Asset-side Implications of Banks' Funding Costs

Yogeshwar Bharat* Subhadeep Halder† Nirupama Kulkarni‡

(Preliminary Draft: September 15, 2023)

Please do not circulate without permission

Abstract

Regulated banking systems with mandated fixed saving deposit rates below the prevailing market rates allow banks to raise deposits cheaply. Consequently, banks lean towards safer assets like government securities, limiting resources available for loans. We examine a 2011 deregulation episode in India using data from Indian banks from 2006 to 2020. Private sector banks increased their share of loans as a share of deposits by 7.6% compared to public sector banks. Private sector banks also increased loans as a percentage of assets by 2%. We construct a static banking model with heterogeneous banks and depositors to explain these empirical findings. Our paper underscores how deposit rate regulation can shape bank asset portfolios, potentially intensifying credit constraints and limiting the level of financial intermediation in the economy. By highlighting the impact of deposit rate deregulation in stimulating bank investment in high-yielding projects, our study aims to showcase how deregulation can alleviate credit shortages and promote economic growth.

JEL Classification: G20, G21, G22, G28, O53

Keywords: Deposit franchise, banking, deposit insurance, state-owned banking, emerging economies

*CAFRAL, Research Department, Reserve Bank of India Main Building, Fort, Mumbai 400 001. E-mail: yogeshwar.bharat@cafral.org.in

†Economics and Planning Unit, Indian Statistical Institute – Delhi Centre, 7 SJS Sanswal Marg, New Delhi – 110016. E-mail: subhadeep20r@isid.ac.in

‡CAFRAL, Research Department, Reserve Bank of India Main Building, Fort, Mumbai 400 001.Ė-mail: nirupama.kulkarni@cafral.org.in

Views expressed in this paper are personal. Not necessarily the official viewpoint of CAFRAL or the Reserve Bank of India (RBI).

1 Introduction

The composition of banks' asset is significantly impacted by any change in its funding costs. One perspective suggests that if funding costs rise, banks might seek high-yield assets to offset these increased expenses. However, this strategy entails investing in riskier assets, potentially jeopardizing their balance sheets and leading to further cost escalation. On the other hand, if banks can maintain a larger margin without compromising deposit inflow despite elevated funding costs, they could mitigate these expenses without resorting to high-return, high-risk investments. This approach hinges on maintaining a reliable depositor base and highlights the delicate balance banks must strike between risk and profitability in response to changes in funding costs.

In this paper, we show that despite an increase in their funding costs, banks can maintain the required margins and therefore can indulge in investing in safer assets if they are assured of a constant inflow of deposits. We use the context of the Indian banking setup to show these implications. Indian banks have primarily adhered to a conventional model, where they acquire funds through deposits and market borrowings. Subsequently, they utilize these funds to extend loans to businesses, individuals, and financial entities, or invest in government securities. Deposits constitute the primary funding source for banks, with savings deposits accounting for about 30-40% of total deposits. Saving deposit rates were regulated for a substantial period of time (2003-2011) with the saving deposit rate fixed at 3.5% which got deregulated in the year 2011[1]. An implication of this regulation was the constant saving deposit rates for all banks which implies that the spread, defined as the difference between the market rate and deposit rates charged by the banks remain fixed across banks, therefore, funding costs remain approximately the same. Hence, any shifts in asset composition during this time can be attributed to factors other than changes in funding costs.

Following the deregulation of savings deposit rates, banks gained the flexibility to adjust these rates in order to attract depositors and optimize their funding costs. This adjustment could involve increasing the spread or expanding the depositor base. However, raising the spread could trigger a reduction in deposits if alternative investment options prove more attractive (Wang et al. (2022)). Consequently, altering savings deposit rates to widen the spread might inadvertently result in higher funding costs for the bank. Despite this, depositors could still opt to remain with the bank due to the institution-specific features associated with the bank where they have deposited their funds. A defining feature of the Indian banking sector is the heterogeneity in the

[1] More on this regulation can be found in the discussion paper by RBI.

ownership of the banks with public sector and private sector banks holding a predominant share in the total industry. A substantial proportion of total savings deposits are parked in the public sector banks that also have a higher share of insured depositors as compared to the private sector banks. Although the proportion of uninsured depositors, that are more likely to withdraw their deposits in the event of any change in spreads or decline in the value of bank (Drechsler et al. (2023), Huang (2011), and Pennacchi (2018)), is lower in public sector banks because of the fact that these banks have the backing of the sovereign government, uninsured depositors in public sector banks enjoy a "de-facto" insurance which prevent them from withdrawing their deposits leading to a stable flow of funds for the public sector banks. This advantage is not available to the private sector banks and therefore need to maintain a lower spread (higher savings deposit ratio) in order to attract deposits which further escalates the cost of funding for these banks.

We demonstrate how the deregulation of savings deposit rates amplified the disparity between the spreads charged by private sector banks and those of public sector banks with public sector banks charging a higher spread (by not changing the deposit rates when the market rate changes). This observation highlights that the funding costs of private sector banks surpass those of public sector banks, that led to change in the composition of asset for private banks and increasing their share of high yielding risky assets. To assess the impact of such deregulation on private sector banks with respect to its loan as a share of asset as well growth of loan, we use a difference in differences methodology to evaluate the average effect on a private bank vis à vis public sector after saving deposit rate was deregulated in the year of2011. Using bank-level data from 2006 to 2020, we found that on an average, private sector banks significantly increased their investment in loans as a share of deposit by around 7.6%, post deregulation in savings rate, as compared to the public sector banks. As a percentage of assets, private sector banks experienced a 2% growth in loans. The deregulation also resulted in a 33% increase in total loan compared to that of public sector banks. Our results are robust as we have also tested the validity of our model by testing for pre period parallel trend and our event study design corroborate to pre period parallel trend.

In addition to the empirical model that studies the impact of deregulation on loan to deposit share for private sector bank with respect to public sector banks, we build a static model of banking based on Drechsler et al. (2017), and Drechsler et al. (2023) with heterogeneous banks and deposit types to demonstrate our empirical findings of divergence of composition of assets post deregulation. In our model, banks only invest in two kinds of assets, and the only source of funds for these banks are deposits.

We found that when the share of insured depositors are higher in public sector banks, then it makes their funding costs lower as the spreads they charge on their depositors are higher, leading to higher profit margins which reduces the need to invest in the high yielding risky assets to cover for the costs and they indulge in the "lazy lending" phenomena prevalent in the Indian banking industry[2] (Mohan (2003), Acharya and Rajan (2020)).

The remainder of this paper proceeds as follows.Section 2 provides a review of the literature. Section 3 covers the institutional details of the Indian banking sector and deregulation in savings deposit rates, while section 4 describes the data and cover some descriptive statistics. Section 5 specifies the empirical design and present the results whereas in section 6 we build a static model to explain the channel responsible for our empirical results. Section 7 concludes and discusses avenues for further research.

2 Related Literature

Our paper belongs to the literature on the maturity transformation role of modern banking theory wherein banks issue short-term deposits and make long-term investments (Diamond and Dybvig (1983), Kashyap et al. (2002), Hanson et al. (2015), Di Tella and Kurlat (2021)). Central to this literature is the liquidity risk that arises from issuing run-prone deposits (Brunnermeier et al. (2012), Bai et al. (2018)). Although we do not explicitly quantify measures of liquidity risk, its presence is pivotal in our theoretical analysis, where the sole source of bank funding is deposits. In our model, risk emerges due to the banks' need to invest in high yielding assets (loans) to cover deposit-raising costs, potentially yielding higher returns but accompanied by downside risk and search costs. Unlike (Brunnermeier et al. (2012)), our model doesn't distinguish between various asset-side risks, but rather classifies risks on the liability side of a bank's balance sheet by considering different types of depositors.

Our paper also contributes to the literature on bank's risk management (Freixas and Rochet (2008), Herndon and Matvos (2016), Berger and Bouwman (2017), van Greuning and Bratanovic (2018), English et al. (2018), Nagel and Purnanandam (2020),Drechsler et al. (2021), Di Tella and Kurlat (2021), Drechsler et al. (2023)). Banks invest a substantial amount in order to generate market power in the deposits market by charging higher deposit spreads (gap between the short-term rate on other assets and the deposit rate) when interest rates are high (Kashyap et al. (2002), DeAngelo and Stulz

[2] A detailed overview of this phenomena can be found here

(2015), Stein (2012), Moreira and Savov (2017), Drechsler et al. (2017), Drechsler et al. (2021)). However, not all types of depositors continue to remain with the bank with an increase in interest rates increases the opportunity cost of depositors to continue to remain with the bank as against investing in other short-term assets. Furthermore, increased interest rates diminish the value of bank assets, triggering higher withdrawal rates among depositors. Given that deposits constitute the primary source of bank funds, an increase in the proportion of these 'less sticky' depositors can strain bank finances. Closest to our paper is Drechsler et al. (2023) who looks at the presence of these two kinds of depositors on the market power of banks during an event of an increase in interest rates. However, their paper only looks at the liability side of the bank's balance sheet assuming that banks have a flow of asset income. We explicitly take the asset-side of the balance sheet in our analysis and show how the size of these different types of depositors can have implications on the share invested in different types of assets. Another significant aspect of our model lies in its portrayal of different types of banks within the economy. We distinguish between public-sector banks, which benefit from sovereign government support during crises, and private-sector banks, lacking such a guarantee. Consequently, private-sector banks face the challenge of not only offering higher deposit rates compared to their public-sector counterparts but also seeking assets with higher returns to sustain their profitability.

The literature has also explored the relation between deposit funding and bank assets. Gatev and Strahan (2006) demonstrate that banks often witness deposit inflows during periods of financial strain, enabling them to supply increased liquidity to their borrowers. Kirti (2020) shows that banks with a higher proportion of floating-rate liabilities tend to provide more floating-rate loans while Egan et al. (2017) investigate the impact of deposit competition on financial fragility. Our paper demonstrates the presence of different types of banks and their interactions with the different types of depositors on the classes of assets invested by the banks and its implications on the bank's profitability.

3 Institutional Details

3.1 Banking Sector India

The formal credit system in India is comprised of three components:

1. Scheduled Commercial Banks - Public Sector Banks, Private Sector Banks, and Foreign Banks

2. Non Scheduled Banks - Cooperative banks, small finance banks, payment banks.
3. Non-Bank Financial Institutions - NBFCs and development finance institutions

Following Agarwal (2023), we highlight certain facts about the banking sector. In 2022, the share of Bank and Non Bank assets stood at 118% of GDP. Of this, Public Sector Banks, Private Sector Banks, and NBFCs accounted for 101% of GDP of assets. Historically, Public Sector Banks have been crucial for supporting bank lending activity. In the late 1990s, these banks along with government directed development institutes contributed to around 80% of system assets. By 2020, this share dropped to around 50% due to increased penetration by NBFCs and Private Sector Banks. Shadow banks have increased their presence capturing around 16% of the financial system measured by assets. NBFCs (part of the shadow banking system) provide similar services like banks but depend more on wholesale funding and face less regulation. Mutual funds are a key part of the shadow banking system due to their role in funnelling funds into NBFCs.

In India, the banks hold a certain amount of cash with the RBI as reserves on which they earn interest. They give out loans (credit) based on deposits received from the depositors. They earn interest on their loans and pay interest on their deposits. A similar model exists for Mutual funds and NBFCs where they raise funding by taking deposits and paying interest on those; while investing the cash at hand into downstream projects [3]. A key component here is the deposit interest rate being paid out by the financial institution; which can also be thought of as the funding cost for the institution.

3.2 Savings Deposit Rate Deregulation

India pursued financial reforms since the early 1990s. Deregulation of interest rates was a key component of these reforms. It was intended at improving competition, allocative efficiency and monetary policy transmission. By Oct 1997, most of the interest rates were deregulated. The only deposit side interest rate that remained regulated was the savings deposit interest rate (also referred to as savings deposit rate in this paper). The RBI released a discussion paper on highlighting the potential pros and cons of deregulating the savings deposit rate such as - improved financial inclusion, worsening of asset/liability mismatch, improved monetary policy transmission, etc. For scheduled commercial banks, in India, deposits are a major source of funding. Savings deposits form around 30-50% of a bank's total deposits. Savings deposits offer the liquidity of current accounts while paying an interest rate on the deposits which is a

[3] For more details see Prabheesh and Durai (2019), Ganesh-Kumar and Gaurav (2019)

feature of term deposit accounts. In the period 2001-10, the aggregate savings deposits saw an average annual growth rate of 19.4%. Further, households are the predominant users of savings deposit accounts. The RBI deregulated the savings deposit rate in Oct 2011 after maintaining at 3.5% for over a decade. However, after Oct 2011, majority of the banks in India have maintained the savings deposit rate at 3.5% with the exception of Yes Bank which went up as high as 7% (possibly to gamble for survival prior to its collapse).

4 Data and Summary Statistics

For deposit and credit data, we use RBI's Bank Statistical Return (BSR) database. It contains deposit and credit data variables such as amount, number of accounts, etc. The data is very granular and has a granularity at year, bank, district, state, branch, type of account holder, geography, applicable interest rate range and time duration, sector, borrower account type, etc. We also have bank level data from the RBI's Database of Indian Economy (DBIE) that gives us assets and liabilities variables such as government securities holding, loans and advances, cash credit, investments, etc. to list a few. For our analysis, we define a variable "Spread" as "Repo Rate - Savings Deposit Rate" at bank-year level. The Repo Rate data has been taken from the CEIC database and aggregated at year level.

