Interest Rate Cap, Relationship Lending, and Bank Competition: Evidence from Bangladesh

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Abstract

Are there market failures in an external finance market in a developing country, and is there a scope for policy intervention? I provide an empirical answer to this question in the context of interest rate cap regulation in the banking market in Bangladesh, where an interest rate cap for business loans was introduced at 13 percent in 2009 and lifted in 2011. This regulation resulted in a sudden decrease and then an increase in the interest rates for bank branches with high interest rates prior to the regulation, while un-affecting those whose interest rates were already lower than the cap. Using the difference-in-difference design, I document that (1) the introduction of the cap significantly increased the credit supply, and (2) this increase persisted after the regulation was lifted. The empirical findings are consistent with a model of relationship lending by imperfectly competitive banks. The results point out two types of market failures that existed prior to the regulation: sub-optimally high level of interest rates due to banks' market power, and under-experimentation of ex-post profitable borrowers.

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1 Introduction

A well-functioning financial market spurs economic growth by reducing the costs of external finance to firms (Rajan and Zingales 1998, Levine 2005). At the same time, the cost of external finance for firms in countries with underdeveloped financial and legal systems are systematically high (Demirgüç-Kunt et al. 2004, Beck et al. 2005). To what extent is this driven by the cost and risk of financing, and to what extent is this driven by market failure (e.g., imperfect competition, asymmetric information)? Is there a scope for a policy intervention?

This paper provides an empirical assessment of this question in the context of interest rate cap regulation in banking market in Bangladesh. On April 19, 2009, Bangladesh Bank (the central bank of Bangladesh) imposed the maximum limit of lending interest rate for business loans at 13 percent under the stated objective of boost industry investment. The cap was lifted on March 9, 2011 under the criticism by International Monetary Fund (IMF). In this paper, I study how this interest rate cap regulation has affected the credit supply during the regulation period and after the cap is lifted. I then discuss how the empirical results inform about the nature of the market failure in the banking market in Bangladesh.

From a theoretical perspective, whether the interest rate caps increase or decrease the credit supply crucially depends on the nature of bank competition. If the bank market is competitive and banks are barely making up the cost (net of default risk), imposing the interest rate cap may actually decrease the credit supply. On the other hand, if banks are imperfectly competitive and earn profit margin, such regulation may actually increase the credit supply.

Furthermore, the interest rate cap may affect the credit supply in the long run in the presence of relationship lending. Over the course of the relationship with borrowers, lenders learn about borrowers' creditworthiness. This makes lenders easier to provide finance in the long run by adjusting the lending terms accordingly. The importance of such relationship lending has been received ample attention in the literature.[1]

I test these predictions by studying the causal effect of the introduction and the removal of interest rate cap regulation in Bangladesh. An important challenge of studying the causal effect of the regulation is that the regulation is introduced endogenously based on the credit market and macroeconomic environment. Hence, just relying on the time series variation does not give a reliable causal effect. To deal with this issue, this paper uses the pre-regulation interest rates at bank branch level as a source of additional cross-sectional variation, and study the causal effect

[1] See, for example, Petersen and Rajan (1994) and Berger and Udell (1995) for early contributions in this literature. Boot and Thakor (2000) and Kysucky and Norden (2016) provide a survey of this literature.

of the regulation with the difference-in-difference method. I show that bank branches with high interest rates prior to the regulation suddenly decreased the interest rates when the policy is introduced, and then suddenly increased the interest rates when the policy is lifted. On the other hand, such patterns do not exist for banks whose interest rates were already lower than the cap.

There are two important empirical findings. First, I find that the interest rate cap significantly increased the credit supply. Furthermore, this increase is almost entirely driven by the increased number of loans (extensive margin), rather than the increase of loan amount (intensive margin). This is consistent with the hypothesis that banking market in Bangladesh was imperfectly competitive before the regulation, and hence the introduction of the interest rate cap increased the credit supply. This finding is a sharp contrast to other studies that tend to find negative impacts of interest rate caps in consumer credit markets in more developed countries.[2].

Second, I find that the increased credit supply did *not* decrease after the regulation is lifted. This is despite the fact that the significant and sudden increase of the interest rates. This is consistent with the theory of relationship lending, where borrowers are locked in the relationship with the bank, and borrowers do not stop lending despite the increased interest rates.

Taking stock, the empirical results point out two important market failures in banking market in Bangladesh prior to the regulation. First is the static market power distortion due to imperfect competition of banks. Because of the market power, the market interest rates were raised above the level where banks break even. This distortion reduced the credit supply below the optimal level. Second is the under-experimentation of ex-post profitable borrowers. The fact that the credit supply did not decrease after the removal of the interest rate cap implies that banks found it optimal to supply credit to the existing borrowers *ex-post*. These borrowers would not have been financed if the regulation had not induced the lending relationship during the regulation period. Hence, the interest rate cap not only increased the access to finance during the regulation period, but also after the regulation was lifted.

It, of course, requires a caution to conclude that the interest rate cap in Bangladesh was an effective policy. Most importantly, because of the empirical design of using variation across bank branches to identify the causal effect of the policy, this paper is silent about the effect of the policy that happened economy-wide. Relatedly, there are other objectives than increasing credit supply that policy makers should have in mind. For example, one of the important concern by IMF about the interest rate cap in Bangladesh is the limited transmission of monetary policy. In

[2]See, for example, Alessie et al. 2005, Benmelech and Moskowitz 2010, Rigbi 2013, Melzer and Schroeder 2017, Cuesta and Sepulveda 2019

light of these important caveats of the direct assessment of the regulation, the main contribution of the paper is not the direct assessment of the policy: Instead, the paper highlights an important nature of market failures in baking market in a developing country, and suggest a room of policy intervention to correct for the market failures.

