All Bank-District values with at least 10 Licenses Issued; (Right) Only ABEP Bank-District values [2006-2010] with at least 10 Licenses Issued

Figure 9: Visual RD: Operating Private Bank Branches from Pre and Post Reform Years



Note: The figure presents the mean values of operating private bank branches, in respective years, for districts falling within 200 persons per branch bins on the y-axis. The horizontal axis is the forcing variable of district population per district at the bin center, with the district population per branch centered on the national average, such that districts from the under banked list fall to the right of the cutoff, which is set to be zero and indicated by the vertical line. A local linear regression of the data with a 3.5 thousand persons per district bandwidth and triangular kernel is shown allowing for different slopes on either side of the cutoff. The year 2000 in the left figure shows the pre-reform values of branches around the cutoff. The figure on the right effectively shows the accumulated effect of the policy since its implementation in 2005.

Figure 10: Discontinuity: Operating Private Banks 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.

Table 4: RD Results: Private Banks Operating Branches

Licenses

VARIABLES	(1) 2002	(2) 2003	(3) 2004	(4) 2005	(5) 2006	(6) 2007	(7) 2008	(8) 2009	(9) 2010	(10) 2011	(11) 2012
Conventional	-0.0761	0.207	0.348	0.448	0.552	1.847*	3.180**	4.782**	6.145**	7.150***	8.120***
	[0.153]	[0.272]	[0.447]	[0.582]	[0.765]	[1.028]	[1.407]	[1.918]	[2.387]	[2.706]	[2.950]
Bias-corrected	-0.124	0.259	0.716	0.768	0.874	2.133**	3.362**	5.072***	6.263***	7.199***	8.176***
	[0.153]	[0.272]	[0.447]	[0.582]	[0.765]	[1.028]	[1.407]	[1.918]	[2.387]	[2.706]	[2.950]
Robust	-0.124	0.259	0.716	0.768	0.874	2.133*	3.362**	5.072**	6.263**	7.199**	8.176**
	[0.181]	[0.319]	[0.539]	[0.697]	[0.903]	[1.209]	[1.640]	[2.237]	[2.780]	[3.140]	[3.428]
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	94	94	94	94	94	94	94	94	94	94	94
N_UBanked	122	122	122	122	122	122	122	122	122	122	122
DepMean	8.671	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

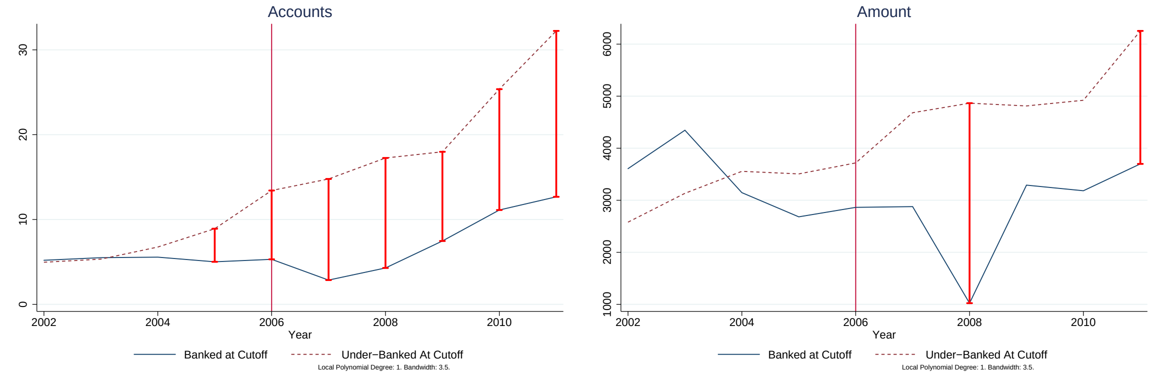
Operating Branches

VARIABLES	(1) 2002	(2) 2003	(3) 2004	(4) 2005	(5) 2006	(6) 2007	(7) 2008	(8) 2009	(9) 2010	(10) 2011	(11) 2012
Conventional	0.106	0.269	0.452	0.486	0.529	0.947	2.535**	3.791**	5.570***	7.293***	8.394***
	[0.135]	[0.277]	[0.469]	[0.561]	[0.758]	[0.901]	[1.219]	[1.662]	[2.130]	[2.635]	[3.001]
Bias-corrected	0.0733	0.288	0.813*	0.785	0.845	1.052	2.808**	3.856**	5.590***	7.351***	8.412***
	[0.135]	[0.277]	[0.469]	[0.561]	[0.758]	[0.901]	[1.219]	[1.662]	[2.130]	[2.635]	[3.001]
Robust	0.0733	0.288	0.813	0.785	0.845	1.052	2.808**	3.856**	5.590**	7.351**	8.412**
	[0.159]	[0.323]	[0.560]	[0.673]	[0.899]	[1.054]	[1.414]	[1.941]	[2.483]	[3.062]	[3.487]
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	94	94	94	94	94	94	94	94	94	94	94
N_UBanked	122	122	122	122	122	122	122	122	122	122	122
DepMean	8.593	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.