For the period prior to 2011, the savings deposit rate was regulated by the RBI and was pegged at 3.5% from March 2003 to Oct 2011. Post October 2011, the saving interest rate was deregulated as a part of a larger deregulation of various other banks rates. Pre deregulation the the saving interest rates was known as it was held constant for all banks. Post deregulation in 2011, every bank was independent of putting up their own rates (however, public sector banks didn't change their saving deposit rates), for each bank we did not have a ready data-set of savings deposit rate across banks. We prepared a novel data set at a bank-year level for our purpose. The historical trend of savings deposit rate for banks was obtained via the snapshots of their web-pages from archive.org. Missing data was imputed using forward-fill or backward-fill where applicable and then aggregated at a bank-year level. We were able to collate bank-year level time series of savings deposit rates for 35 banks including public and private sector banks, while we have data for 58 banks in the regulated period.

Using our novel data set of saving deposit rates across banks, we find from figure 4 that saving deposit rate was pegged at 3.5% prior to deregulation. Post deregulation, the saving deposit rates of public sector banks remain unchanged for a long time (till

2017) but on the other hand private banks savings rate truly became deregulated and saw variation in saving rates over time on an average. Similar trend was seen in the time series of "Spread" too. Figure 5 shows that public sector bank is charging a higher spread vis à vis private sector banks. Our study looks at the deposit franchise channel of public sector banks coupled with higher share of insured borrowers (figure 11) which leads to "Lazy Lending" by public sector banks post deregulation and private sector banks are more involved in investing into high yielding risky asset in form of providing loans over investing in government securities as they have a higher share of uninsured depositors and a relatively lower "Spread" than public banks.

Table 1 shows descriptive statistics for various bank level variables used in our analysis by their ownership. In our summary statistics we have data from 79 different banks spanning from fiscal year 2006 to 2020 (right before COVID19 pandemic). The last column tests the difference in group means of banks in the pre and post deregulation era and this mean difference test is conducted for private and public sector bank separately. Average of loan to deposit and loan to asset ratio shows a significant increase for private sector banks per and post deregulation, whereas for public sector bank, difference is not significant for these variables. When we observe absolute values of deposit, assets, and loans, mean difference for these variables are positive and significant for public and private sector banks. However, we cannot argue that they capture any causal impact of the deregulation, but it alludes to some time specific trend and correlation related to deregulation and banks asset and deposit size. Similarly, we see that the difference in mean of "Spread" for public sector banks are significant and positive, signifying that even post deregulation, public sector banks are not changing their saving deposit rates, but that is not the case with the "Spread" of private sector bank. In the next section, we will try to capture the causal impact of deregulation primarily on private sector banks and how it affect their composition of asset portfolio in comparison to public sector banks.

5 Impact of Deregulation on Saving Deposit and Loans Disbursed

The deregulation of saving interest rate in the year of 2011 had a significant effect on the trajectory of loan to deposit ratio between public and private sector banks. Figure 6 clearly shows that post deregulation, private sector and public sector banks a re showing divergence in loan to deposit ratio and the share is increasing for private sector banks, not only that, the gap between the share is also increasing. Simultaneously, when we look at the impact of deregulation on investment in government securities, figure 7 doesn't show a large divergence over time as we observed in case of loan to deposit ratio. Looking at the growth of loan to deposit and government securities to deposit shows us the pattern due to deregulation. But the deregulation had a primary effect on saving deposit rates and the first thing that get affected will be level of deposit for private and public sector banks. Figure 9 shows the growth of deposit over time for public and private sector banks and we find that private sector banks has a high growth in aggregate deposits. This leads to a higher share in uninsured depositors for private banks which can be seen in figure 11 where share of insured depositors is consistently lower for private banks vis à vis public sector banks. Combined with higher uninsured depositors and high deposit growth, loans growth rate has been even higher for private sector banks than public sector banks and it is clearly established in figure 8.

In this section we try to test the hypothesis that post deregulation of saving deposit rates, does private and public sector banks behave differently with respect to their asset portfolio. We try to establish that post deregulation, the public sector banks didn't increase their saving deposit rate but in order to attract more depositors, private sector banks increased their saving rates. In order to increase their profit, private sector banks invest in high yielding risky assets in form of loans rather that investing in government securities over the required SLR. Public sector banks were able to extract extra profit by increasing the spread compared to private sector banks. In order to test the hypothesis that private sector banks are investing more in high yielding risky assets compared to public sector bank, we are using standard difference in differences analysis with our treatment group are private sector banks and control group is public sector banks. The rationale to use public sector bank as control group can be seen from figure 4, where post deregulation, the saving rates remains unchanged over time for public sector banks and private sector banks has a variable rate. So, using difference in differences method, we will try to find the average effect of deregulation on private sector banks lending decision vis à vis public sector banks.

5.1 Empirical Strategy

A difference in differences estimation strategy follows naturally from the policy variation that occur due to deregulation. Although the policy was applicable for all banks but figure 4 shows that for public sector banks the rate remains unchanged after policy change and it was private sector banks whose rates are changing with time. So, our treatment and control groups are private and public sector banks respectively. We will further check our assumption of control and treatment group using pre-trend analysis. We construct the treatment effect variable as follows:

$$Deregulation_{b,t} = \mathbb{1}_{b \in Private\ Bank}\ X\ \mathbb{1}_{t>2011} \quad (1)$$

where b denotes a bank, t denotes year. The difference in differences strategy implemented is a standard two way fixed effect framework:

$$y_{b,t} = \beta Deregulation_{b,t} + \phi_b + \delta_t + \epsilon_{b,t}, \quad (2)$$

where $y_{b,t}$ denotes outcome variables for bank b in period t, ϕ_b denotes bank fixed effects, and δ_t denotes year fixed effects. Our primary object of interest is β, which captures the average treatment effect (ATE). The treatment and control groups are already mentioned above.

5.2 Results

Our difference in differences estimate β shows that for private sector banks, share of loans to deposit ratio has risen post deregulation and our estimates are positive and significant. Table 2 shows that for private sector banks, there is an increase of 7.6 percentage point in loan to deposit ratio compared to public banks, so is the case with loan to asset ratio too. Where private sector banks share increased on an average by 2 percentage points. We have shown that loans for private sector banks has risen as a share of deposit and loans both but we should also look the effect of this deregulation at levels of deposit and loans since savings rate deregulation would have a direct impact on the quantum of deposit and therefore loans disbursed.

Similar results are also seen when we look at growth of loan disbursed and total asset of private sector banks with respect to public sector banks, our estimate β is positive and strongly significant. Table 3 shows that for private sector banks, the deregulation resulted in a 33 percentage point increase in total loans compared to public banks, so is the case with total asset too. Where private sector banks showed an increased on an average by 31 percentage points over public sector banks.

5.3 Parallel trend Assumption for the Model

To check if our difference in differences strategy is successful in this context, we need to ensure that pre policy parallel trend holds.To test the assumption, we follow Autor (2003). More specifically, we run an event design study to see the effect before and after the deregulation. We run the following regression:

$$y_{b,t} = \sum_{l=-k}^{k} \beta_l Deregulation_{b,t}(t = 2011 + k) + \phi_b + \delta_t + \epsilon_{b,t}, \quad (3)$$

Here $k > 0$; A test for pre policy parallel trend assumption is that $\beta_l = 0 \; \forall l < 0$ i.e. coefficients of all leads of the treatment is 0. Figure 10 showing the event study establishes the parallel trend assumption pre intervention. It is interesting to note that the intervention started to show effect (this is the effect captured for public bank with respect to private bank hence negative) with a lag and that can be attributed to the fact that banks might take time to adjust their portfolio structure. We claim that our coefficient is robust as we have taken bunch of fixed effects to control for various time and individual varying variations.

In this section, we have established using our empirical strategy that post deregulation private sector banks have increased their their share of loan disbursement as share of total deposit in comparison to public sector banks. We have also seen similar effect on level terms too where growth of loans and deposits were higher for private sector bank vis à vis public sector bank. Our empirical strategy captures the effect of such deregulation but we are not able to figure out, how much this is because of the deposit franchise which is enjoyed by public sector bank more than private sector banks and simultaneously the share of insured/uninsured depositors that puts an extra pressure on private sector banks to indulge in venturing into more high yielding risky investment decision compared to public sector banks. In the next section, we try to formulate a static partial equilibrium model with two types of banks and understand how deposit franchise intertwined with insured/uninsured depositors has an impact of banks decisions of their asset portfolio.

6 Model

We provide a simple model of banks' profit maximization based on Drechsler et al. (2017). In the baseline case, we build a simple static model with imperfect competition between banks. For simplicity, we focus only on the bank side of the story, keeping the household and firm side silent for the time being. There are two types of banks: public-sector banks and private-sector banks. While the former is owned by the sovereign state and therefore has sovereign backing, no such provision is available for the private banks. We shall assume, in the baseline case, that all the banks within a group, public or private, are the same and therefore talk about only the representative bank from both groups. We can also think of looking at the problem of the average public-sector bank and the average private-sector bank but the results and the underlying reasoning will not change because of that[4].

The bank's problem is to invest in assets from the amount of total deposits it raises, which is the only source of funds for them, in order to maximize its profits. There are two kinds of assets that the bank can invest in risky loans and risk-free government bonds. As mentioned above, deposits are the only source of their funding. Figure 1 shows the typical balance sheet of a bank in our baseline scenario.

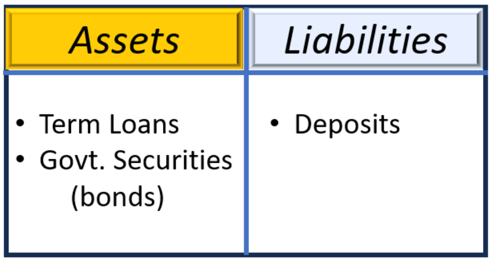

Figure 1: Balance Sheet of a bank (Public or Private)

There are two types of agents in the economy, call them borrowers and depositors. We assume that the two types of agents are segregated from each other (Kashyap et al. (2020), Alvero et al. (2023))[5]. The total mass of agents is normalized to 1 for simplicity. Denote by $\mathcal{L}$ the total fraction of agents who are borrowers and $\mathcal{S}$ the fraction of agents who are depositors

$$\mathcal{L} + \mathcal{S} = 1$$

Borrowers can borrow either from the public sector bank or the private sector bank but the important point to note is that they co-exist in the same market, which will amount to some kind of congestion costs for the banks (Caballero et al. (2008)).[6] Similarly, depositors can also deposit their savings in both the banks. We further assume that the banks don't discriminate depositors but some depositors, by virtue of the amount they deposit, become classified as "insured" depositors, who are covered under a deposit insurance scheme, while the rest are "uninsured". In the baseline version of our model,

[4]Here we assume that there is no market power within the groups but in the subsequent sections, we will also have market power and market concentration in the banking model

[5]This is not a strong assumption and we use this only to simplify our calculations. Given that we are only bothered about the bank's problem in our baseline model, having a segregated household sector will not change any of our calculations.

[6]While the term "congestion cost" has been used in banking mainly for zombie lending(see Acharya and Steffen (2015), , Acharya et al. (2019), Acharya et al. (2021) Kalemli-Özcan et al. (2022)), the context of congestion in our setup is emanating from the fact that the same pool of borrowers have to be served by the banks. This is like the classic Cournot competition, where the same market of buyers are served by 2 or more sellers and al the firms compete to capture the larger share of market (Maskin and Tirole (1987)).

banks choose how much deposits to raise from these depositors.

6.1 Assets Side

As discussed earlier, banks can invest their total deposits into two types of assets. In this static version of the model, we do not focus on the maturity of the assets and assume that they both are of only 1 time period thus precluding maturity transformation. Banks can invest in a government bond that is deemed to be risk-free and pays a return equal to the short-term rate or they can invest in risky loans that pay a risk premium over and above the short-term rate. premium over and above the short-term rate. Let γ^{Pub} be the proportion of deposits issued in risky loans and $(1-\gamma^{Pub})$ in government securities by the public sector bank and the corresponding ratios for the private banks are γ^{Pri} and $(1-\gamma^{Pri})$. The return from investing in government bonds is assumed to be r, the short-rate (repo rate) while, following Drechsler et al. (2017), investing in loans is risky and the bank charges a premium over an above the short-rate which is given by ξ_0^j for $j \in \{Pub, Pri\}$. However, given that these loans are deemed to be risky, thus the bank has limited lending opportunity and that is given by ξ_1^j for $j \in \{Pub, Pri\}$. The parameter ξ_1^j is the "congestion cost" associated with lending to borrowers in the same lending market [7]. As mentioned earlier, $\mathcal{L}$ is the total fraction of borrowers to be served in the market, which we assume to be fixed. Therefore,

$$\mathcal{L} = \gamma^{Pub} + \gamma^{Pri} \tag{4}$$

where γ^{Pub} and γ^{Pri} are also the proportion of borrowers served by the public and private sector banks respectively[8] .