This paper contributes to several strands of literature. First, this paper contributes to the literature of the papers examining the impacts of interest rate caps. As documented by Maimbo and Henriques Gallegos (2014), interest rate caps are a common policy both in developing and developed countries. The available evidence, however, is mostly limited to consumer credit market in developed countries (Alessie et al. 2005, Benmelech and Moskowitz 2010, Rigbi 2013, Melzer and Schroeder 2017, Cuesta and Sepulveda 2019). This paper studies loans for firms in a developing country. In terms of the results, this paper finds *positive* impacts on credit supply, while the existing studies tend to find negative impacts. This is consistent with the evidence that banks in weaker institutions may earn higher profit margin (Demirgüç-Kunt et al. 2004). Another important distinction of this paper from the literature is that this paper documents both the introduction and removal of the cap, and documents the asymmetry between these two effects.

Second, this paper provide empirical guidance to the long-standing literature of market imperfection in external finance market. In particular, the paper contributes to the literature of relationship lending under imperfect competition of lenders (Petersen and Rajan 1995, McMillan and Woodruff 1999, Fisman and Raturi 2004). In contrast to the existing literature that highlights the importance of lenders' competition *after* the relationship is built, this paper highlights the implication of the imperfect competition *before* initiating the relationship.

Third, this paper contributes to the literature about the limited access to finance by firms in developing countries. There is ample evidence that firms in developing countries are credit constrained (De Mel et al. 2008, Hsieh and Klenow 2009, Banerjee and Duflo 2014). The evidence of this paper points out the possible sources of market failures in external finance market in a developing country.

The rest of the paper is organized as follows. In Section 2, I explain the institutional details of the interest rate caps introduced in Bangladesh. Section 3 introduces a simple model that predict the effects of the interest rate cap on credit supply. Section 4 presents the empirical results. Section 5 concludes.

2 Banks in Bangladesh and Interest Rate Cap Regulation

Despite the prevalence of micro-finance institutions and informal financial institutions, formal commercial banks are dominant sources of firms' external finance in Bangladesh. Commercial banks in Bangladesh operate under the supervision of Bangladesh Bank, the central bank of Bangladesh.[3]

On April 19, 2009, Bangladesh Bank imposed a maximum limit of interest rate at an annualized rate of 13 percent for a major category of business loans.[4] Prior to this change, there were no direct regulation to the interest rate on bank loans, except for export financing at 7 percent. According to Unnayan Onneshan (2011), the cap is introduced "to boost investment." This policy, however, led to a severe criticism by International Monetary Fund (IMF).[5] Under the external pressure, on March 9, 2011, Bangladesh Bank withdrew the cap except for the term loans and agricultural sector loans.[6]

Figure 1 shows that this regulation significantly bounded the interest rates of bank loans during the regulation period. Panel (A) plots the transition of the proportion of loans whose annualized interest rates are equal to or below 13 percent. When the cap was introduced (second quarter of 2009), this proportion suddenly went up from 20 percent to 50 percent, and continued to increase to 90 percent by the end of 2010. (The primary reason why there were outstanding loans above 13 percent during the regulation period is due to the loans disbursed prior to the regulation.) Right after the cap was lifted (first quarter of 2011), this proportion again suddenly dropped to about 60 percent, and went down to 30 percent by the fourth quarter of 2011. Panel (B) shows that these patterns arise due to the loans whose interest rates are exactly at 13 percent.

Despite the clear evidence that the regulation has suddenly bounded the interest rates, studying the causal effect of the regulation just relying on the time series variation is not credible. A big concern is that the regulation is introduced endogenously based on the credit market and macroeconomic environment. In particular, if the objective of the policy is to encourage industry

[3]There are broadly four types of banks in Bangladesh; State-Owned Commercial Banks (SCBs), State-Owned Development Financial Institutions (DFIs), Private Commercial Banks (PCBs) and Foreign Commercial Banks (FCBs). As of December 2013, there are 4 SCBs, 4 DFIs, 39 PCBs, and 9 FCBs, totaling 56 number of banks.

[4]More specifically, the circular issued by Bangladesh Bank states that the cap applies to working capital to and term loans to large and medium scale industry, agriculture, housing sector loans, and trade financing. In the data, this corresponds to loans to all sectors except government, other public sector and individuals. I also exclude agricultural sector from my analysis, whose interest rates are systematically lower than the cap throughout the sample period.

[5]In fact, Reuters (2012) reports that IMF tagged a condition to withdraw the interest rate cap for the new credit disbursement.

[6]Term loans for industries are also lifted on January 4, 2012. However, on January 22, 2012, Bangladesh Bank introduced another regulation to cap the spread between lending and deposit rates to a single digit. In my analysis, I study the period until the end of 2011.

investment, the timing of the introduction of the policy is likely to be correlated with the aggregate credit demand. It is also needless to say that this is around the time period of global recession. From the perspective of Bangladesh, the reduction of the export to developed countries was of particular concern.

To deal with this issue, this paper proposes to use the bank-branch level interest rates prior to the regulation as a source of exogenous variation of the exposure to the regulation. Bank branches that used to charge higher average interest rates above the caps before the regulation incurred larger reduction of the average interest rates during the regulation period. More formally, my identification strategy is the difference-in-difference method with pre-regulation branch-level interest rates as a source of additional cross-sectional variation.