Figure 11: Discontinuity: 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.

Table 5: RD Results: Private Banks Aggregate Deposits and Credit

Private 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	-0.194	0.1000	1.333	3.090*	5.650*	8.757***	8.085*	6.537	9.867*	14.25
	[0.516]	[0.720]	[1.148]	[1.648]	[3.344]	[2.996]	[4.563]	[4.074]	[5.867]	[9.148]
Bias-Corrected	-0.200	0.435	1.897*	3.404**	6.655**	9.850***	9.294**	7.569*	10.89*	14.77
	[0.516]	[0.720]	[1.148]	[1.648]	[3.344]	[2.996]	[4.563]	[4.074]	[5.867]	[9.148]
Robust	-0.200	0.435	1.897	3.404*	6.655*	9.850***	9.294*	7.569	10.89	14.77
	[0.607]	[0.860]	[1.336]	[1.955]	[3.915]	[3.678]	[5.355]	[4.754]	[6.856]	[10.62]
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	5.045	5.484	6.728	8.800	12.83	13.77	16.82	17.78	22.82	25.80

Standard errors in brackets

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

Private Sector Credit Amounts

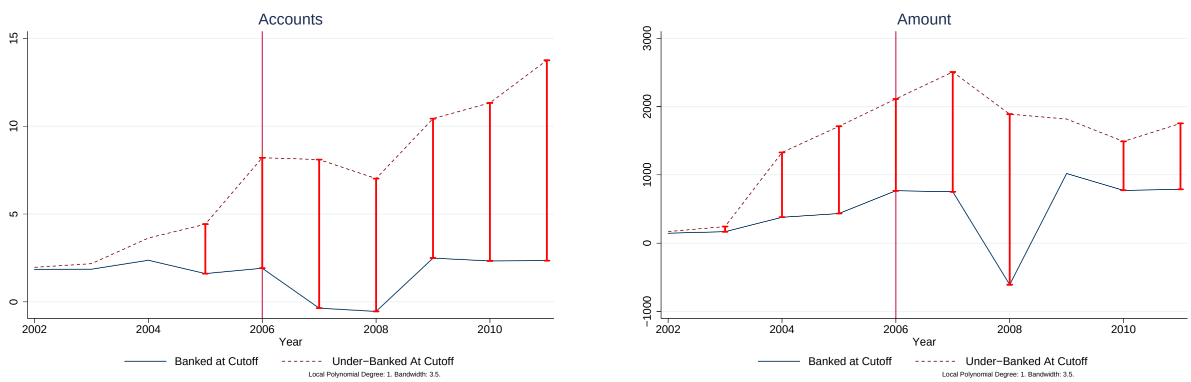
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
VARIABLES	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Conventional	-651.6	-728.7	104.3	835.5	890.5	1,398	2,724	1,219	1,227	1,844
	[1,357]	[1,703]	[1,628]	[1,120]	[1,404]	[1,796]	[2,118]	[1,232]	[1,139]	[1,374]
Bias-Corrected	-359.1	-272.8	485.2	1,489	1,555	2,063	3,717*	2,222*	1,895*	2,484*
	[1,357]	[1,703]	[1,628]	[1,120]	[1,404]	[1,796]	[2,118]	[1,232]	[1,139]	[1,374]
Robust	-359.1	-272.8	485.2	1,489	1,555	2,063	3,717	2,222	1,895	2,484
	[1,558]	[1,954]	[1,859]	[1,334]	[1,730]	[2,185]	[2,770]	[1,571]	[1,403]	[1,715]
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	2649	3223	3026	3466	3922	4920	5917	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.

Figure 12: Discontinuity 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.

Table 6: RD Results: Private Credit to Personal Loans

Accounts in Personal Loans

VARIABLES	(1) 2002	(2) 2003	(3) 2004	(4) 2005	(5) 2006	(6) 2007	(7) 2008	(8) 2009	(9) 2010	(10) 2011
Conventional	0.137	0.387	1.422*	2.435**	5.460**	6.855***	5.440**	5.846**	7.274***	9.151*
	[0.203]	[0.374]	[0.825]	[0.989]	[2.153]	[1.951]	[2.282]	[2.608]	[2.577]	[4.719]
Bias-Corrected	0.184	0.537	1.694**	2.530**	5.920***	7.738***	6.087***	6.352**	8.001***	9.700**
	[0.203]	[0.374]	[0.825]	[0.989]	[2.153]	[1.951]	[2.282]	[2.608]	[2.577]	[4.719]
Robust	0.184	0.537	1.694*	2.530**	5.920**	7.738***	6.087**	6.352**	8.001***	9.700*
	[0.242]	[0.433]	[0.936]	[1.206]	[2.544]	[2.536]	[2.790]	[3.090]	[3.057]	[5.472]
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	1.877	1.910	2.857	3.681	6.138	6.313	6.491	9.120	9.056	9.707