Figure 2 provides a broad overview of the type of assets the banks can invest in and their associated returns.

[7] This assumption is required since we are not describing the household or the firm side explicitly, which means that we are not considering that firms can have access to credit from other institutions as well apart from banks.

[8] Consider γ^j for $j \in \{Pub, Pri\}$ as a representation of the fraction of borrowers chosen by the banks. This fraction is equivalent to the portion of borrowers served out of the total number of borrowers, denoted as $\mathcal{L}$. Essentially, it reflects the share of loans to deposits selected by the banks.

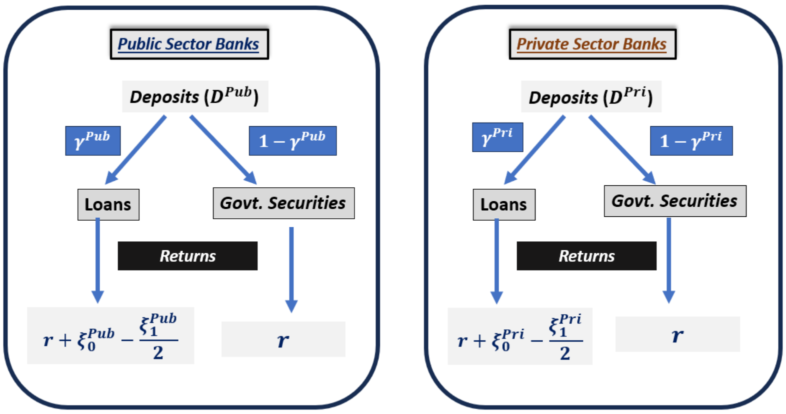

Figure 2: Assets Side

6.2 Deposit Side

The deposits side of the bank holds a distinct interest. The bank has access to two types of depositors: insured and uninsured. Insured depositors are typically individual savers who are covered by the deposit insurance limit established by the sovereign government. In contrast, uninsured depositors are individuals or entities that deposit funds for transactions or long-term savings but aren't protected by the insurance limit. As we treat total deposits without differentiating between savings, term, or current deposits, the nomenclature of insured and uninsured is defined based on the insurance limit. However, given that the bank itself can be backed by the sovereign government, an inherent "de-facto" insurance mechanism is in place for public-sector banks. With sovereign backing, even borrowers who surpass the government's insurance limits are indirectly shielded by the government due to the public-sector bank's ownership status. This feature has significant implications for deposit withdrawal behavior and subsequently impacts the banks' profits. In contrast, uninsured depositors in private banks lack this privilege, exposing them to the risk of losing their deposits should vulnerabilities emerge in the bank's balance sheet.

Let α_I^{Pub} be the share of total deposits in public sector banks that are insured and $(1-\alpha_I^{Pub})$is the uninsured deposits share in public sector banks. By a similar notion, α_I^{Pri} and $(1-\alpha_I^{Pri})$ are the insured and uninsured depositors share in private banks. Following Drechsler et al. (2023) there is a withdrawal rate for insured and uninsured depositors that depends on the interest rate on deposits banks give and the short-term rate (repo rate in our context). Let $\omega_I^{Pub}(r)$ and $\omega_I^{Pri}(r)$ be the withdrawal rate for insured depositors in public and private banks respectively, and where r is the short-term policy rate. The corresponding withdrawal process for uninsured depositors are given by $\omega_U^{Pub}(r)$ and $\omega_U^{Pri}(r)$. Even though the insured and uninsured depositors in a public sector bank are likely to behave in a similar way but there are going to be differences in the withdrawal rate between them in a private bank and among public and private sector banks. The withdrawal rates for the uninsured types, following Drechsler et al. (2023), are given as

$$\omega_U^{Pub}(r) = 1 - (1 - \underline{\omega}_U^{Pub}(r))\lambda^{Pub}(\nu^{Pub}) \tag{5}$$

$$\omega_U^{Pri}(r) = 1 - (1 - \underline{\omega}_U^{Pri}(r))\lambda^{Pri}(\nu^{Pri}) \tag{6}$$

where $\underline{\omega}_U^j$ for $j \in \{Pub, Pri\}$ is the baseline withdrawal rate in the absence of any run. λ^j denotes the fraction of uninsured depositors who don't run and that depends on the solvency ratio of the bank (ν^j) for $j \in \{Pub, Pri\}$[9]. The bank pays a deposit rate r_d^j for $j \in \{Pub, Pri\}$ and since they have market power in the deposit market, they pay a lower deposit rate than the policy rate (r) (Drechsler et al. (2017), Drechsler et al. (2021)).

$$r_{Pub}^d = \beta^{Pub} r \tag{7}$$

$$r_{Pri}^d = \beta^{Pri} r \tag{8}$$

where $\beta^j \in (0, 1)$ for $j \in \{Pub, Pri\}$.

Figure 3 gives a broad overview of the deposit side story of the banks.

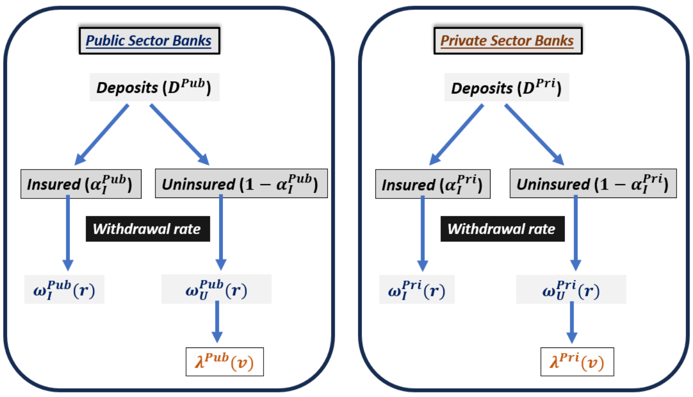

Figure 3: Deposit Side

[9] The solvency ratio of a bank is given as the ratio of its total value (defined as the sum of its liquid assets and the deposit franchise) to the total deposits. Formally

$$\nu^j = \frac{V^j}{D^j}$$

for $j \in \{Pub, Pri\}$

6.3 Profit Function

Given this setup that we have described, we can now write the profit function of both the banks.

Profit Function of Public Sector Bank

In order to write the profit function of the public bank, we make use the fact that given the sovereign backing of the public bank, the uninsured deposits also get a "de-facto" insurance as therefore, implicitly behaves, as if they are insured as well. Using this fact, we assume that the withdrawl rates of both the insured and uninsured deposits are same and equal to some baseline withdrawl rate. Specifically, we assume that $\omega_U^{Pub} = \omega_I^{Pub} = \omega^{Pub}$. Then, the profit function of the public sector bank is given as

$$
\begin{aligned}
\max_{\gamma^{Pub}, D^{Pub}} \pi^{Pub} &= \underbrace{\left(r + \xi_0^{Pub}\right) \gamma^{Pub} D^{Pub}}_{\text{return on loan}} - \underbrace{\frac{\xi_1^{Pub}}{2} \mathcal{L} \gamma^{Pub}}_{\text{Congestion Cost}} + \underbrace{r(1-\gamma^{Pub}) D^{Pub}}_{\text{return on bonds}} \\
&\quad \underbrace{- \alpha_I^{Pub} \left[\omega^{Pub} + (1-\omega^{Pub})(\beta^{Pub} r + c)\right] D^{Pub}}_{\text{Insured types}} \\
&\quad \underbrace{- (1-\alpha_I^{Pub}) \left[\omega^{Pub} + (1-\omega^{Pub})(\beta^{Pub} r + c)\right] D^{Pub}}_{\text{Uninsured types}} \\
&= \underbrace{\left(r + \xi_0^{Pub}\right) \gamma^{Pub} D^{Pub}}_{\text{return on loan}} - \frac{\xi_1^{Pub}}{2} \mathcal{L} \gamma^{Pub} + \underbrace{r(1-\gamma^{Pub}) D^{Pub}}_{\text{return on bonds}} \\
&\quad - \left[\omega^{Pub} + (1-\omega^{Pub})(\beta^{Pub} r + c)\right] D^{Pub} \\
&= \left(r + \xi_0^{Pub}\right) \gamma^{Pub} D^{Pub} - \frac{\xi_1^{Pub}}{2} (\gamma^{Pub} + \gamma^{Pri}) \gamma^{Pub} + r(1-\gamma^{Pub}) D^{Pub} \\
&\quad - \left[\omega^{Pub} + (1-\omega^{Pub})(\beta^{Pub} r + c)\right] D^{Pub} \qquad (9)
\end{aligned}
$$

where the first term determine the return on lending, the second term shows the congestion cost of lending, the next etrm shows the return on bonds while the last term shows the cost part of the bank to maintain the flow of deposits where costs depend on the savings deposit rate that needs to be paid and the operating cost (c). For simplicity we have assumed that the operating cost is fixed across both the bank types.

The bank maximizes its profits by choosing the share of lending (γ^{Pub}) and the amount to deposits to be raised (D^{Pub}). The FOCs are given as w.r.t γ^{Pub}

$$\frac{\partial \pi^{Pub}}{\partial \gamma^{Pub}} = (r + \xi_0^{Pub})D^{Pub} - rD^{Pub} - \frac{\xi_1^{Pub}}{2}(2\gamma^{Pub} + \gamma^{Pri}) = 0$$

$$\xi_0^{Pub} D^{Pub} = \frac{\xi_1^{Pub}}{2}(2\gamma^{Pub} + \gamma^{Pri}) \tag{10}$$

which shows that

$$\gamma^{Pub} = \frac{\xi_0^{Pub} D^{Pub}}{\xi_1^{Pub}} - \frac{\gamma^{Pri}}{2} \tag{11}$$

The above equation shows the negative relationship between the loan shares of both the banks. An increase in the share of borrowers served by the private bank (γ^{Pri} goes up) will lead to a reduction in the fraction of borrowers to be served by the public sector bank, which shows the presence of congestion in the market. $\frac{\partial \gamma^{Pub}}{D^{Pub}} > 0$ meaning that more deposit will lead to higher lending ceteris paribus, in order to earn higher returns from investing.

w.r.t D^{Pub}

$$\frac{\partial \pi^{Pub}}{\partial D^{Pub}} = \left(r + \xi_0^{Pub}\right)\gamma^{Pub} + r(1 - \gamma^{Pub}) - \left[\omega^{Pub} + (1 - \omega^{Pub})(\beta^{Pub} r + c)\right] = 0$$

$$\implies \gamma^{Pub} = \frac{\left[\omega^{Pub} + (1 - \omega^{Pub})(\beta^{Pub} r + c)\right] - r}{\xi_0^{Pub}} \tag{12}$$

Equation 12 shows share of loans for public sector bank as a function of the parameters. Figure 12 illustrates the relationship between the value of γ^{Pub} and r for different values of β^{Pub}. It is evident that, regardless of the specific values of β, there is a negative relationship between γ^{Pub} and r. This suggests that as the interest rate r rises, public sector banks may allocate a larger portion of their investments to government securities. This strategy allows the bank to capitalize on the higher returns offered by these assets while avoiding the risks associated with lending.

Comparing the different values of β^{Pub}, we can see that for any given level of r, higher the β^{Pub}, higher the proportion invested in loans γ^{Pub}. This is attributed to the fact that as the deposit spread decreases (β increases), the bank's operational costs rise. Consequently, in order to maintain profitability, the bank must allocate a larger share of its resources to higher-yield, albeit riskier, loans.

In order to observe the effect of withdrawals on the asset portfolio, Figure 14 illustrates the loan share, γ^{Pub}, concerning the interest rate r and the withdrawal rate ω. A higher r results in a higher γ^{Pub}, assuming the withdrawal rate ω^{Pub} remains fixed. This occurs because as the interest rate rises, banks tend to invest more in risky assets to generate higher returns.

It's worth noting that as withdrawal rates increase, banks are compelled to invest more in risky loans, causing γ^{Pub} to rise. This observation aligns with the findings of Drechsler et al. (2023). When withdrawal rates are high, banks must compensate for deposit losses by increasing investments in lending, which provides higher returns.

Furthermore, if we consider the withdrawal rate as a function of the spread and interest rate, such that

$$\omega^{Pub} = w(\beta^{Pub}, r)$$

where the withdrawal rate decreases with higher β^{Pub} (indicating a lower spread and thus higher deposit rates), as well as decreases with higher r (Abadi et al. (2023), Jiang et al. (2023)), then Figure 14 shows that as r increases, the withdrawal rate (ω^{Pub}) decreases. This decrease in the withdrawal rate leads to a decline in γ^{Pub} as well. Our model, therefore, generates the negative relationship between r and ω^{Pub}. Next we solve for the problem of the Private Sector Bank.