Figure 2 illustrates my main idea. The figure plots the average annualized interest rate of loans for industries charged by different branches in Bangladesh. Before the regulation started, the average interest rates charged by bank branches are stable and show no time trend. As soon as the interest rate cap was introduced, the interest rates of bank branches that used to charge the average interest rates above 13 percent before the regulation ("treatment branches") suddenly decreased the interest rates. On the other hand, those of bank branches that used to charge below 13 percent prior to the regulation ("control branches") show no significant trend break. Consequently, the gap of the interest rates between the treatment and control branches suddenly decreased. Right after the regulation was lifted, the treatment branches again suddenly increased the interest rates, while control branches do not show a trend break. Hence, the gap of the interest rates between the treatment and control branches again suddenly widened.

Figure 2 confirms that the interest rate cap affected branches differently based on the pre-regulation interest rate variation. In Section 4, I follow this idea and formally execute the difference-in-difference method to study the effect of interest rate cap.

3 Conceptual Framework

In this section, I build a simple model of relationship lending by imperfectly competitive banks. I then discuss the model's prediction about the impacts of the interest rate cap on short-term and long-term credit supply.

The model is a simple extension of Petersen and Rajan (1995), a canonical two-period model of relationship lending. The main modification is that I incorporate imperfect competition of lenders before the relationship starts. Banks face potential borrowers with investment opportunity over

two periods. If the borrower invest and succeeds in the project, the bank can lock in a fraction of borrowers and extract rents in the next period. At the same time, the market is imperfectly competitive, and the bank charges the interest rate above the marginal cost (net of default risk) in the first period. Hence, depending on the degree of imperfect competition in the first period, as well as the degree to which the bank can lock in the borrowers in the second period, introducing the interest rate ceiling in the first period will increase or decrease the equilibrium credit supply in both periods.

3.1 Model Set-up

There is a continuum of entrepreneurs with measure one looking for finance. At date 1, each borrower has a project that requires one unit of consumption goods as an investment. Hereinafter, I take the consumption goods as a numéraire. If invested, the project succeeds and returns R_1 with probability p, and fails and returns zero with probability $1-p$ at the end of date 1. Furthermore, if the project is successful in date 1, the entrepreneur will access another project in the beginning of date 2. This project again requires one unit of consumption goods as an investment in the beginning of date 2, and returns R_2 with probability one at the end of period 2. If the project is not financed in date 1, the borrower will never have an investment opportunity in date 2.

There are no storage technology in this economy, and hence borrowers need to finance investment from banks in both dates. I assume that there is a representative bank under imperfect competition. The bank's cost of raising one unit of funding is constant at c.

I now describe how the credit market clears in both dates. In date 1, the bank will post the interest rate r_1. Based on this interest rate, each entrepreneur determines whether to borrow from the bank and invest in the project. To borrow from the bank, each entrepreneur i incurs a fixed cost u_i to go to the bank. u_i is distributed following the cumulative distribution function $F(\cdot)$, which has a full support and twice continuously differentiable.

In the beginning of date 2, the bank observes which entrepreneurs succeeded in date 1 project and has an investment opportunity in date 2. Note that these are the only potential borrowers in date 2 in this economy. I assume that the bank can lock in the borrowers with probability γ. In this event, the bank can fully extract rents from these borrowers; i.e., the bank charges interest rate R_2. However, with the remaining probability, the borrower leave the bank and seeks the

funding from outside economy at interest rate R_2.[7]

I now discuss how the bank sets interest rate in date 1. To do so, I first characterize the aggregate credit demand given the interest rate r_1. Given all the rent is extracted by the bank in date 2, the entrepreneur's decision to borrow depends solely on the surplus in date 1. Hence, the entrepreneur i with cost u_i borrows from the bank if and only if

$$R_1 - r_1 - u_i > 0. \tag{1}$$

By integrating over u_i, the demand function is given by $D(r_1) = 1 - F(R_1 - r_1)$. For convenience, I denote the inverse of the elasticity of demand by $\epsilon(r_1) \equiv -1/\frac{r_1}{D(r_1)}\frac{\partial D(r_1)}{\partial r_1}$.

Next, I consider the break-even interest rate for the bank in date 1. For each entrepreneur, the cost of funding in both dates is c. The bank breaks even if this cost is equal to the expected benefit in date 1, pr_1, plust the expected profit in date 2, $p\gamma(R_2 - c)$. Hence, the break-even interest rate for the bank is $c/p - \gamma(R_2 - c)$.

Followed the approach of Weyl and Fabinger (2013), I introduce the imperfect competition in a reduced-form manner. More specifically, I assume that the bank charges the interest rate as follows:

$$r_1 = \frac{c/p - \gamma(R_2 - c)}{1 - \theta\epsilon(r_1)}, \tag{2}$$

where θ is the conduct parameter that governs the degree of imperfect competition. If $\theta = 1$, the bank is under monopoly, and $\theta = 0$, the market is under perfect competition.

3.2 Effect of Interest Rate Cap

I now analyze the impacts of the interest rate cap. To correspond to the empirical setting, I consider the case where the cap is imposed in date 1 at $\bar{r}$ and lifted in the beginning of date 2. The following prediction summarizes the condition under which the equilibrium credit supply increases in each period.

Proposition 1 *Consider the policy to cap the interest rate at $\bar{r}_1$ in date 1, and lift the cap in the beginning of date 2.*

(i) The equilibrium credit supply in date 1 increases if and only if $\bar{r}_1 \geq c/p - \gamma(R_2 - c)$.

(ii) The equilibrium credit supply in date 2 increases if and only if $\bar{r}_1 \geq c/p - \gamma(R_2 - c)$ and $\gamma > 0$.

[7] Petersen and Rajan (1995) interpret γ as the degree of competition of banks *after* the relationship is built. This parameter is generically different from the degree of competition in date 1. Also note that, for our purpose, it does not matter whether the borrower goes to outside economy or other banks in the economy if the bank cannot lock in the borrower.