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

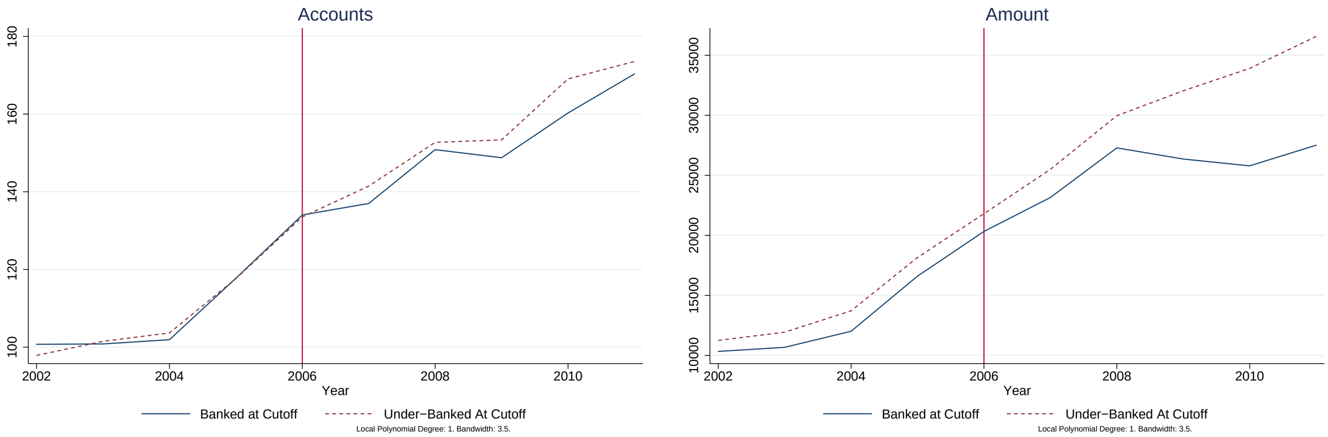
Amount to Personal Loans

VARIABLES	(1) 2002	(2) 2003	(3) 2004	(4) 2005	(5) 2006	(6) 2007	(7) 2008	(8) 2009	(9) 2010	(10) 2011
Conventional	19.96	63.08	813.6*	1,161**	1,348**	1,619**	1,941	527.7	581.5	737.8*
	[17.70]	[43.42]	[475.6]	[530.3]	[602.9]	[710.6]	[1,283]	[524.0]	[355.5]	[401.8]
Bias-Corrected	29.42*	84.22*	871.3*	1,213**	1,497**	1,766**	2,353*	556.6	655.1*	748.3*
	[17.70]	[43.42]	[475.6]	[530.3]	[602.9]	[710.6]	[1,283]	[524.0]	[355.5]	[401.8]
Robust	29.42	84.22*	871.3*	1,213**	1,497**	1,766**	2,353	556.6	655.1	748.3
	[20.34]	[50.94]	[497.9]	[611.5]	[718.7]	[849.8]	[1,795]	[614.4]	[412.1]	[459.6]
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	151.7	199.6	724.4	1003	1384	1658	1986	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 uniform kernel.

Figure 13: Discontinuity: Credit from Public Sector Banks



Note: Public sector banks include State Bank of India and Associated Banks, Nationalised Banks, IDBI and Regional Rural Banks.

Table 7: RD: 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

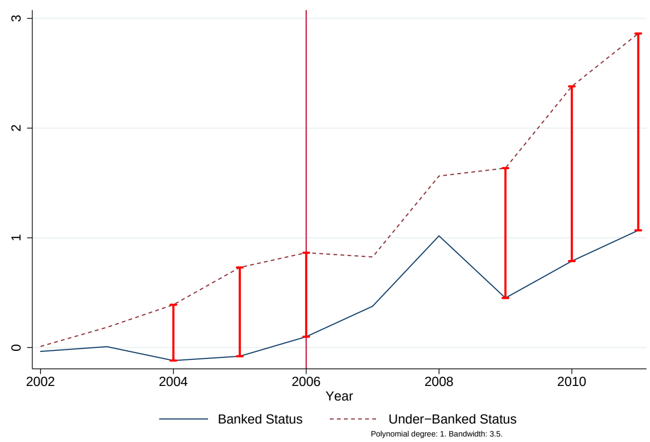
Public Sector Credit Amounts

	(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: Public sector banks include State Bank of India and Associated Banks, Nationalised Banks, IDBI and Regional Rural Banks.