Profit function for private bank

The profit function for the private sector bank is given by

$$\begin{aligned}
\max_{\gamma^{Pri}, D^{Pri}} \pi^{Pri} &= \underbrace{\left(r + \xi_0^{Pri}\right) \gamma^{Pri} D^{Pri}}_{\text{return on loan}} - \underbrace{\frac{\xi_1^{Pri}}{2} \mathcal{L} \gamma^{Pri}}_{\text{Congestion Cost}} + \underbrace{r(1-\gamma^{Pri}) D^{Pri}}_{\text{return on bonds}} \\
&\quad - \underbrace{\alpha_I^{Pri} \left[\omega_I^{Pri} + (1-\omega_I^{Pri})(\beta^{Pri} r + c)\right] D^{Pri}}_{\text{Insured types}} \\
&\quad - \underbrace{(1-\alpha_I^{Pri}) \left[\omega_U^{Pri} + (1-\omega_U^{Pri})(\beta^{Pri} r + c)\right] D^{Pri}}_{\text{Uninsured types}} \\
&= \underbrace{\left(r + \xi_0^{Pri}\right) \gamma^{Pri} D^{Pri}}_{\text{return on loan}} - \underbrace{\frac{\xi_1^{Pri}}{2} (\gamma^{Pub} + \gamma^{Pri}) \gamma^{Pri}}_{\text{Congestion Cost}} + \underbrace{r(1-\gamma^{Pri}) D^{Pri}}_{\text{return on bonds}} \\
&\quad - \underbrace{\alpha_I^{Pri} \left[\omega_I^{Pri} + (1-\omega_I^{Pri})(\beta^{Pri} r + c)\right] D^{Pri}}_{\text{Insured types}} \\
&\quad - \underbrace{(1-\alpha_I^{Pri}) \left[\omega_U^{Pri} + (1-\omega_U^{Pri})(\beta^{Pri} r + c)\right] D^{Pri}}_{\text{Uninsured types}}
\end{aligned} \tag{13}$$

where again the first three terms show the return from investment in assets and the congestion cost associated with lending, while the last two terms denote the cost side of the bank that includes the deposit rate and operating cost but, unlike the private sector bank, different for the two types of deposits (insured and uninsured). The FOCs for the private bank are given as

FOC w.r.t γ^{Pri}

$$
\begin{aligned}
\frac{\partial \pi^{Pri}}{\partial \gamma^{Pri}} &= (r + \xi_0^{Pri}) D^{Pub} - r D^{Pri} - \frac{\xi_1^{Pri}}{2}(2\gamma^{Pri} + \gamma^{Pub}) = 0 \\
\xi_0^{Pri} D^{Pri} &= \frac{\xi_1^{Pri}}{2}(2\gamma^{Pri} + \gamma^{Pub}) \qquad (14)
\end{aligned}
$$

which implies

$$
\gamma^{Pri} = \frac{\xi_0^{Pri} D^{Pri}}{\xi_1^{Pri}} - \frac{\gamma^{Pub}}{2} \qquad (15)
$$

Like in the case of public sector bank, the congestion is showing up in the previous equation with $\dfrac{\partial \gamma^{Pri}}{\partial \gamma^{Pub}} < 0$.

FOC w.r.t D^{Pri}

$$
\begin{aligned}
\frac{\partial \pi^{Pri}}{\partial D^{Pri}} &= \left(r + \xi_0^{Pri}\right) \gamma^{Pri} + r(1 - \gamma^{Pri}) - \alpha_I^{Pri} \left[\omega_I^{Pri} + (1 - \omega_I^{Pri})(\beta^{Pri} r + c)\right] \\
&- (1 - \alpha_I^{Pri}) \left[\omega_U^{Pri} + (1 - \omega_U^{Pri})(\beta^{Pri} r + c)\right] = 0 \\
&\implies \xi_0^{Pri} \gamma^{Pri} = \alpha_I^{Pri} \left[\omega_I^{Pri} + (1 - \omega_I^{Pri})(\beta^{Pri} r + c)\right] \qquad (16) \\
&+ (1 - \alpha_I^{Pri}) \left[\omega_U^{Pri} + (1 - \omega_U^{Pri})(\beta^{Pri} r + c)\right] - r
\end{aligned}
$$

which upon solving will give us

$$
\gamma^{Pri} = \frac{\alpha_I^{Pri} \left[\omega_I^{Pri} + (1 - \omega_I^{Pri})(\beta^{Pri} r + c)\right] + (1 - \alpha_I^{Pri}) \left[\omega_U^{Pri} + (1 - \omega_U^{Pri})(\beta^{Pri} r + c)\right] - r}{\xi_0^{Pri}} \qquad (17)
$$

In order to see the impact of various parameters on the lending share, we plot Figure 13 which represents γ^{Pri} against r. Like we found in the previous case (Fig 12), we found a similar relationship between the interest rate and the lending share. Therefore, private banks face analogous incentives to those of public banks because of the similar kind of structure of the balance sheets of the two banks. The primary distinction between the two figures lies in the levels of γ. In the case of private banks, γ is higher compared to public banks for any value of r or deposit beta. This difference can be attributed to the additional costs incurred by private banks due to the presence of two types of depositors: insured and uninsured with the uninsured depositors, with their greater propensity to withdraw, impose higher costs on private banks which makes them invest more in the risky assets to earn the higher returns.

Given that the heterogeneity of depositors is a crucial determinant of the bank's costs, which in turn affect the composition of the bank's assets, we have also generated a plot illustrating the behavior of the loan investment rate (γ^{Pri}) in relation to the withdrawal rates of the two types of depositors. While insured depositors enjoy similar insurance benefits to their counterparts in public banks and, therefore, exhibit withdrawal rates comparable to those of public banks, uninsured depositors lack this benefit and consequently have higher withdrawal rates. These differing withdrawal rates and behaviors between the two types of depositors significantly impact the asset composition of private sector banks. Figure 15 plots the result. As evident from the figure, γ^{Pri} exhibits a positive correlation with both withdrawal rates. However, what's noteworthy is the rate at which γ^{Pri} increases for ω_U compared to ω_I. This highlights the fact that due to the higher withdrawal rates associated with uninsured depositors, the bank, in order to maintain the same cash flows and mitigate outflows, shifts the composition of its assets towards riskier loans that yield higher returns. Our static model also reproduces this behavior.

In our model, banks raise deposits from a fixed pool of depositors in the economy. While in our baseline model, we do not explicitly address how households choose deposits; rather, banks determine the amount of deposits to raise, as it constitutes their primary source of funds. Equations 10 and 14 govern the deposit choices for the public sector bank and the private sector bank, respectively. From these equations and considering the relationship we have identified between γ^{Pub} and γ^{Pri} with respect to r, we find that:

$$\frac{\partial D^{Pub}}{\partial r} < 0 \quad \text{and} \quad \frac{\partial D^{Pri}}{\partial r} < 0$$

This implies that as the interest rate increases, banks raise fewer deposits to minimize their costs associated with maintaining deposits. This result is in line with findings from Drechsler et al. (2017) and Wang et al. (2022). Up to this point, our analysis has primarily compared the two types of banks separately, focusing on interlinkages only to a limited extent. In the next step, we will compare the asset choices made by banks and how they aim to hedge their costs in the presence of heterogeneous depositors and their corresponding outflow rates.

Hedging Costs with Outflows

One of the distinguishing aspects of our model is the incorporation of inherent features differentiating the two types of banks present in the market. On one hand, the sovereign backing of the public sector bank provides a "de-facto" insurance to all depositors, even those not covered under the legal deposit insurance, while the absence of such a feature in the private sector bank poses a greater threat to uninsured depositors. As a result, the outflow rates differ significantly between the two types of banks. While our static model does not encompass a "run" like scenario due to higher interest rate risk[10], the presence of varying withdrawal rates among the sources of funds (deposits) leads to differences in the asset composition between private and public banks. To investigate this further, we analyze the disparity in the loan-to-deposit ratio between private and public banks.

From equations 12 and 17 and assuming that $\xi_0^{Pub} = \xi_0^{Pri} = \xi_0$ (the term premium on the loans are same), we get

$$\gamma^{Pri} - \gamma^{Pub} = \frac{1}{\xi_0}\Big(\alpha_I^{Pri}\left[\omega_I^{Pri} + (1-\omega_I^{Pri})(\beta^{Pri}r + c)\right] + (1-\alpha_I^{Pri})\left[\omega_U^{Pri} + (1-\omega_U^{Pri})(\beta^{Pri}r + c)\right] - \left[\omega^{Pub} + (1-\omega^{Pub})(\beta^{Pub}r + c)\right]\Big) \tag{18}$$

which upon solving will give

$$\gamma^{Pri} - \gamma^{Pub} = \frac{1}{\xi_0}\Big(\alpha_I^{Pri}\left(\omega_I^{Pri} - \omega_U^{Pri}\right) + \alpha_I^{Pri}(\beta^{Pri}r + c)\left(\omega_U^{Pri} - \omega_I^{Pri}\right) + \left(\omega_U^{Pri} - \omega^{Pub}\right) + \left[(\beta^{Pri}r + c) - (\beta^{Pub}r + c)\right] + \omega^{Pub}(\beta^{Pub}r + c) - \omega_U^{Pri}(\beta^{Pri}r + c)\Big) \tag{19}$$

which shows that the difference between the lending rates in risky loans depend on the types of depositors and the cost of maintaining the deposit flows. Depending upon the parameter values and the strength of the terms, we can see the discrepancy between the lending rates of the banks.

First, for the sake of simplicity, we assume *no heterogeneity* between borrower types and base bank withdrawal rates solely on the spread and the interest rate. This exercise aims to assess the influence of costs on lending rates. Given that public sector banks

[10] In the static framework we do not incorporate the situation of a bank run as this will require us to explicitly model the interlinkages between depositors in the two types of banks. Our baseline model abstract away from such linkages. For more details on how heterogeneity of depositors impact bank runs see Goldstein and Pauzner (2005), Iyer et al. (2012),Kiyotaki and Moore (2012), Kashyap et al. (2014), Perotti and Suarez (2015) Egan et al. (2017), Gambacorta et al. (2018) and Drechsler et al. (2023).

charge a higher spread than private sector banks, we leverage this disparity to examine the relationship between $\gamma^{Pri} - \gamma^{Pub}$ and factors affecting the bank's cost. Figure 16 plots the result. It shows that there is a positive relationship between r and $\gamma^{Pri} - \gamma^{Pub}$ meaning that the private bank lends more relative to the public bank. Now, an increase in r has two opposing effects. On one hand, an increase in r will lead to higher costs, given the deposit beta, which will make the bank invest more in the risky asset that yields a higher return to maintain the same level of profits. On the other hand, an increase in r will also lead to lower withdrawals, given our assumption about the outflow rate $w_r(\beta, r) < 0$, which will lower costs for the bank and therefore increase profit for the same composition of assets[11]. The positive relation between $\gamma^{Pri} - \gamma^{Pub}$ and r in Figure 16 shows that the first effect dominates and thus the increase in cost will lead to the bank lend more and lending will be more in case of private bank which has a higher deposit rate than the public bank.

With respect to operating costs, c, there is no gap between the lending shares of the two banks. This is because of the way operating cost enters the expression. Since there is no difference between the two types of depositors, operating cost in the two banks almost rescind each other and therefore will not have any impact on lending shares. Thus, when the withdrawl rates are same for both the banks, then factors that increase the cost of bank will make the bank increase lending in order to earn higher returns.

Next, we consider the general case with deposit heterogeneity and their corresponding withdrawal rates to examine the relationship between the gap in lending rates of the two banks, as given by equation 19. Figure 17 illustrates the difference in lending rates in relation to the interest rate r and the share of insured depositors in the private bank (α^{Pri}). Similar to the case without heterogeneity, the difference between lending rates is positively correlated with the interest rate. This is because, as the interest rate rises, the deposit rates increase for both banks, resulting in higher costs for them. Consequently, they are more inclined toward higher-yield, risky assets. However, since the deposit rate is higher for the private bank, it engages more in lending relative to the public bank, widening the lending gap between them.

Regarding the share of insured deposits, an increase in this share leads to a reduction in the lending rate gap, approaching zero. This occurs because, as α^{Pri} increases, the private bank is assured of a steady flow of deposits with lower withdrawal rates. This reduces the costs associated with maintaining such deposits, prompting the private bank to engage in less risky lending, thereby reducing its lending share. In the extreme case where $\alpha^{Pri} = 1$, we revert to the previous scenario without deposit heterogeneity,

[11]Given our assumption of the same rate being received on the government bonds and also on the risky loans (which is $r + \xi_0$), the revenue stream of the bank will also increase in case of an increase in r, so the profits will increase even for the same composition of assets.

and the lending rate gap between the two banks becomes negligible [12].

From our baseline static model, we have identified factors that can impact the composition of assets for banks. Deposit heterogeneity matters significantly when withdrawal rates differ for various types of deposits. In the absence of deposit heterogeneity, the composition of assets is nearly identical in this simplified model. However, to comprehensively examine the role of interlinkages between the deposit and lending markets, we require a model that explicitly considers both the firm and household sectors. The next step involves addressing the maturity structure of assets. Thus far, our analysis has treated both bonds and loan amounts as short-term assets, but incorporating a term structure will provide a more accurate representation of real-world dynamics. Additionally, our current static model calls for expansion into a dynamic one that encompasses households and firms. This broader framework will enable us to capture the intricate interplay between deposits and lending within a comprehensive banking model, aligning with the findings of researchers such as Drechsler et al. (2021) and Wang (2018).