Statement (i) claims simply that the credit supply increases as long as the cap is above the bank's break-even interest rate. Note that the condition in (i) is likely to be satisfied if θ is larger. To see this, if $\theta = 0$ (i.e., perfect competition), the equilibrium interest rate coincides with the break-even interest rate (i.e., equation 2). In this case, no $\bar{r}_1$ increases the credit supply.

Statement of (ii) claims that the interest rate cap has a persistent positive effect on credit supply as long as $\gamma > 0$. This is intuitive; conditional on lending in date 1, the bank finds it optimal to lend to successful borrowers in date 2. Note that these borrowers would have not been financed had there been no interest rate cap in date 1.

It is also straightforward that the socially optimal level of the interest rate cap in this model is the bank's break-even interest rate. The scope of the welfare improvement arises for two types of market distortions. First, the interest rate cap solves the static market power distortion and increase the sub-optimally low level of credit supply in date 1. Second, without the regulation, the bank does not engage in the "experimentation" of borrowers (i.e., create lending relationship in date 1 to extract rents from date 2) at the socially optimal level. This also arises due to the static market power distortion in date 1. Hence, the interest rate cap forces borrowers to engage in experimentation of socially profitable borrowers. Of course, the model is a partial equilibrium one, and one should be cautious when drawing welfare implication of the actual interest rate cap policy.

4 Empirical Results

4.1 Data

The main data set I use in this paper is the confidential micro data of SBS-3 (Scheduled Bank Statistics). In Bangladesh, all banks have to submit detailed information about advances from all of their branches to Bangladesh Bank at the end of each quarter. The information reported contains the number of outstanding loan accounts and total outstanding amount within each bin of the annualized interest rate, the presence and the types of collateral, classification status, borrowers' sector, and the economic purpose of the loans.[8] I use the data from the first quarter of 2008 to the fourth quarter of 2011 for my analysis.

To select the relevant category of loans subject to the regulation, I omit loans whose borrow-

[8] More detailed descriptions about the SBS-3 data set can be found in Bangladesh Bank (2013), accessed at https://www.bangladesh-bank.org/aboutus/draftguinotification/guideline/draftsbs.pdf. Note that there were some changes in the specification of the SBS-3 data entry in 2013, and this paper uses the data set before this revision.

ers' sectors fall into the category of government, other public sectors, and individuals. I then aggregate the data set at the bank branch level. To obtain the interest rate at each branch in each quarter, I take the weighted average by the outstanding loan amount excluding loans under bad/loss accounts (i.e., loans whose repayment is past due over nine months).

4.2 Regression Specification

My main identification strategy is the difference in difference method using the branch-level variation of the pre-regulation interest rates. As discussed in Section 2, the introduction and the removal of the interest rate cap are associated with a sudden decrease and an increase of interest rates for bank branches, particularly for branches whose interest rates are above 13 percent prior to the regulation. On the other hand, those that charge below 13 percent do not show a significant trend. Motivated by this observation, I run the following regression:

$$Y_{it} = \sum_{s} \beta_s \text{TrtIntensity}_i \times 1[t = s] + \eta_i + \nu_t + \epsilon_{it}, \tag{3}$$

where i is the bank branch, t is the quarter, and Y_{it} is the outcome variable of interest (e.g., interest rates, amount and number of outstanding loans). TrtIntensity_i is the measure that captures how much branch i is exposed to the interest rate cap regulation, and it is constructed as follows: I first take the average annualized interest rates of outstanding loans by bank branch i from the first quarter of 2008 to the first quarter of 2009. If it is above 13 percent, I take the difference between the average interest rates and 13 percent. If it is below 13 percent, I assign zero. Hence, β_s captures the marginal increase of the outcome variables in quarter t if the pre-regulation interest rate increases by one percent. To test the identification assumption of parallel pre-trends, I test whether β_s is insignificant and close to zero before the regulation starts. Note that β_s for $s = 2009Q1$ is omitted as baseline.

The sample of the regression is all bank branches that have positive amount of outstanding loans for business loans in the first quarter of 2008. This corresponds to 5,830 number of bank branches that belong to 48 banks. To incorporate the possibility that outcome variables are correlated within each bank and over time, the standard errors are clustered at the bank level.

While regression (3) informs the differential impacts of the interest rate cap regulation on various outcome variables, it is also useful to provide an estimates of how the outcome variables (e.g., credit supply measures) respond to one percentage point change of the interest rates. To

empirically estimate this magnitudes, I execute the following IV regression:

$$Y_{it} = \alpha_1 \text{InterestRate}_{it} + \alpha_2 \text{InterestRate}_{it} * 1[t \geq 2010Q4] + \eta_i + \nu_t + \epsilon_{it}, \tag{4}$$

where the first two terms are instrumented by $\text{TrtIntensity}_{it} * 1[t \geq 2009Q2]$ and $\text{TrtIntensity}_{it} * 1[t \geq 2011Q1]$. I allow the effects of the increase/decrease of the interest rates to differ when the interest rate cap is introduced (α_1) and when the interest rate cap is lifted (α_2). The asymmetric responses of credit supply is the prediction of the model of relationship lending in Section 3.

4.3 Results

4.3.1 Effects of Interest Rate Caps on Interest Rates and Credit Supply

Figure 3 shows the impacts of interest rate caps on interest rates and credit supply. Each figure shows the estimated coefficients on TrtIntensity_{it} interacted with quarter dummies.