Figure 14: Discontinuity: Percentage Change in Private Sector Direct Credit Amount to Rural Agriculture



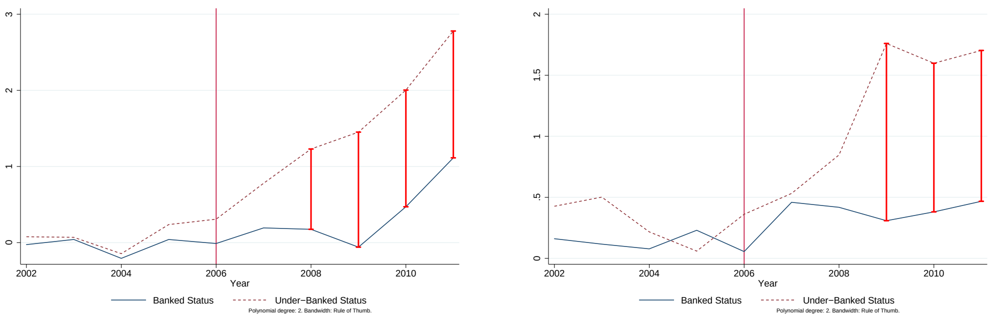
Note: Amounts

Table 8: RD Results: Percentage Change in Private Sector Direct Credit Amount to Rural Agriculture

VARIABLES	(1) 2002	(2) 2003	(3) 2004	(4) 2005	(5) 2006	(6) 2007	(7) 2008	(8) 2009	(9) 2010	(10) 2011
Conventional	-0.00665	0.138	0.436*	0.835***	0.892**	0.338	0.294	1.135**	1.441***	1.583***
	[0.120]	[0.180]	[0.235]	[0.314]	[0.393]	[0.452]	[0.542]	[0.569]	[0.554]	[0.497]
Bias-Corrected	0.0462	0.231	0.568**	1.036***	1.114***	0.341	0.395	1.243**	1.714***	1.700***
	[0.120]	[0.180]	[0.235]	[0.314]	[0.393]	[0.452]	[0.542]	[0.569]	[0.554]	[0.497]
Robust	0.0462	0.231	0.568*	1.036***	1.114**	0.341	0.395	1.243*	1.714**	1.700***
	[0.144]	[0.218]	[0.290]	[0.381]	[0.477]	[0.562]	[0.664]	[0.694]	[0.679]	[0.603]
Bandwidth	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500
N_Left	95	95	95	95	95	95	95	95	95	95
N_Right	120	120	120	120	120	120	120	120	120	120

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

Figure 15: Discontinuity: Percentage Change in Private Credit Amount made from Semi-Urban Branches



(Left) Direct Agriculture, (Right) Indirect Agriculture

Table 9: RD Results: Percentage Change in Private Credit Amount made from Semi-Urban Branches

Direct Agriculture, 2nd degree polynomial

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
VARIABLES	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
D(UnderBanked)	0.104	0.0282	0.0615	0.196	0.320	0.586	1.055*	1.511***	1.533**	1.666***
	[0.125]	[0.192]	[0.215]	[0.317]	[0.439]	[0.531]	[0.625]	[0.523]	[0.614]	[0.592]
Observations	208	183	250	286	301	234	236	263	263	298
R-squared	0.040	0.085	0.040	0.038	0.077	0.085	0.070	0.077	0.037	0.037
DepMean	-0.00440	0.0584	0.169	0.356	0.469	0.897	1.241	1.184	1.583	2.013
Bandwidth	3.303	2.882	4.138	4.747	4.955	3.817	3.836	4.352	4.364	4.873

Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

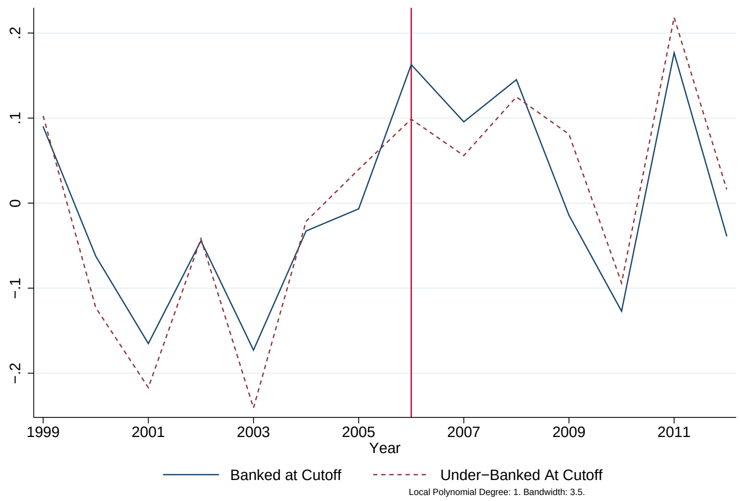
Indirect Agriculture, 2nd degree polynomial

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
VARIABLES	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
D(UnderBanked)	0.266	0.385	0.139	-0.171	0.306	0.0727	0.429	1.452**	1.218**	1.236**
	[0.289]	[0.307]	[0.401]	[0.361]	[0.309]	[0.605]	[0.513]	[0.637]	[0.578]	[0.608]
Observations	210	335	276	319	416	206	323	224	272	253
R-squared	0.022	0.018	0.016	0.012	0.015	0.038	0.027	0.047	0.034	0.056
DepMean	0.312	0.110	0.147	0.172	0.213	0.450	0.706	0.871	1.027	0.955
Bandwidth	3.373	5.784	4.573	5.458	7.692	3.179	5.620	3.631	4.506	4.191

Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Note: Analysis uses Rule of Thumb bandwidth

Figure 16: Discontinuity: 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.