7 Conclusion

When banks funding costs are regulated i.e. saving deposit rates are fixed by authorities, it leads to creation of captive depositors who do not have an incentive to move from one bank to another in search of a higher deposit rates. Such regulated regime leads to a scenario where banks are more comfortable in investing in less risky assets (government securities) which in turn reduces the share of fund available for loans. In a regulated regime, banks can extract higher profit by reducing their funding cost in a period of high interest rates as they are getting a higher spread. This leads to a scenario of "Lazy Lending" for banks where they can extract higher profit through the deposit channel and continue investing in safer assets. The situation changes in case of deregulated regime, where depositors are no longer captive in nature and they can move to banks that provide better deposit rates. In order to attract more depositors, bank can increase their deposit rates and as the funding cost increases for banks, their asset portfolio changes with an increase in the share of high yielding risky asset.

[12]Our results do not explicitly model the flow of deposits from one bank to another, nor do we explicitly represent the deposit market. In scenarios where the deposit market is fixed, and insured depositors are migrating towards private banks, it's conceivable that the share of such deposits could decrease in the public bank. Our baseline model does not account for this specific aspect. For example, if the share of insured deposits were to decrease in the public sector bank, it could potentially lead to a negative gap between the two banks' lending rates.

We use bank level asset and liability data of Indian banks from 2006 to 2020 along with information related to saving deposit rates and repo rates to obtain these results. Post deregulation, private sector banks increase their portfolio of loans as a share of deposit by 7.6% with respect to public sector banks. The increase was 2% for loan as a share of asset. Similarly, private sector banks growth of loans with respect to public sector banks were 33% higher. We not only established a causal impact of such deregulation for private and public sector banks, we also created a static partial equilibrium model with two types of banks and analyse the deposit channel is playing a role in the funding cost of asset conditional on heterogeneity in share of insured/uninsured depositors by bank types.

The results of this paper has implication beyond India and can be replicated to any emerging economies where banking sector works under various regulations and those regulations can have effect on banks decision to diversify or concentrate their asset portfolio. Emerging economies have a serious problem of access to credit to households and corporates through traditional channel, and any regulation that hampers banks' incentive to invest into high yielding risky assets or projects, will further aggravate the credit crunch in the economy. Our study tries to highlight this issue and showcase how deregulation in deposit rates helps banks to invest in riskier projects and reducing credit demand in the economy.

References

Abadi, J., Brunnermeier, M., and Koby, Y. (2023). The reversal interest rate. *American Economic Review*, 113(8):2084–2120.

Acharya, V. V., Eisert, T., Eufinger, C., and Hirsch, C. (2019). Whatever it takes: The real effects of unconventional monetary policy. *The Review of Financial Studies*, 32(9):3366–3411.

Acharya, V. V., Lenzu, S., and Wang, O. (2021). Zombie lending and policy traps. Technical report, National Bureau of Economic Research.

Acharya, V. V. and Rajan, R. (2020). Indian banks: A time to reform. *University of Chicago Booth School of Business Working Paper*.

Acharya, V. V. and Steffen, S. (2015). The "greatest" carry trade ever? understanding eurozone bank risks. *Journal of Financial Economics*, 115(2):215–236.

Agarwal, R. (2023). The past future of indian finance. *M-RCBG Associate Working Paper Series 2023.212*.

Alvero, A., Ando, S., and Xiao, K. (2023). Watch what they do, not what they say: Estimating regulatory costs from revealed preferences. *The Review of Financial Studies*, 36(6):2224–2273.

Autor, D. H. (2003). Outsourcing at will: The contribution of unjust dismissal doctrine to the growth of employment outsourcing. *Journal of labor economics*, 21(1):1–42.

Bai, J., Krishnamurthy, A., and Weymuller, C.-H. (2018). Measuring liquidity mismatch in the banking sector. *The journal of Finance*, 73(1):51–93.

Berger, A. N. and Bouwman, C. H. (2017). Bank liquidity creation and financial crises. *Journal of Financial Intermediation*, 30:1–29.

Brunnermeier, M. K., Gorton, G., and Krishnamurthy, A. (2012). Risk topography. *Nber macroeconomics annual*, 26(1):149–176.

Caballero, R. J., Hoshi, T., and Kashyap, A. K. (2008). Zombie lending and depressed restructuring in japan. *American economic review*, 98(5):1943–1977.

DeAngelo, H. and Stulz, R. M. (2015). Liquid-claim production, risk management, and bank capital structure: Why high leverage is optimal for banks. *Journal of financial economics*, 116(2):219–236.

Di Tella, S. and Kurlat, P. (2021). Why are banks exposed to monetary policy? *American Economic Journal: Macroeconomics*, 13(4):295–340.

Diamond, D. W. and Dybvig, P. H. (1983). Bank runs, deposit insurance, and liquidity. *Journal of political economy*, 91(3):401–419.

Drechsler, I., Savov, A., and Schnabl, P. (2017). The deposits channel of monetary policy. *The Quarterly Journal of Economics*, 132(4):1819–1876.

Drechsler, I., Savov, A., and Schnabl, P. (2021). Banking on deposits: Maturity transformation without interest rate risk. *The Journal of Finance*, 76(3):1091–1143.

Drechsler, I., Savov, A., Schnabl, P., and Wang, O. (2023). Banking on uninsured deposits. Technical report, National Bureau of Economic Research.

Egan, M., Hortaçsu, A., and Matvos, G. (2017). Deposit competition and financial fragility: Evidence from the us banking sector. *American Economic Review*, 107(1):169–216.

English, W. B., Van den Heuvel, S. J., and Zakrajšek, E. (2018). Interest rate risk and bank equity valuations. *Journal of Monetary Economics*, 98:80–97.

Freixas, X. and Rochet, J.-C. (2008). *Microeconomics of banking*. MIT press.

Gambacorta, L., van Rixtel, A., and Schiaffi, S. (2018). Financial regulation and shadow banking: A small-scale dsge perspective. *Journal of Banking & Finance*, 97:104–120.

Ganesh-Kumar, A. and Gaurav, S. (2019). Bank credit allocation in india: Has the priority sector norms stifled the efficiency of banks? *Journal of Economic Policy and Research*, 14(2):71–94.

Gatev, E. and Strahan, P. E. (2006). Banks' advantage in hedging liquidity risk: Theory and evidence from the commercial paper market. *The Journal of Finance*, 61(2):867–892.

Goldstein, I. and Pauzner, A. (2005). Demand–deposit contracts and the probability of bank runs. *the Journal of Finance*, 60(3):1293–1327.

Hanson, S. G., Shleifer, A., Stein, J. C., and Vishny, R. W. (2015). Banks as patient fixed-income investors. *Journal of Financial Economics*, 117(3):449–469.

Herndon, T. and Matvos, G. (2016). The value of risk management in agricultural banking. *Journal of Finance*, 71(2):867–906.

Huang, R. (2011). Deposit insurance and bank risk-taking: Evidence from internal loan ratings. *American Economic Journal: Economic Policy*, 3(3):123–151.

Iyer, R., Puri, M., and Ryan, N. (2012). Understanding bank runs: do depositors monitor banks? *The American Economic Review*, 102(4):1414–1445.

Jiang, E. X., Matvos, G., Piskorski, T., and Seru, A. (2023). Monetary tightening and us bank fragility in 2023: Mark-to-market losses and uninsured depositor runs? Technical report, National Bureau of Economic Research.

Kalemli-Özcan, Ş., Laeven, L., and Moreno, D. (2022). Debt overhang, rollover risk, and corporate investment: Evidence from the european crisis. *Journal of the European Economic Association*, 20(6):2353–2395.

Kashyap, A. K., Rajan, R., and Stein, J. C. (2002). Banks as liquidity providers: An explanation for the coexistence of lending and deposit-taking. *The Journal of finance*, 57(1):33–73.

Kashyap, A. K., Tsomocos, D. P., and Vardoulakis, A. P. (2014). Banks, liquidity management, and monetary policy. *American Economic Review*, 104(5):429–34.

Kashyap, A. K., Tsomocos, D. P., and Vardoulakis, A. P. (2020). Optimal bank regulation in the presence of credit and run-risk. Technical report, National Bureau of Economic Research.

Kirti, D. (2020). Why do bank-dependent firms bear interest-rate risk? *Journal of Financial Intermediation*, 41:100823.

Kiyotaki, N. and Moore, J. (2012). Bank runs, deposit insurance, and capital requirements. *Journal of Political Economy*, 120(2):286–319.

Maskin, E. and Tirole, J. (1987). A theory of dynamic oligopoly, iii: Cournot competition. *European economic review*, 31(4):947–968.

Mohan, R. (2003). Transforming indian banking: in search of a better tomorrow. *Reserve Bank of India Bulletin*, 1.

Moreira, A. and Savov, A. (2017). The macroeconomics of shadow banking. *The Journal of Finance*, 72(6):2381–2432.

Nagel, S. and Purnanandam, A. (2020). Banks' risk dynamics and distance to default. *The Review of Financial Studies*, 33(6):2421–2467.

Pennacchi, G. G. (2018). Bank runs, deposit insurance, and liquidity. *Journal of Political Economy*, 126(6):2329–2367.

Perotti, E. and Suarez, J. (2015). Bank runs, prudential tools, and social welfare in a global game. *Journal of Money, Credit and Banking*, 47(1):45–80.

Prabheesh, K. and Durai, S. R. S. (2019). The determinants of bank asset concentration in india: Does financial development matter? *Journal of Applied Economics*, 22(2):388–411.

Stein, J. C. (2012). Monetary policy as financial stability regulation. *The Quarterly Journal of Economics*, 127(1):57–95.

van Greuning, H. and Bratanovic, S. (2018). Risk management in financial institutions. *Journal of Banking and Finance*, 93:268–294.

Wang, O. (2018). Banks, low interest rates, and monetary policy transmission. *NYU Stern School of Business*.

Wang, Y., Whited, T. M., Wu, Y., and Xiao, K. (2022). Bank market power and monetary policy transmission: Evidence from a structural estimation. *The Journal of Finance*, 77(4):2093–2141.