Panel (A) shows the effects of the cap on the interest rates following regression (3). As predicted from the discussion of Section 2, there are strong and sudden effects on the branch-level interest rates. Before the regulation, there are no statistically significant pre-trends. Right after the cap is introduced, coefficients become suddenly negatively significant, indicating that bank branches with high treatment intensity decrease the interest rates relatively more. The coefficients keep decreasing until the regulation is lifted. This gradual response is likely because some outstanding loans were disbursed before the cap is introduced and the contracts were not revised. Right after the regulation is lifted in the first quarter of 2011, the coefficients increase suddenly toward zero. The coefficient is still negatively significant in the end of 2011. This is partly because of a fraction of outstanding loans are disbursed during the regulation, as well as the samples include term loans whose interest rate cap was not lifted in January 2011.

How does the credit supply responds to this decrease and then increase of interest rates? Panel (B) and (C) show the effects on the log of the amount and the number of total outstanding loans (excluding those under bad/loss accounts). There are no statistically significant pre-trends prior to the regulation, ensuring the validity of the difference-in-difference design. The figures reveal two striking findings. First, the introduction of the cap *increases* the credit supply. Second, removal of the cap does *not* decrease the credit supply. Note that the latter happens *despite* the fact that the interest rates significantly increased for high treatment intensity branches. These results are consistent with the prediction of Proposition 1 under the stated condition (imperfect competition of banks during the regulation period, and the presence of relationship lending).

Table 1 documents the same results in the regression table format. Columns (1) to (3) correspond to each panel of Figure 3. Note that the coefficients of Column (2) and (3) are almost identical, indicating that the increased credit supply is almost entirely driven by the extensive margin.

To formally test whether the credit supply responds to the changes of interest rates, Columns (4) and (5) show the results of the IV regression (4). In this specification, I investigate the impacts of the changes of interest rates induced by the two timing of the policy change: when the cap is introduced and when the cap is lifted. The results are summarized twofold. First, the credit supply responds negatively to the change of the interest rates when the cap is introduced. More specifically, one percentage point increase of the annualized interest rate decrease the credit supply by 11 percent. The magnitude is almost the same as the total outstanding amount and the number of loans, indicating that this increased credit supply is almost entirely driven by the extensive margin. Second, the credit supply does *not* respond to the change of interest rates when the cap is lifted. The insignificance result is *not* due to the imprecise estimates. In fact, the coefficient of the interest rates when the cap is introduced (α_1) is as precisely estimated as that when the cap is lifted (α_2). Furthermore, the null hypothesis that α_1 is the same as α_2 are easily rejected at 1% critical value.

Robustness. The identification assumption of the difference-in-difference specification is that the treatment intensity is not correlated with the unobserved trend of the outcome variables across branches. While I the absence of pre-trends prior to the regulation partially resolves the concern, it is still possible that the outcome variables suddenly changed their trends at the precise timing of the introduction and the removal of the cap. Here, I resolve this concern by controlling for further fixed effects, as well as using placebo of loans for individuals.

In Table 2, I show that the results are robust for controlling for additional fixed effects in regression (3). Columns (1), (3), (5) control for the interaction of the district and quarter fixed effects. (There are 64 districts in Bangladesh). These fixed effects control for the unobserved time-varying credit demand at the district level. The results are unchanged by this treatment.

Columns (2), (4), (6) further control for the bank and quarter fixed effects. Hence, this specification further controls for the unobserved time-varying credit demand for each bank. Including these fixed effects do not change the results except for one thing: I find no increase of interest rates when the cap is removed (after 2011Q1). This indicates that the reversal of interest rates documented in Table 1 is primarily driven by bank-level variation, but not within bank, across-bank-branch variation.

As yet another robustness exercise, I show that there are no responses of the cap to the category of loans which are not subject to the regulation. Table 3 show the results of regression (3), where the outcome variables are now defined using loans whose borrowers' sectors fall into the category of "Individuals". The treatment intensity dummies are defined in the same manner as Table 1 using loans for industry. I find no statistically significant effects on interest rates or the credit supply of loans for individuals.

4.3.2 Effects on Loan Performance

Table 4 documents the effects of interest rate caps on classified loans and collaterals. Columns (1) and (2) show the impacts of outstanding loans under bad/loss accounts. A loan is classified as bad/loss if the payment is past due for over nine months. There are no effects right after the cap is introduced (2009Q2-Q4), while the effect becomes significantly positive after one year (after 2010Q1). The lagged positive response is a natural consequence that a fraction of increased outstanding loans (i.e., Table 1) went into bad/loss after some non-repayment periods. Column (3) and (4) shows that the are positive statistically significant impacts on the proportion of the bad/loss account out of all the outstanding loans. This is consistent with the interpretation that the interest rate cap forced banks to initiate relationship with new borrowers, some of which ended up as failing relationship.

Lastly, Column (5) shows that there are no statistically significant effects on the proportion of uncollateralized loans, indicating that the banks do not respond to the interest rate cap by adjusting the level of collateral they require from the borrowers.

4.4 Interpretation and Policy Implication

The results established in this section is broadly consistent with the prediction in Proposition 1 in Section 3 under the stated conditions (imperfect competition of banks during the regulation period and the presence of relationship lending). Prior to the introduction of the interest rate cap, banks charged a markup in the interest rates they charge. Because of this markup, the banks can still keep supplying credit under the cap, and the reduced interest rates increased the credit demand. After the cap is lifted, the bank can "lock in" successful borrowers and increase the interest rates without reducing their loan demand. With this interpretation, this paper reveals two important market failures in banking market in Bangladesh prior to the regulation: the static market power distortion due to imperfect competition of banks, and the under-experimentation of the socially profitable borrowers.