Table 10: RD Results: Rainfall

Averaged Percentage Deviation from the Mean

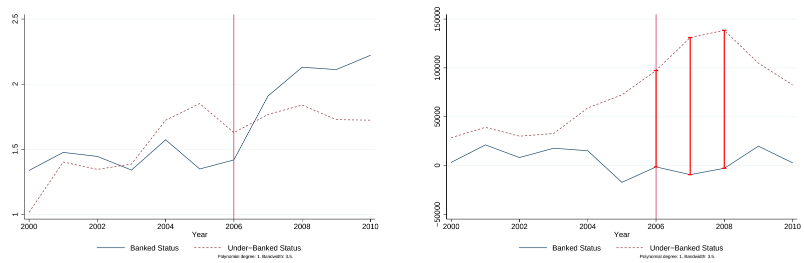
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
VARIABLES	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Conventional	0.01000	-0.0151	-0.00208	-0.0176	-0.0396	-0.0114	0.00883	-0.0638	-0.0373	0.0187	0.0520	0.0633	0.00992	0.0181
	[0.0529]	[0.0794]	[0.0601]	[0.0454]	[0.0444]	[0.0719]	[0.0514]	[0.0707]	[0.0761]	[0.0930]	[0.0707]	[0.0694]	[0.0760]	[0.0669]
Bias-Corrected	0.000778	-0.0165	0.0129	-0.0197	-0.0354	-0.0180	0.00278	-0.0874	-0.0580	0.0296	0.0720	0.0644	0.0131	0.0330
	[0.0529]	[0.0794]	[0.0601]	[0.0454]	[0.0444]	[0.0719]	[0.0514]	[0.0707]	[0.0761]	[0.0930]	[0.0707]	[0.0694]	[0.0760]	[0.0669]
Robust	0.000778	-0.0165	0.0129	-0.0197	-0.0354	-0.0180	0.00278	-0.0874	-0.0580	0.0296	0.0720	0.0644	0.0131	0.0330
	[0.0636]	[0.0973]	[0.0753]	[0.0543]	[0.0531]	[0.0875]	[0.0624]	[0.0849]	[0.0923]	[0.115]	[0.0872]	[0.0864]	[0.0922]	[0.0817]
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	3.500	3.500
N_Banked	94	94	94	94	94	94	94	94	94	93	94	94	94	94
N_UBanked	120	120	120	120	120	120	120	120	120	120	120	120	120	120
DepMean	0.0811	-0.0517	-0.155	-0.0416	-0.208	-0.0304	0.0111	0.0970	0.0506	0.111	0.0545	-0.127	0.174	0.0362

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

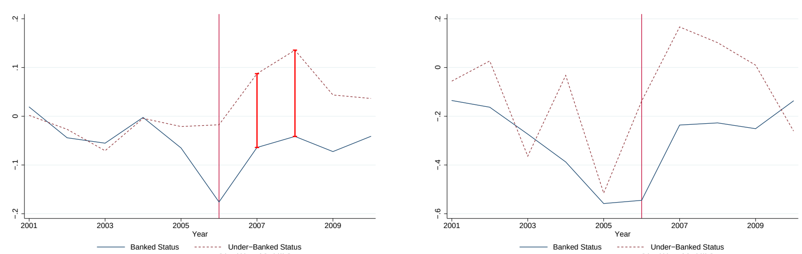
Note: Estimated using local linear regressions. Bandwidths are set 3.5 thousand persons per branch and estimated using a triangular kernel.

Figure 17: Discontinuity: Individual Crops

Cotton Statistics



Percentage Change in Wheat Statistics from 2000 Levels



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

Table 11: RD Results: Individual Crops

Cotton Productivity

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
VARIABLES	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
D(UnderBanked)	-0.321	-0.0737	-0.0995	0.0461	0.150	0.502	0.209	-0.141	-0.290	-0.384	-0.498
	[0.241]	[0.246]	[0.192]	[0.290]	[0.347]	[0.536]	[0.385]	[0.471]	[0.493]	[0.483]	[0.510]
Observations	138	144	140	138	144	92	134	105	127	129	120
R-squared	0.048	0.020	0.034	0.020	0.025	0.112	0.059	0.070	0.057	0.046	0.065
DepMean	1.281	1.469	1.304	1.341	1.748	1.911	1.780	2.007	1.876	1.766	1.805
Bandwidth	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500

Robust 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)	(10)	(11)
VARIABLES	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
D(UnderBanked)	25,288	17,971	21,921	15,036	43,844	89,591	98,746*	140,389*	141,320*	85,028	79,853
	[19,063]	[25,015]	[20,575]	[24,755]	[38,316]	[60,711]	[53,774]	[79,739]	[76,421]	[61,160]	[63,289]
Observations	138	144	140	138	144	92	134	105	127	129	120
R-squared	0.077	0.109	0.088	0.045	0.030	0.154	0.048	0.041	0.027	0.017	0.059
DepMean	45257	43945	44461	37751	63781	114338	96429	130783	111645	107685	115830
Bandwidth	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500

Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Percentage Change in Wheat Productivity from 2000 Levels

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
VARIABLES	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
D(UnderBanked)	-0.0172	0.0173	-0.0155	-0.00194	0.0439	0.158	0.151*	0.177**	0.116	0.0777
	[0.0467]	[0.0764]	[0.0601]	[0.0794]	[0.0702]	[0.123]	[0.0859]	[0.0860]	[0.0964]	[0.0853]
Observations	190	188	181	183	186	182	150	174	181	151
R-squared	0.044	0.034	0.053	0.015	0.027	0.054	0.053	0.077	0.043	0.064
DepMean	-0.0196	-0.00692	-0.0390	0.0117	-0.0105	-0.00368	0.0418	0.0403	0.0515	0.0576
Bandwidth	5	5	5	5	5	5	5	5	5	5

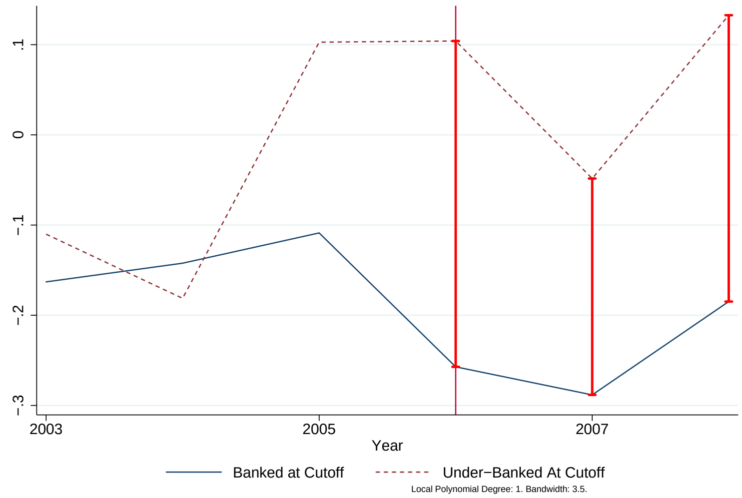
Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Percentage Change in Wheat Output (Tonnes) from 2000 Levels

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
VARIABLES	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
D(UnderBanked)	0.0796	0.190	-0.0904	0.355	0.0427	0.407	0.403	0.329	0.261	-0.124
	[0.218]	[0.378]	[0.203]	[0.306]	[0.394]	[0.325]	[0.446]	[0.510]	[0.332]	[0.325]
Observations	190	188	181	183	186	182	150	174	181	151
R-squared	0.024	0.015	0.013	0.034	0.043	0.029	0.044	0.021	0.064	0.103
DepMean	-0.220	-0.107	-0.362	-0.124	-0.279	-0.0870	0.0349	-0.230	-0.0249	-0.131
Bandwidth	5	5	5	5	5	5	5	5	5	5

Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Figure 18: Discontinuity: Crop Yield Index



Note: Index of crop yield using weighted averages of the crops rice, wheat, sugar, jowar and groundnut. Weighted by crop revenue share. Estimated using local linear regressions with controls for district average rainfall percentage deviation from the mean and the pre-randomization 2002 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.

Table 12: RD Results: Crop Yield Index

Averaged Percentage Deviation from the Mean

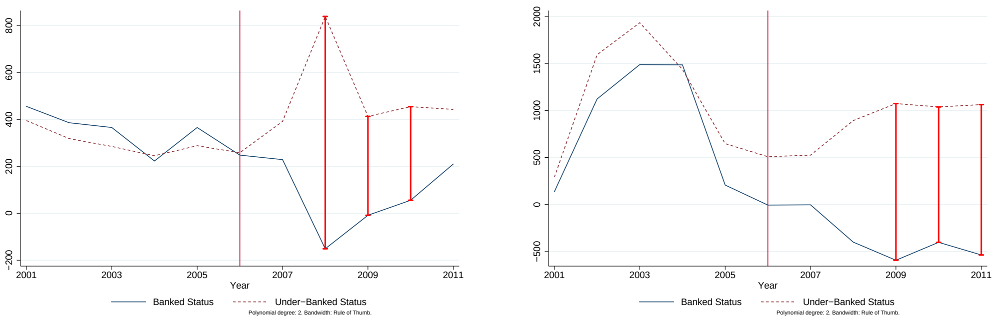
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	2003	2004	2005	2006	2007	2008
Conventional	0.0110	-0.117	0.123	0.377	0.179	0.298
	[0.0999]	[0.143]	[0.124]	[0.269]	[0.156]	[0.182]
Bias-Corrected	-0.00242	-0.127	0.114	0.490*	0.217	0.353*
	[0.0999]	[0.143]	[0.124]	[0.269]	[0.156]	[0.182]
Robust	-0.00242	-0.127	0.114	0.490	0.217	0.353
	[0.119]	[0.170]	[0.143]	[0.359]	[0.196]	[0.229]
Bandwidth	3.500	3.500	3.500	3.500	3.500	3.500
N_Banked	47	44	38	47	44	44
N_UBanked	74	72	67	74	60	72
DepMean	-0.115	-0.0303	0.0340	0.0133	-0.0710	-0.0497

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, sugar, jowar and groundnut. Weighted by crop revenue share. Estimated using local linear regressionswith controls for district average rainfall percentage deviation from the mean and the pre-randomization 2002 value of the dependent variable. Bandwidths are set 3.5 thousand persons per branch and estimated using a triangular kernel.