Plots and Tables

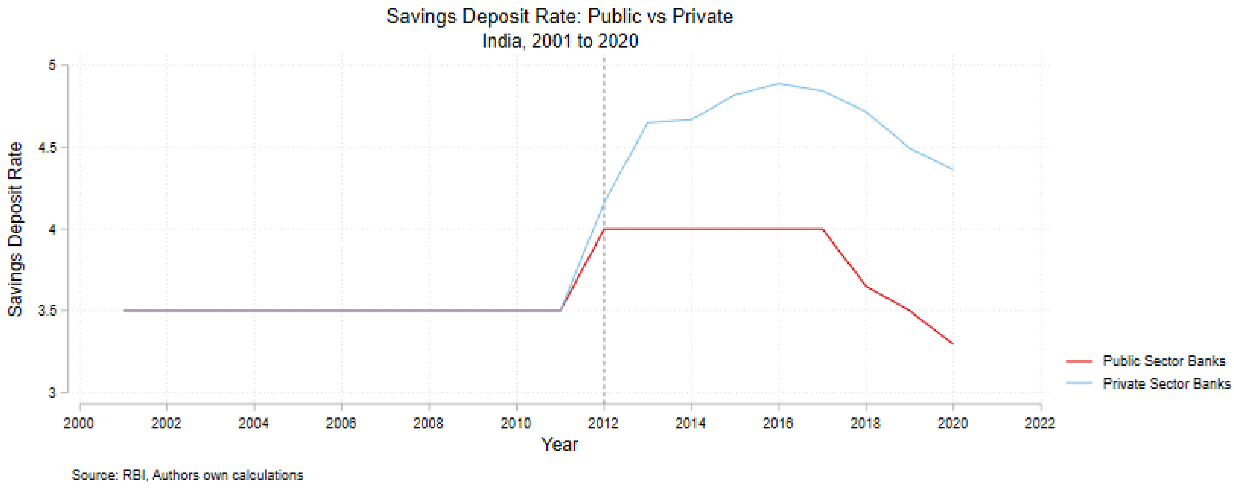

Figure 4: Savings Deposit Rate: Public Vs Private

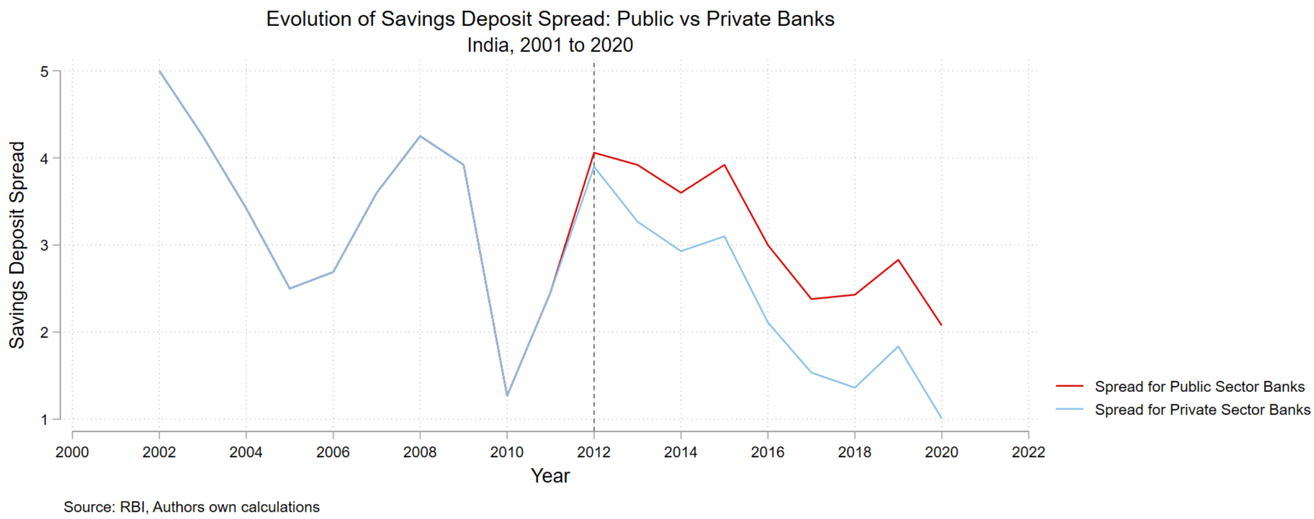

Figure 5: Savings Deposit Spread: Public vs Private Sector Banks

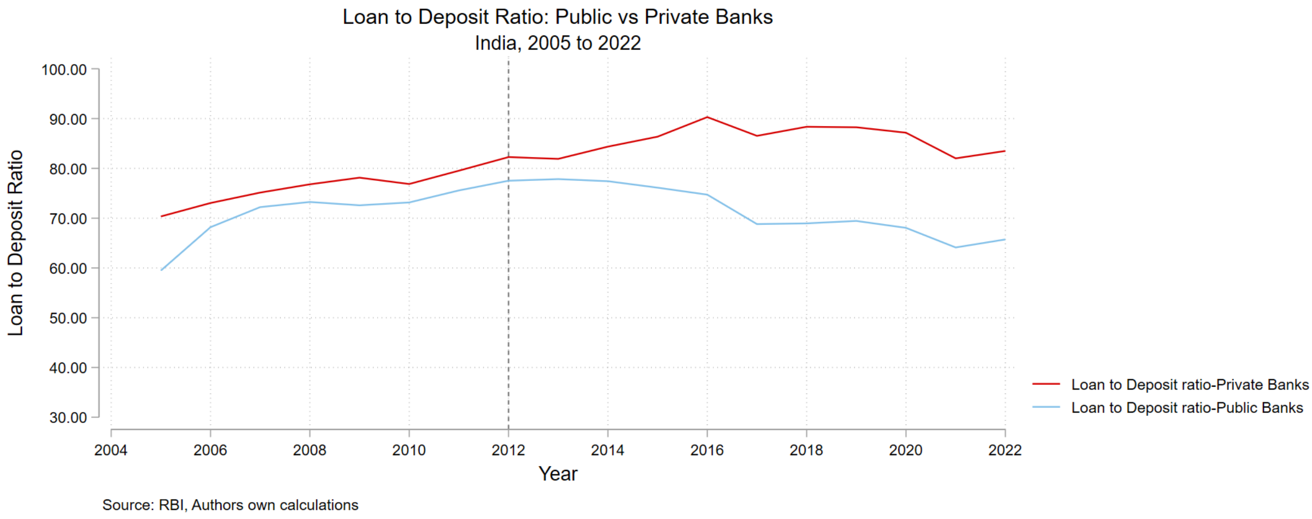

Figure 6: Loan to Deposit Ratio

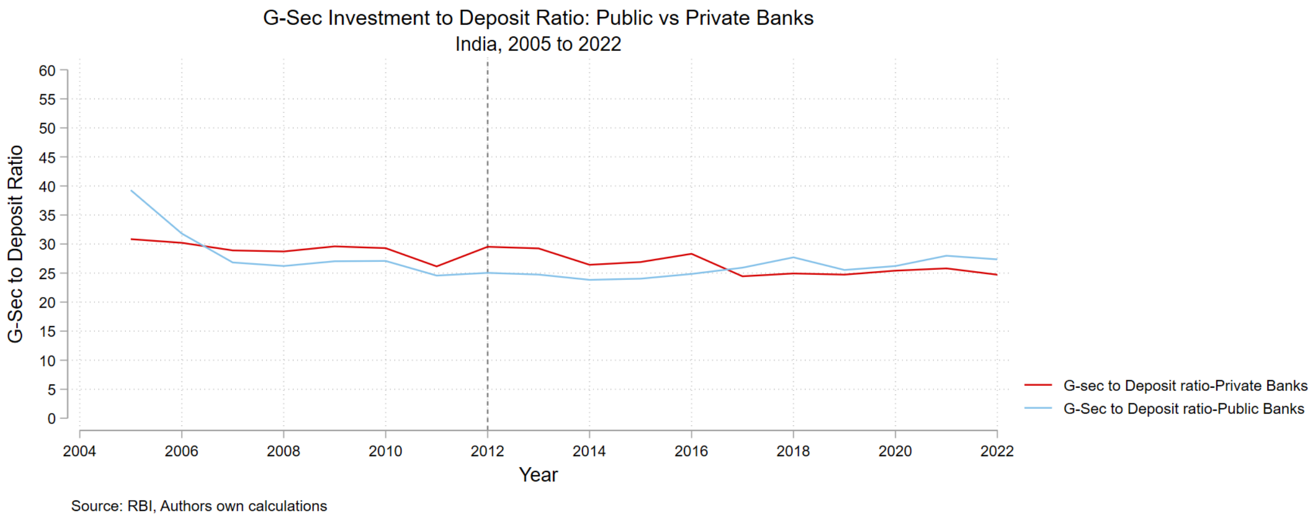

Figure 7: G-Sec Investment to Deposit Ratio

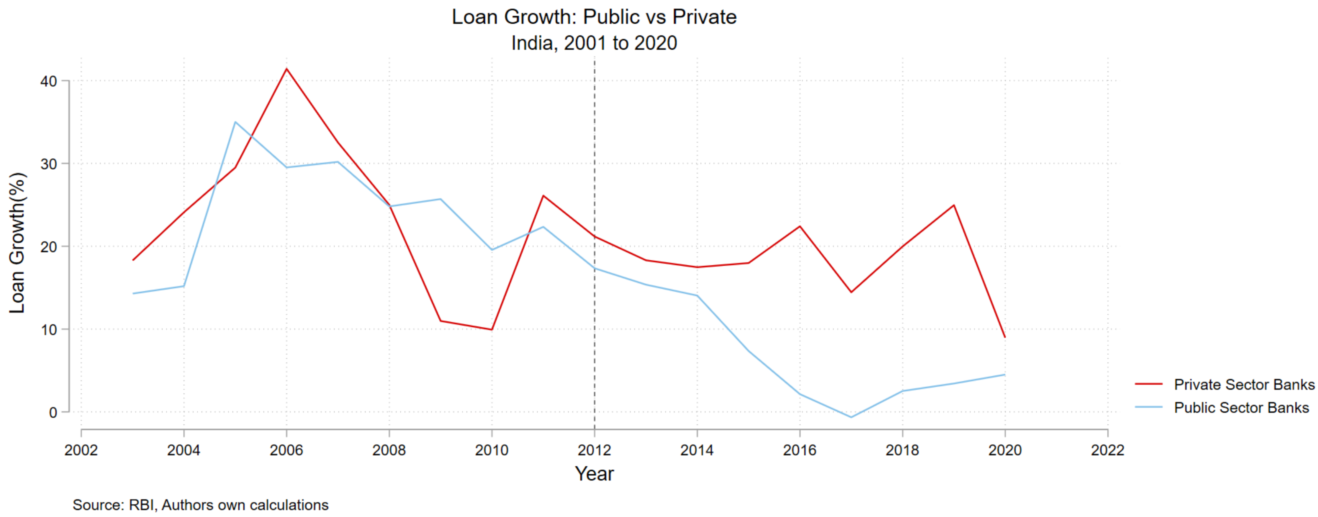

Figure 8: Loan Growth: Public Sector Banks against Private Sector Banks

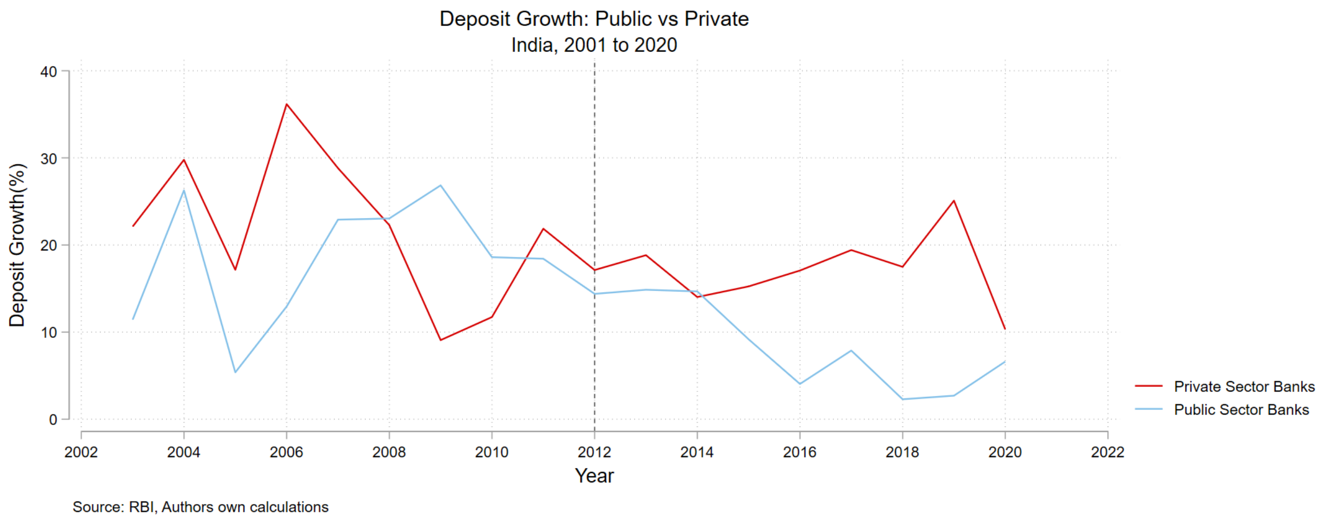

Figure 9: Deposit Growth: Public Sector Banks against Private Sector Banks

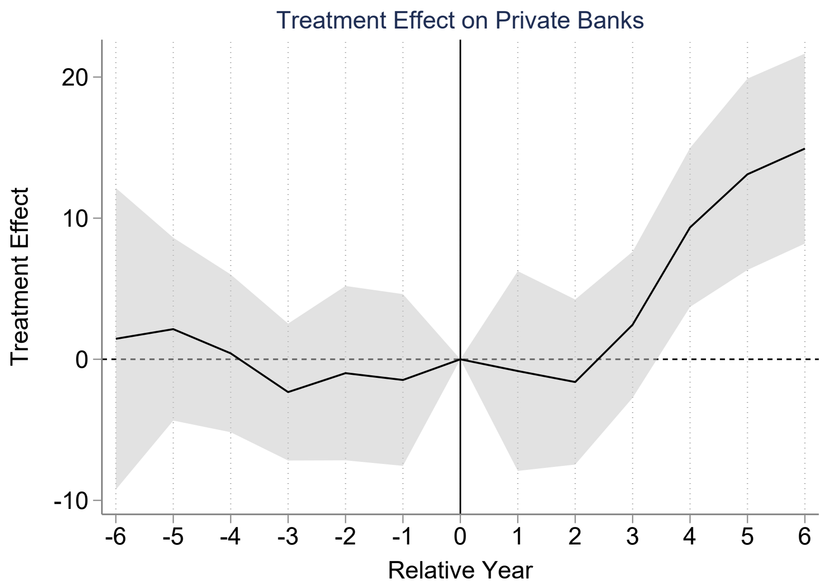

Figure 10: Event Study for Loan-to-Deposit Ratio.