It of course requires a caution to conclude that the interest rate cap in Bangladesh was an effective policy. Most importantly, because of the empirical design of using variation across bank branches to identify the causal effect of the policy, this paper is silent about the effect of the policy that happened economy-wide. Relatedly, there are other objectives than increasing credit supply that policy makers should have in mind. For example, one of the important concern by IMF about the interest rate cap in Bangladesh is the limited transmission of monetary policy. In light of these important caveats of the direct assessment of the regulation, the main contribution of the paper is not the direct assessment of the policy: Instead, the paper highlights an important nature of market failures in baking market in a developing country, and suggest a room of policy intervention to correct for the market failures.

5 Conclusion

This paper studies the effect of interest rate cap regulation in banking market in Bangladesh. An interest rate cap for business loans was introduced at 13 percent in 2009 and lifted in 2011. This regulation resulted in a sudden decrease and then increase of the interest rates for bank branches with high interest rates prior to the regulation, while un-affecting those whose interest rates were already lower than the cap. Using the difference-in-difference design, I document that (1) the introduction of the cap significantly increased the credit supply, and (2) this increase persisted after the regulation was lifted. The empirical findings are consistent with a model of relationship lending by imperfectly competitive banks. Taking stock, the results point out two types of market failures that existed prior to the regulation: sub-optimally high level of interest rates due to banks' market power, and under-experimentation of socially profitable borrowers.

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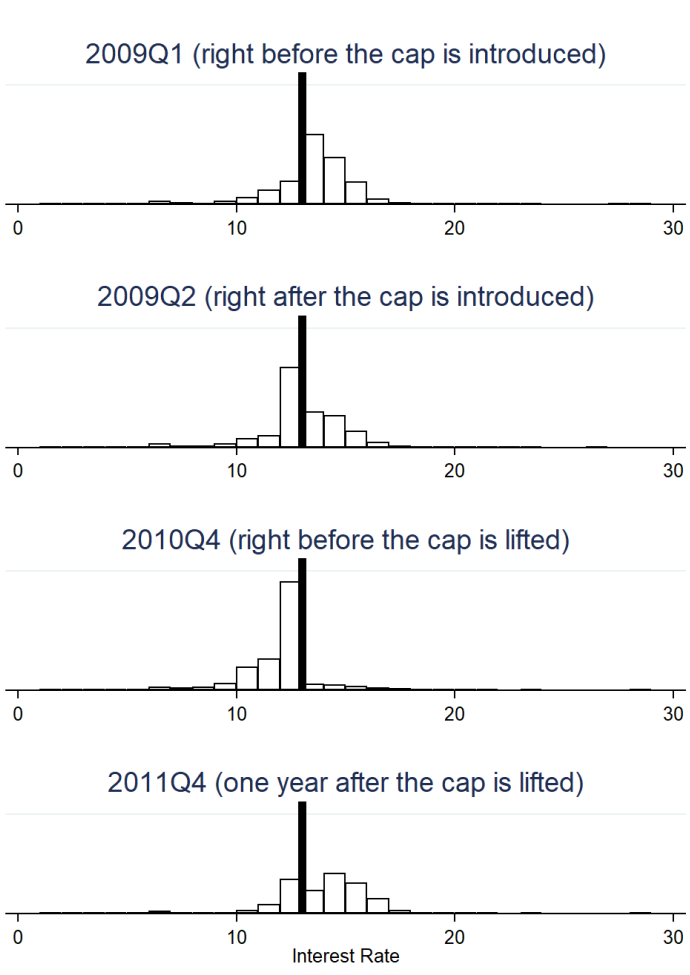
Figure 1: Interest Rate for Industry Loans around Regulation Period

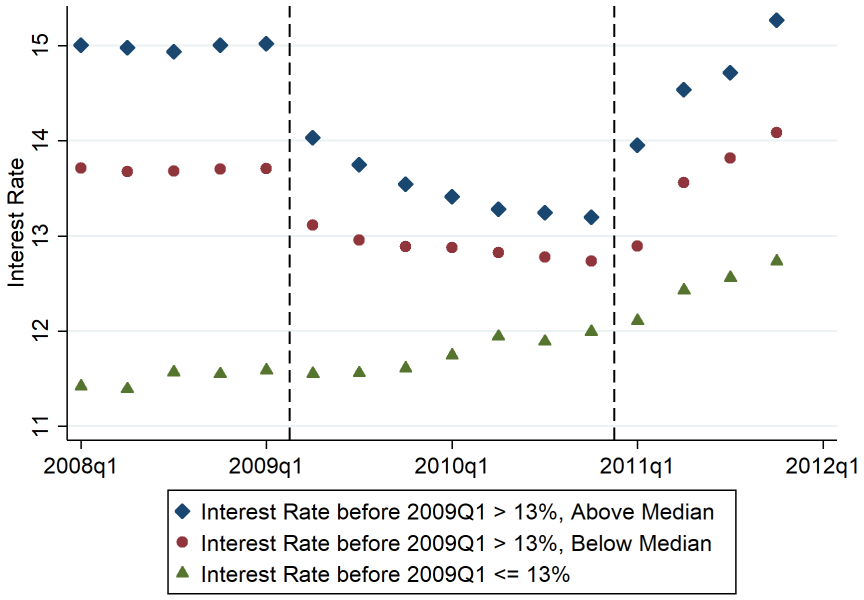
(A) Proportion of Outstanding Loans with Interest Rate below 13%

(B) Histograms of Outstanding Loans by Interest Rates



Note: The figures are created using the micro data of SBS-3 obtained from Bangladesh Bank. Panel (A) shows the proportion of loans whose annualized interest rates are equal to or below 13 percent in each quarter weighted by the outstanding amount. Panel (B) shows the distribution of loans for each annualized interest rates weighted by the outstanding amount.