Figure 19: Discontinuity: Private Credit to Industrial Loans



Note: Accounts (Left), Amounts (Right). Estimated using Rule of Thumb bandwidths.

Table 13: RD Results: Private Credit to Key Sectors

Accounts in Industrial Activities

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
VARIABLES	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
D(UnderBanked)	-60.36	-67.52	-80.78	22.40	-77.60	10.16	162.7	990.0*	421.5*	398.7*	232.6
	[310.4]	[269.8]	[294.8]	[160.4]	[242.6]	[187.3]	[483.7]	[582.3]	[240.9]	[231.2]	[224.9]
Observations	207	202	203	203	209	216	275	259	247	246	228
R-squared	0.073	0.045	0.061	0.141	0.080	0.160	0.031	0.074	0.078	0.097	0.102
DepMean	323.5	274.2	278.3	188.8	238.1	281.9	493.3	794.8	390.8	405.1	461.8
Bandwidth	3.225	3.135	3.142	3.150	3.327	3.488	4.537	4.291	4.069	4.067	3.699

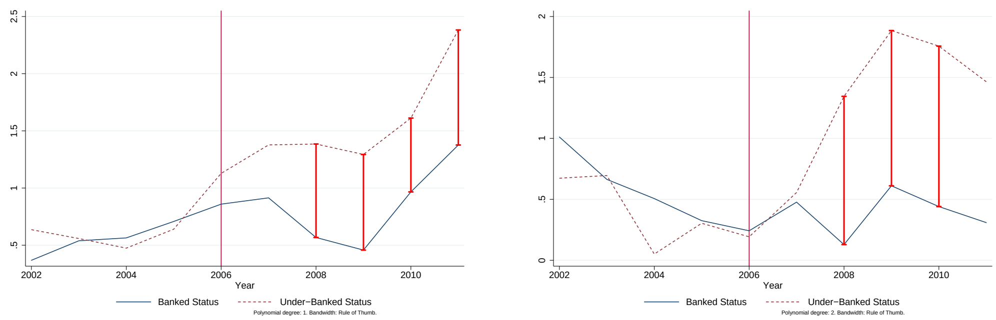
Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Amount to Industrial Activities

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
VARIABLES	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
D(UnderBanked)	153.5	470.3	445.0	-48.42	440.2	514.6	528.6	1,292	1,666*	1,440*	1,599*
	[235.8]	[1,662]	[2,080]	[1,747]	[1,111]	[1,474]	[1,698]	[1,123]	[966.5]	[827.0]	[934.4]
Observations	253	224	232	288	234	237	239	240	230	248	252
R-squared	0.211	0.119	0.110	0.121	0.124	0.089	0.093	0.175	0.195	0.210	0.202
DepMean	379.2	1916	2332	1402	1428	1287	1615	1618	1553	1350	1642
Bandwidth	4.175	3.639	3.790	4.763	3.818	3.902	3.964	3.986	3.759	4.118	4.169

Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Figure 20: Discontinuity: Percentage Change in Private Credit Amount made from Semi-Urban Branches



(Left) Construction; (Right) Manufacturing

Table 14: RD Results: Percentage Change in Private Credit Amount made from Semi-Urban Branches

Construction, 1st degree polynomial

VARIABLES	(1) 2002	(2) 2003	(3) 2004	(4) 2005	(5) 2006	(6) 2007	(7) 2008	(8) 2009	(9) 2010	(10) 2011
D(UnderBanked)	0.268	0.0196	-0.0894	-0.0676	0.269	0.463	0.817**	0.836**	0.646*	1.006**
	[0.254]	[0.305]	[0.229]	[0.361]	[0.281]	[0.359]	[0.414]	[0.354]	[0.379]	[0.453]
Observations	209	208	314	208	295	239	224	259	270	247
R-squared	0.123	0.088	0.222	0.122	0.140	0.101	0.149	0.107	0.114	0.157
DepMean	0.368	0.454	0.330	0.493	0.853	0.994	1.074	0.760	1.115	1.829
Bandwidth	3.341	3.276	5.401	3.313	4.832	3.963	3.624	4.293	4.466	4.088

Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Manufacturing, 2nd degree polynomial

VARIABLES	(1) 2002	(2) 2003	(3) 2004	(4) 2005	(5) 2006	(6) 2007	(7) 2008	(8) 2009	(9) 2010	(10) 2011
D(UnderBanked)	-0.338	0.0317	-0.455	-0.0213	-0.0495	0.0793	1.216**	1.274*	1.316*	1.155
	[0.674]	[0.759]	[0.743]	[0.732]	[0.671]	[0.789]	[0.605]	[0.728]	[0.696]	[0.762]
Observations	348	330	254	313	304	252	303	237	285	278
R-squared	0.032	0.045	0.038	0.012	0.011	0.012	0.037	0.031	0.040	0.018
DepMean	0.599	0.572	0.221	0.269	0.115	0.128	0.458	0.864	0.623	0.842
Bandwidth	5.982	5.694	4.220	5.363	5.130	4.166	5.085	3.884	4.741	4.618

Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Note: Analysis uses Rule of Thumb Bandwidths

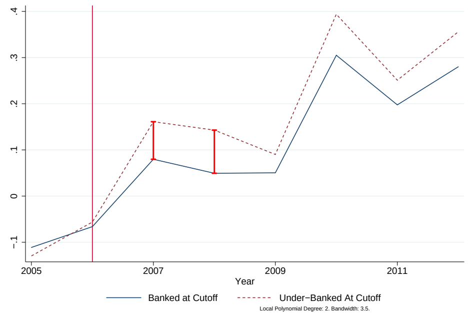
Table 15: Diff n Diff: States Selected around Under Banked Threshold, 1999-2010

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	Ln_Cap_No_Land_Inv	Ln_Net_Assets	Ln_Working_Capital	Ln_Loans	Ln_Tot_Investment	Cap_Labor_Ratio	Ln_Cap_Labor_Ratio
TreatXPost2006	0.170	0.162	0.244	0.270**	0.213	3.674**	0.0660
	[0.173]	[0.155]	[0.153]	[0.117]	[0.147]	[1.572]	[0.124]
Post2006	-0.151*	-0.0977	-0.129	-0.231*	-0.0460	-1.398	-0.0592
	[0.0681]	[0.0541]	[0.101]	[0.123]	[0.110]	[1.076]	[0.0345]
Treat	44.18	132.5***	218.3***	8.015	246.4***	1,040**	65.92*
	[46.96]	[40.71]	[40.12]	[29.95]	[37.86]	[406.6]	[31.82]
Log Number Employees	1.117***	1.118***	1.024***	0.914***	1.127***	-2.216**	-0.112***
	[0.0372]	[0.0375]	[0.0416]	[0.0394]	[0.0427]	[0.715]	[0.0243]
Log Number Units	0.365*	0.377**	0.202	0.273	0.204**	12.72***	0.327**
	[0.169]	[0.163]	[0.112]	[0.180]	[0.0908]	[3.716]	[0.133]
Plant Age	-0.0158**	-0.0184**	0.0422***	0.0165**	0.0381***	-0.368**	-0.0380***
	[0.00650]	[0.00642]	[0.0106]	[0.00556]	[0.00842]	[0.121]	[0.00406]
Plant Age Sq	4.46e-05	6.97e-05	-0.000350**	-0.000122	-0.000322***	0.00281**	0.000237***
	[5.12e-05]	[4.87e-05]	[0.000144]	[7.03e-05]	[9.79e-05]	[0.00112]	[4.53e-05]
Constant	-87.01***	11.11	-71.02***	-93.64***	-143.6***	-244.1	-5.584
	[24.29]	[22.64]	[20.30]	[25.48]	[23.33]	[304.1]	[14.64]
Observations	106,671	106,702	91,529	85,904	102,259	106,606	106,565
R-squared	0.272	0.274	0.199	0.083	0.204	0.012	0.095
State FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State Trend	Yes	Yes	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: Analysis includes only enterprises in operation. Excludes financial year 2006 the policy reform was implemented part way through the financial year.

Figure 21: Discontinuity: Difference in Log Mean District Light from 2004 Level



Note: 2nd Degree Polynomial.

Table 16: RD Results: Difference in Log Mean District Light from 2004

VARIABLES	(1) 2005	(2) 2006	(3) 2007	(4) 2008	(5) 2009	(6) 2010	(7) 2011	(8) 2012
Conventional	-0.0258	0.00485	0.0942***	0.0917***	0.0346	0.0972	0.0810*	0.0940
	[0.0193]	[0.0272]	[0.0297]	[0.0322]	[0.0707]	[0.0605]	[0.0492]	[0.0589]
Bias-Corrected	-0.0297	0.00720	0.108***	0.104***	0.0426	0.119**	0.105**	0.116**
	[0.0193]	[0.0272]	[0.0297]	[0.0322]	[0.0707]	[0.0605]	[0.0492]	[0.0589]
Robust	-0.0297	0.00720	0.108***	0.104***	0.0426	0.119*	0.105**	0.116*
	[0.0210]	[0.0300]	[0.0319]	[0.0353]	[0.0773]	[0.0663]	[0.0531]	[0.0637]
Bandwidth	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500
N_Banked	94	94	94	93	94	94	94	94
N_UBanked	122	122	122	122	122	122	122	122
DepMean	-0.139	-0.0808	0.114	0.0720	0.0259	0.355	0.219	0.296

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

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

Table 17: NREGA Discontinuity in District Phase Assignment

VARIABLES	(1) Phase_1	(2) Phase_2	(3) 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