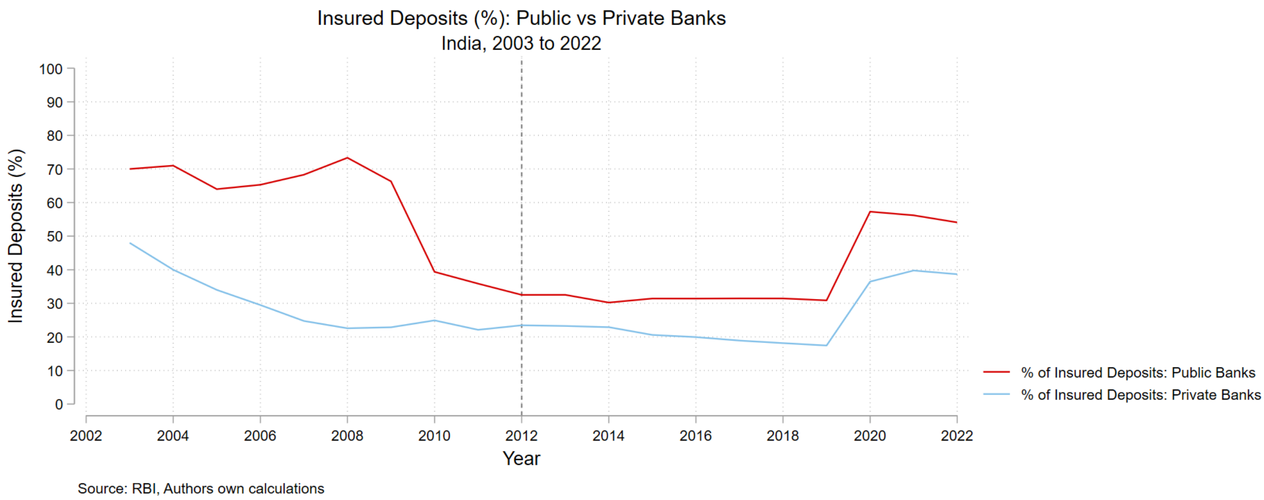

Figure 11: Insured for Public versus Private Sector Banks

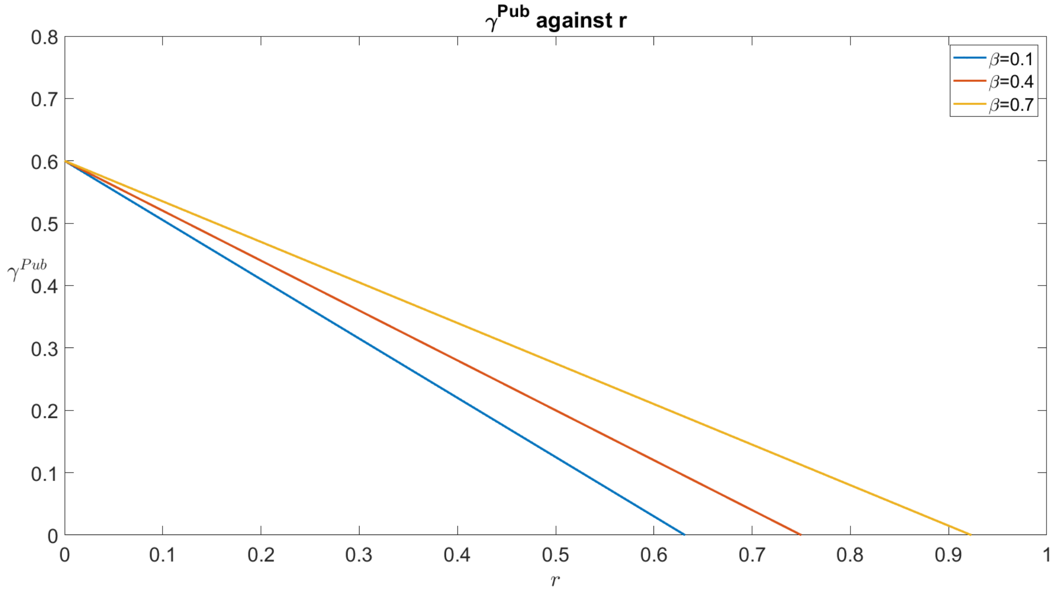

Figure 12: γ^{Pub} for different values of β

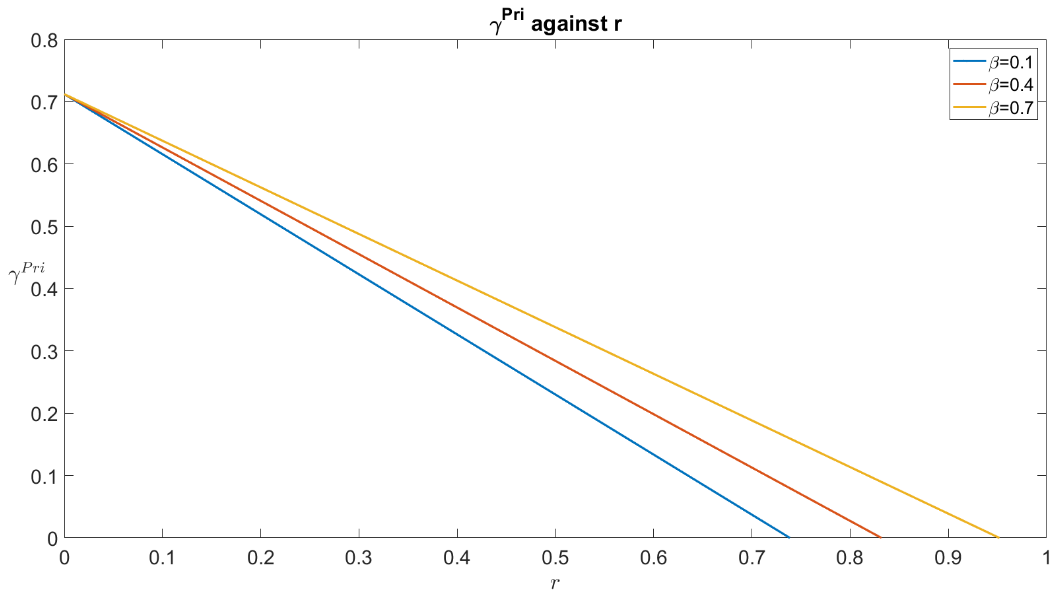

Figure 13: γ^{Pri} for different values of β

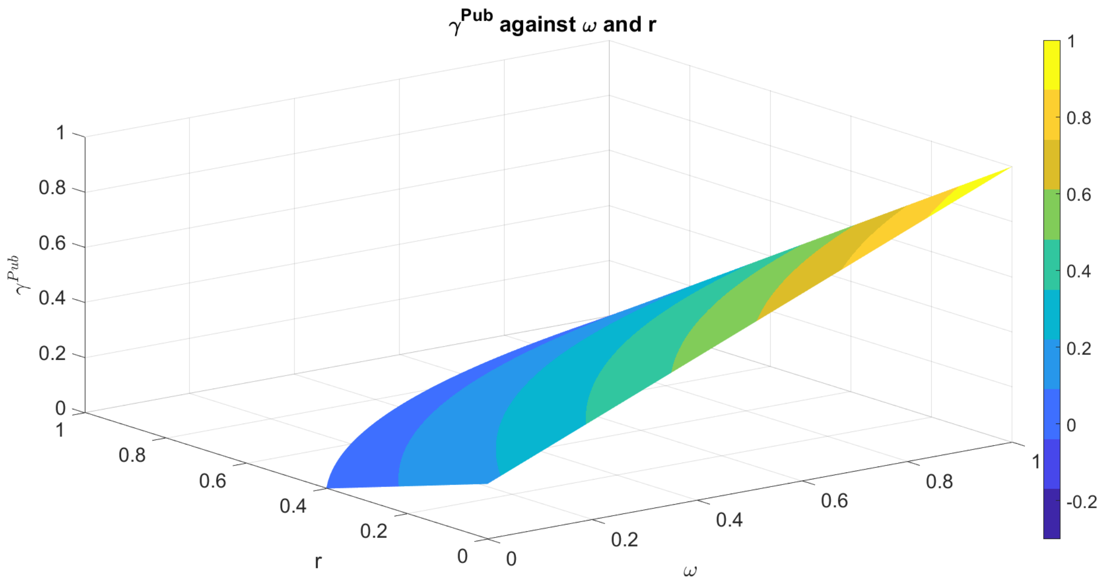

Figure 14: γ^{Pub} against ω and r
Note: This figure is generated for $\beta^{Pub} = 0.5$ and $c = 0.2$

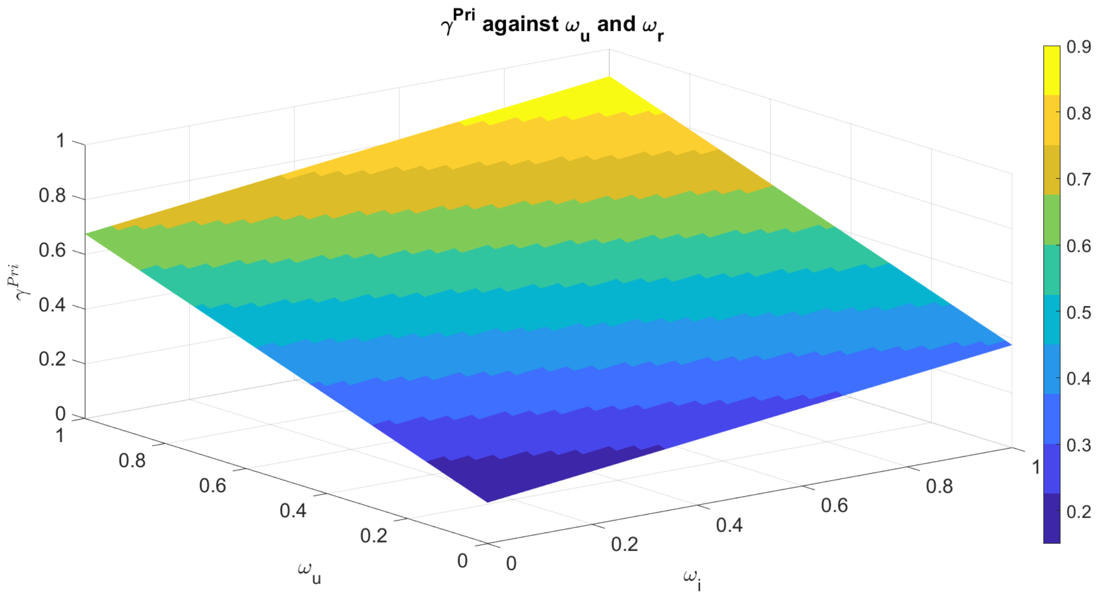

Figure 15: γ^{Pri} against ω_U and ω_I
Note: This figure is generated for $\beta^{Pub} = 0.5$, $c = 0.2$, $r = 0.1$, and $\alpha_I = 0.3$

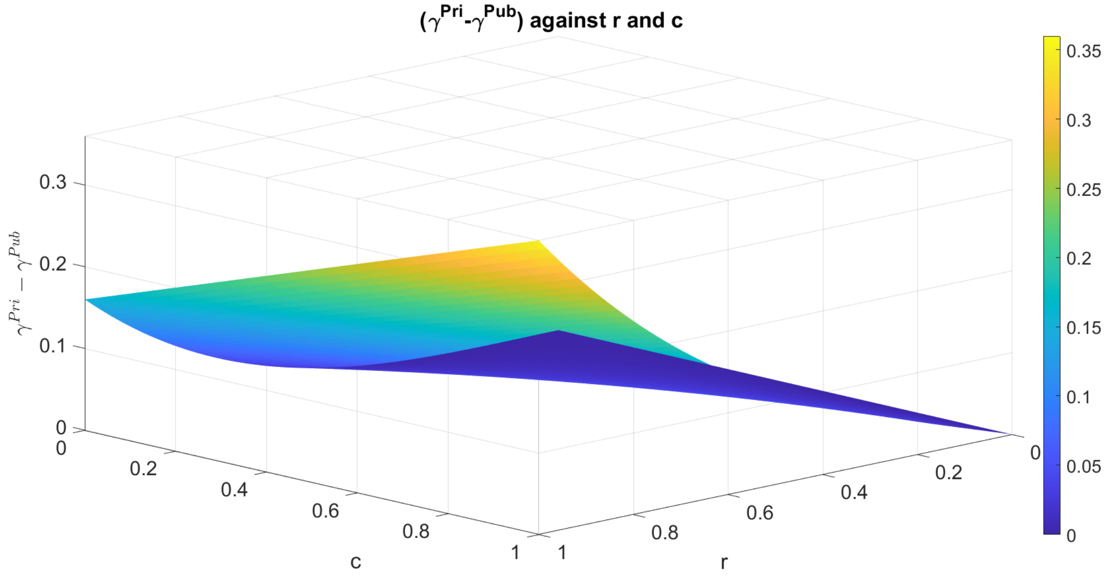

Figure 16: $\gamma^{Pri} - \gamma^{Pub}$ against r and c
Note: This figure is generated for $\beta^{Pub} = 0.3$,$\beta^{Pri} = 0.5$