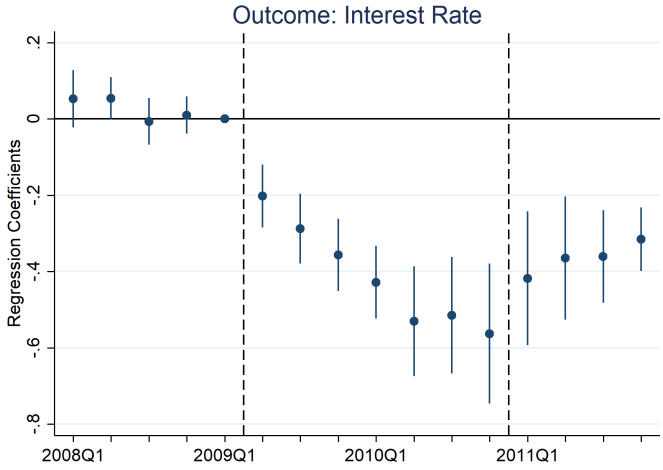
Figure 2: Transition of Bank Branch-level Interest Rate



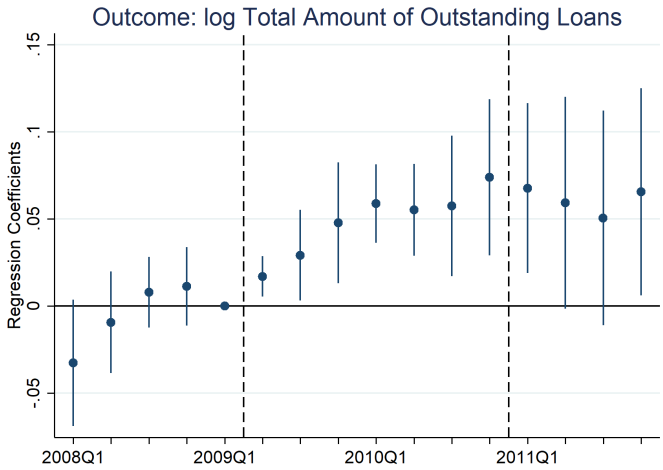
Note: The figure plots the average annualized interest rate of loans for industries charged by different branches in Bangladesh. I divide bank branches into three strata by the average interest rates charged prior to the regulation. The interest rate for each bank branch is computed from the micro data of SBS-3 obtained from Bangladesh Bank (see Section 4.1). The statistics is based on bank branches with at least one outstanding industry loans in the first quarter of 2008.

Figure 3: Impacts of Interest Rate Cap on Interest Rates and Credit Supply

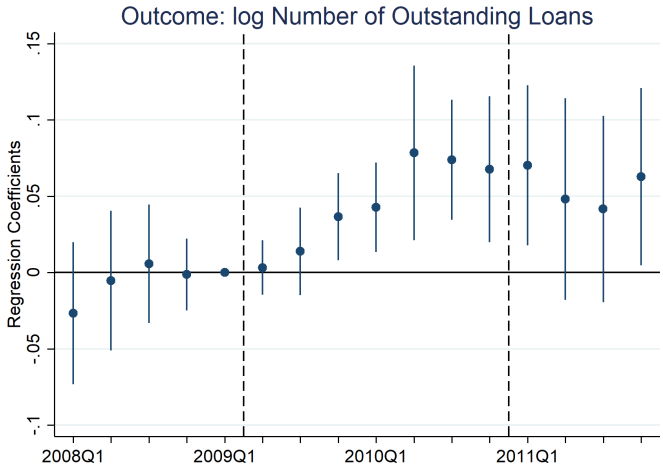
(A) Interest Rates



(B) log Total Outstanding Amount



(C) log Number of Outstanding Loans



Note: The figures plot the estimated coefficients of the treatment intensity interacted with quarter dummies of regression (3), as well as their 95 percent confidence intervals. The coefficient of 2009Q1 times treatment dummy is omitted as baseline. The interest rate cap is introduced on April 19, 2009 (2009Q2), and lifted on March 9, 2009 (2011Q1). Standard errors are clustered at the bank level. From the amount and number of outstanding loans (Panels B and C), loans under bad/loss accounts are excluded.

Table 1: Impacts of Interest Rate Cap on Interest Rates and Credit Supply

	(1) Interest Rate	(2) log Outstanding Amount	(3) log Number of Loans	(4) log Outstanding Amount	(5) log Number of Loans
Trt Intensity x 2008Q1-Q4	0.03	-0.01	-0.01		
	(0.03)	(0.01)	(0.02)		
Trt Intensity x 2009Q1	0.00	0.00	0.00		
	(.)	(.)	(.)		
Trt Intensity x 2009Q2-Q4	-0.28***	0.03***	0.02		
	(0.04)	(0.01)	(0.01)		
Trt Intensity x 2010Q1-Q4	-0.51***	0.06***	0.06***		
	(0.07)	(0.01)	(0.02)		
Trt Intensity x 2011Q1-Q4	-0.36***	0.06**	0.06*		
	(0.06)	(0.03)	(0.03)		
Interest Rate				-0.12***	-0.11***
				(0.03)	(0.04)
Interest Rate x after 2010Q4				0.03	0.03
				(0.04)	(0.03)
Specification	OLS	OLS	OLS	IV	IV
First Stage F-statistics				37	37
Branch FE	X	X	X	X	X
Quarter FE	X	X	X	X	X
Number of Banks	48	48	48	48	48
Number of Branches	5821	5821	5821	5821	5821
Observations	88743	88743	88743	88743	88743

Note: Column (1) to (3) show the results of the regression (3). TrtIntensity_i is the measure that captures how much branch i is exposed to the interest rate cap regulation, and it is constructed as follows: I first take the average annualized interest rates of outstanding loans by bank branch i from the first quarter of 2008 to the first quarter of 2009. If it is above 13 percent, I take the difference between the average interest rates and 13 percent. If it is below 13 percent, I assign zero. Column (4) and (5) follows regression (4), where the two endogenous variables are instrumented by $\text{TrtIntensity}_{it} * 1[t \geq 2009Q2]$ and $\text{TrtIntensity}_{it} * 1[t \geq 2011Q1]$. Standard errors are clustered at the bank level. *p<0.1; **p<0.05; ***p<0.01.