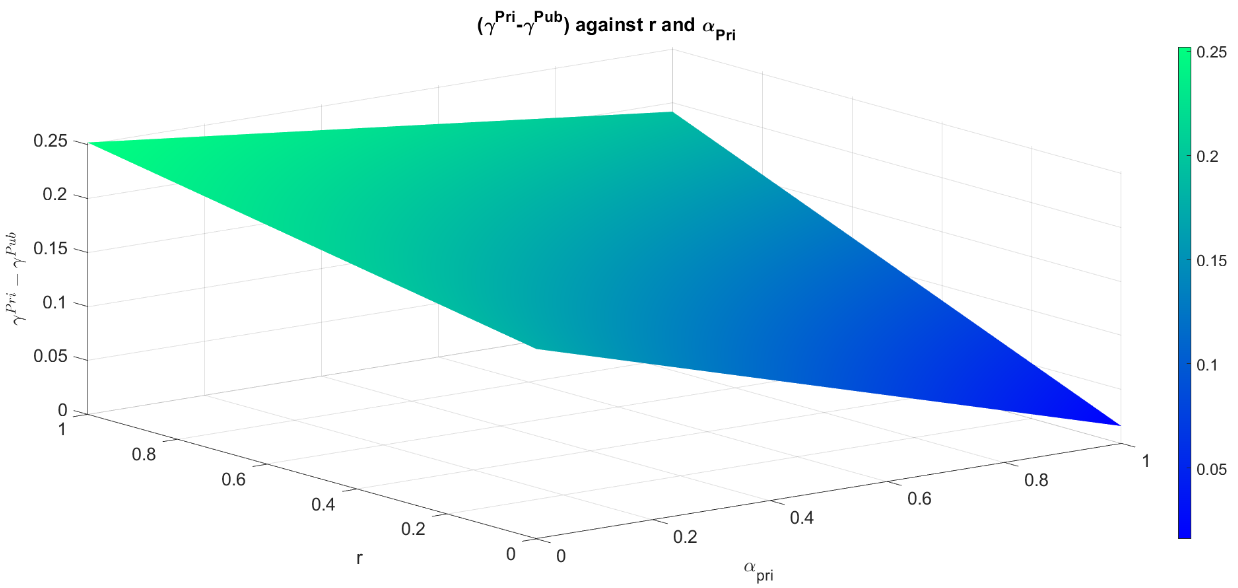

Figure 17: $\gamma^{Pri} - \gamma^{Pub}$ against r and α_I^{Pri}
Note: This figure is generated for $\beta^{Pub} = 0.3$,$\beta^{Pri} = 0.5$,$\omega_U^{Pri} = 0.6$, $\omega_I^{Pri} = 0.4$, and $\omega^{Pub} = 0.38$

Table 1: Summary Statistics

	Observation (1)	All (2)	Pre Deregulation (3)	Post Dergulation (4)	Difference (Post-Pre) (5)
Panel A: Public Sector Bank					
Loan to Deposit	439	71.29	70.63	71.7	1.07
		(1.2)	(2.04)	(1.54)	(2.52)
Loan to Asset	439	58.88	57.83	59.55	1.72
		(0.99)	(1.83)	(1.16)	(2.05)
Total Deposit	439	5844.07	2669.19	7864.45	5195
		(704.56)	(415.79)	(515.04)	(730)
Loans and Advances	439	4148.92	1923.24	5565.26	3642
		(474.75)	(333.99)	(261.83)	(423)
Total Asset	439	7040.09	3250.22	9451.83	6201
		(836.26)	(494.59)	(596.94)	(850)
Savings Deposit Rate	449	3.64	3.5	3.86	0.36
		(0.01)	(0.0)	(0.02)	(0.02)
Spread	449	3.15	3.17	3.12	-0.05
		(0.04)	(0.04)	(0.05)	(0.08)
Panel B: Private Sector Bank					
Loan to Deposit	320	81.72	75.69	85.55	9.86
		(1.35)	(1.19)	(0.87)	(1.45)
Loan to Asset	320	58.52	55.03	60.74	5.70
		(0.79)	(0.62)	(0.58)	(0.88)
Total Deposit	320	2024.41	647.43	2900.66	2253
		(376.27)	(89.11)	(439.75)	(562)
Loans and Advances	320	1709.78	496.1	2482.12	1986
		(324.09)	(74.31)	(369.71)	(472)
Total Asset	320	2820.97	894.54	4046.87	3153
		(513.75)	(127.56)	(584.44)	(748)
Savings Deposit Rate	329	3.89	3.5	4.55	1.05
		(0.044)	(0.0)	(0.09)	(0.07)
Spread	329	2.89	3.15	2.44	-0.71
		(0.06)	(0.06)	(0.12)	(0.12)

Note: Deposits, Loans and Assets in INR Thousand Crores. The pre - and post- deregulation period correspond to the years 2006-2011 and 2012-2020 respectively. Columns 2 to 4 report means and standard deviations in parentheses. Column 5 reports differences of group means between columns 3 and 4 with standard errors in parentheses

Table 2: Effect of Deregulation on Investments: Private Vs Public Banks

The table below provides estimates of a difference-in-differences regression to assess the relevance of deregulation of savings interest rate for public and private sector banks.The dependent variable is share of various types of investment that bank does in form of loans and government securities to total deposits. It is regressed against $Deregulation_{b,t}$ which is defined in equation 1. This is a baseline regression with no controls. The analysis is at bank level and are annual and cover 79 Indian schedule commercial banks from 2006 to 2020 in an unbalanced panel. Robust standard errors are used.

Outcome Variables	$\frac{Loan}{Deposits}$	$\frac{GSec-SLR}{Deposits}$	$\frac{Loan}{Assets}$	$\frac{GSec-SLR}{Assets}$
Deregulation	7.634***	1.624	2.063**	0.149
	(2.641)	(1.133)	(1.052)	(0.701)
Observations	682	682	682	682
Bank FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

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

Table 3: Effect of Deregulation on Investments: Private Vs Public Banks

The table below provides estimates of a difference-in-differences regression to study the effect of deregulation of savings interest rate for public and private sector banks.The dependent variable is logarithm of investment that bank does in form of loans and government securities to total deposits. It is regressed against $Deregulation_{b,t}$ which is defined in equation 1. This is a baseline regression with no controls. The analysis is at bank level and are annual and cover 79 Indian schedule commercial banks from 2006 to 2020 in an unbalanced panel. Robust standard errors are used.

Outcome Variables	*Log(loans)*	*Log(G-Sec investments)*	*Log(Assets)*
Deregulation	0.33***	0.29**	0.31**
	(0.114)	(0.124)	(0.113)
Observations	682	682	682
Bank FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes

Standard errors in parentheses

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

Appendix A: Technical Derivations

FOCs

Solving for Public Sector Bank

$$
\begin{aligned}
\max_{\gamma^{Pub}, D^{Pub}} \pi^{Pub} = & \underbrace{\left(r + \xi_0^{Pub} - \frac{\xi_1^{Pub}}{2} D^{Pub} \right) \gamma^{Pub} D^{Pub}}_{\text{return on loan}} + \underbrace{r(1-\gamma^{Pub}) D^{Pub}}_{\text{return on bonds}} \\
& - \underbrace{\alpha_I^{Pub} \left[\omega_I^{Pub} + (1-\omega_I^{Pub})(\beta^{Pub} r + c) \right] D^{Pub}}_{\text{Insured types}} \\
& - \underbrace{(1-\alpha_I^{Pub}) \left[\omega_U^{Pub} + (1-\omega_U^{Pub})(\beta^{Pub} r + c) \right] D^{Pub}}_{\text{Uninsured types}}
\end{aligned}
\tag{20}
$$

Taking FOC

w.r.t γ^{Pub}

$$
\begin{aligned}
\frac{\partial \pi^{Pub}}{\partial \gamma^{Pub}} &= \left(r + \xi_0^{Pub} - \frac{\xi_1^{Pub}}{2} D^{Pub} \right) D^{Pub} - r D^{Pub} = 0 \\
\implies & \underbrace{\left(r + \xi_0^{Pub} - \frac{\xi_1^{Pub}}{2} D^{Pub} \right)}_{\text{Marginal return on risky loans}} = \underbrace{r}_{\text{Marginal return on safe bonds}} \\
\implies & \boxed{\frac{2\xi_0^{Pub}}{\xi_1^{Pub}} = D^{Pub}}
\end{aligned}
\tag{21}
$$

w.r.t D^{Pub}

$$
\begin{aligned}
\frac{\partial \pi^{Pub}}{\partial D^{Pub}} &= \left(r + \xi_0^{Pub} - \xi_1^{Pub} D^{Pub}\right)\gamma^{Pub} + r(1-\gamma^{Pub}) - \alpha_I^{Pub}\left[\omega_I^{Pub} + (1-\omega_I^{Pub})(\beta^{Pub} r + c)\right] \\
&- (1-\alpha_I^{Pub})\left[\omega_U^{Pub} + (1-\omega_U^{Pub})(\beta^{Pub} r + c)\right] = 0 \\
&\implies r\gamma^{Pub} + (\xi_0^{Pub} - \xi_1^{Pub} D^{Pub})\gamma^{pub} + r - r\gamma^{Pub} - \alpha_I^{Pub}\left[\omega_I^{Pub} + (1-\omega_I^{Pub})(\beta^{Pub} r + c)\right] \\
&- \left[\omega_U^{Pub} + (1-\omega_U^{Pub})(\beta^{Pub} r + c)\right] + \alpha_I^{Pub}\left[\omega_U^{Pub} + (1-\omega_U^{Pub})(\beta^{Pub} r + c)\right] = 0 \\
&\implies \left(\xi_0^{Pub} - \xi_1^{Pub}\frac{2\xi_0^{Pub}}{\xi_1^{Pub}}\right)\gamma^{pub} + r \\
&+ \alpha_I^{Pub}\left[\omega_U^{Pub} + (1-\omega_U^{Pub})(\beta^{Pub} r + c) - \omega_I^{Pub} - (1-\omega_I^{Pub})(\beta^{Pub} r + c)\right] \\
&- \left[\omega_U^{Pub} + (1-\omega_U^{Pub})(\beta^{Pub} r + c)\right] = 0 \\
&\implies r - \xi_0^{Pub}\gamma^{pub} + \alpha_I^{Pub}\Bigg[(\omega_U^{Pub} - \omega_I^{Pub}) + (\beta^{Pub} r + c) - \omega_U^{Pub}(\beta^{Pub} r + c) \\
&- (\beta^{Pub} r + c) + \omega_I^{Pub}(\beta^{Pub} r + c)\Bigg] - \left[\omega_U^{Pub} + (1-\omega_U^{Pub})(\beta^{Pub} r + c)\right] = 0 \\
&\implies r + \alpha_I^{Pub}\Bigg[(\omega_U^{Pub} - \omega_I^{Pub}) - (\omega_U^{Pub} - \omega_I^{Pub})(\beta^{Pub} r + c)\Bigg] \\
&- \left[\omega_U^{Pub} + (1-\omega_U^{Pub})(\beta^{Pub} r + c)\right] = \xi_0^{Pub}\gamma^{pub}
\end{aligned}
$$

where in the third step we have used equation(14). Thus we have

$$
\gamma^{pub} = \frac{r + \alpha_I^{Pub}(\omega_U^{Pub} - \omega_I^{Pub})\Bigg[1 - \beta^{Pub} r - c\Bigg] - \left[\omega_U^{Pub} + (1-\omega_U^{Pub})(\beta^{Pub} r + c)\right]}{\xi_0^{Pub}} \tag{22}
$$

$$
\gamma^{pub} = \frac{r + \alpha_I^{Pub}(\omega_U^{Pub} - \omega_I^{Pub})\Bigg[1 - \beta^{Pub} r - c\Bigg] - \left[\omega_U^{Pub} + (\beta^{Pub} r + c) - \omega_U^{Pub}(\beta^{Pub} r + c)\right]}{\xi_0^{Pub}} \tag{23}
$$

$$
\gamma^{pub} = \frac{r + \alpha_I^{Pub}(\omega_U^{Pub} - \omega_I^{Pub})(1 - \beta^{Pub} r - c) - \omega_U^{Pub}(1 - \beta^{Pub} r - c) - (\beta^{Pub} r + c)}{\xi_0^{Pub}}
$$

Solving for Private Sector Bank

$$
\begin{aligned}
\underset{\gamma^{Pri},D^{Pri}}{max}\ \pi^{Pri} = & \underbrace{\left(r+\xi_0^{Pri}-\frac{\xi_1^{Pri}}{2}D^{Pri}\right)\gamma^{Pri}D^{Pri}}_{\text{return on loan}} + \underbrace{r(1-\gamma^{Pri})D^{Pri}}_{\text{return on bonds}} \\
& - \underbrace{\alpha_I^{Pri}\left[\omega_I^{Pri}+(1-\omega_I^{Pri})(\beta^{Pri}r+c)\right]D^{Pri}}_{\text{Insured types}} \\
& - \underbrace{(1-\alpha_I^{Pri})\left[\omega_U^{Pri}+(1-\omega_U^{Pri})(\beta^{Pri}r+c)\right]D^{Pri}}_{\text{Uninsured types}}
\end{aligned} \tag{24}
$$

Taking the FOC

w.r.t γ^{Pub}

$$
\begin{aligned}
\frac{\partial \pi^{Pri}}{\partial \gamma^{Pri}} &= \left(r+\xi_0^{Pri}-\frac{\xi_1^{Pri}}{2}D^{Pri}\right)D^{Pri} - rD^{Pri} = 0 \\
\implies \underbrace{\left(r+\xi_0^{Pri}-\frac{\xi_1^{Pri}}{2}D^{Pri}\right)}_{\text{Marginal return on risky loans}} &= \underbrace{r}_{\text{Marginal return on safe bonds}} \\
\implies & \boxed{\frac{2\xi_0^{Pri}}{\xi_1^{Pri}} = D^{Pri}}
\end{aligned} \tag{25}
$$

w.r.t D^{Pri}

Using symmetry, we will get

$$
\boxed{\gamma^{Pri} = \frac{r+\alpha_I^{Pri}\left[(\omega_U^{Pri}-\omega_I^{Pri})-(\omega_U^{Pri}-\omega_I^{Pri})(\beta^{Pri}r+c)\right]-\left[\omega_U^{Pri}+(1-\omega_U^{Pri})(\beta^{Pri}r+c)\right]}{\xi_0^{Pri}}} \tag{26}
$$