Table 2: Impacts of Interest Rate Cap: Including District and Bank times Quarter Fixed Effects

	(1) Interest Rate	(2) Interest Rate	(3) log Outstanding Amount	(4) log Outstanding Amount	(5) log Number of Loans	(6) log Number of Loans
Trt Intensity x 2008Q1-Q4	0.03	0.05	-0.00	0.01	-0.00	-0.01
	(0.03)	(0.04)	(0.01)	(0.01)	(0.02)	(0.01)
Trt Intensity x 2009Q1	0.00	0.00	0.00	0.00	0.00	0.00
	(.)	(.)	(.)	(.)	(.)	(.)
Trt Intensity x 2009Q2-Q4	-0.29***	-0.27***	0.03***	0.04***	0.02*	0.03**
	(0.04)	(0.04)	(0.01)	(0.01)	(0.01)	(0.01)
Trt Intensity x 2010Q1-Q4	-0.50***	-0.46***	0.06***	0.08***	0.06***	0.07***
	(0.07)	(0.06)	(0.01)	(0.01)	(0.02)	(0.02)
Trt Intensity x 2011Q1-Q4	-0.38***	-0.54***	0.06**	0.10***	0.06**	0.09***
	(0.06)	(0.07)	(0.03)	(0.02)	(0.03)	(0.02)
Specification	OLS	OLS	OLS	OLS	OLS	OLS
Branch FE	X	X	X	X	X	X
Quarter FE	X	X	X	X	X	X
District x Quarter FE	X	X	X	X	X	X
Bank x Quarter FE		X		X		X
Number of Banks	48	48	48	48	48	48
Number of Branches	5821	5821	5821	5821	5821	5821
Observations	88673	88641	88673	88641	88673	88641

Note: The table reports the results of the regression (3). See the footnote of Table 1 for additional information. Standard errors are clustered at the bank level. *p<0.1; **p<0.05; ***p<0.01.

Table 3: Impacts of Interest Rate Cap: Placebo (Loans to Individuals)

	(1) Interest Rate	(2) log Outstanding Amount	(3) log Outstanding Amount
Trt Intensity x 2008Q1-Q4	0.00	0.00	0.01
	(0.04)	(0.02)	(0.02)
Trt Intensity x 2009Q1	0.00	0.00	0.00
	(.)	(.)	(.)
Trt Intensity x 2009Q2-Q4	0.05	0.01	0.01
	(0.04)	(0.02)	(0.02)
Trt Intensity x 2010Q1-Q4	0.04	0.00	0.04
	(0.06)	(0.03)	(0.03)
Trt Intensity x 2011Q1-Q4	0.11	-0.01	0.06
	(0.07)	(0.04)	(0.04)
Specification	OLS	OLS	OLS
Branch FE	X	X	X
Quarter FE	X	X	X
Number of Banks	47	47	47
Number of Branches	5370	5370	5370
Observations	72707	72707	73335

Note: The table reports the results of the regression (3), with the outcome variables of interest rates and outstanding loans borrowers' sectors fall into the category of individuals. The treatment intensity dummies are defined in the same manner as Table 1 using loans for industry. See the footnote of Table 1 for additional information. Standard errors are clustered at the bank level. *p<0.1; **p<0.05; ***p<0.01.

Table 4: Impacts of Interest Rate Cap on Loan Performance

	(1) log Bad/Loss Loan Amount	(2) log Bad/Loss Loan Count	(3) % Bad/Loss Loan Amount	(4) % Bad/Loss Loan Count	(5) % No Collateral Loans
Trt Intensity x 2008Q1-Q4	0.02	0.02	-0.13	-0.03	-0.37
	(0.02)	(0.01)	(0.10)	(0.10)	(0.34)
Trt Intensity x 2009Q1	0.00	0.00	0.00	0.00	0.00
	(.)	(.)	(.)	(.)	(.)
Trt Intensity x 2009Q2-Q4	0.01	0.02	-0.01	0.14	0.07
	(0.02)	(0.02)	(0.10)	(0.11)	(0.16)
Trt Intensity x 2010Q1-Q4	0.07	0.09**	0.30*	0.44***	0.58
	(0.04)	(0.04)	(0.16)	(0.12)	(0.40)
Trt Intensity x 2011Q1-Q4	0.10	0.12*	0.66	0.82***	1.06
	(0.06)	(0.07)	(0.43)	(0.29)	(0.95)
Specification	OLS	OLS	OLS	OLS	OLS
Indep. Var. Mean (2008Q1)	3.35	2.38	13.42	13.94	4.58
Branch FE	X	X	X	X	X
Quarter FE	X	X	X	X	X
Number of Banks	48	48	48	48	48
Number of Branches	4722	4879	5821	5821	5821
Observations	52616	55625	88743	88743	88743

Note: The table reports the results of the regression (3). A loan is classified as "bad/loss" if the payment is past due for over nine months. The unit of the outcome variables in Columns (3) and (4) are in percentage points. Standard errors are clustered at the bank level. *p<0.1; **p<0.05; ***p<0.01.