Do NBFCs Propagate Real Shocks?

Ghosh, Saurabh and Mazumder, Debojyoti

11 November 2021

Do NBFCs Propagate Real Shocks?

Saurabh Ghosh* and Debojyoti Mazumder *†‡

November 11, 2021

Abstract

In this paper, we try to explain the role of Non-bank Financial Intermediation (NBFI) to percolate and propel a real shock to the rest of the economy through the bank-NBFI interactions. We propose a simple theoretical model which identifies the channels and distinguishes between idiosyncratic, structural and sectoral shocks, cleanly. In our model, the non-deposit taking Non-bank Financial companies (NBFCs) which are the provider of risky, small and fragmented loans, are financed by borrowing from commercial banks. This link connects the NBFCs with the commercial banks and, in turn, with the rest of the economy. A higher realization of the failed firms (idiosyncratic shock) in the NBFC financed sector and a rise in the sector-wide productivity risk (sectoral risk) increase the interest rate charged by the banks and unemployment rate but reduces the real wages and per capita capital formation of the economy. However, when the average number of failed firms increases (structural shock), the reverse happens.

JEL Classification: E44, G23, G21, J64

Keywords: NBFC, Bank-NBFC interaction, Real Shock, Unemployment

*Strategic Research Unit, DEPR, Reserve Bank of India, Fort, Mumbai: 400001.

†Corresponding Author. Email: debojyotim@rbi.org.in, debojyoti.eco@gmail.com.

‡This paper represents the opinions of the authors solely and not those of the Reserve Bank of India.

1 Introduction

Financial Stability Board (FSB) defined *shadow banking* as "credit intermediation involving entities and activities (fully or partly) outside of the regular banking system". In October 2018, the FSB announced its decision to replace the term shadow banking with the term Non-bank Financial Intermediation. Notwithstanding the nomenclature, these financial institutions are perennially involved in maturity, credit and liquidity transformation, without explicit access to central banks liquidity (Pozsar et. al. (2010), Pozsar et al. (2013)). In many countries, these intermediaries are not subjected to stringent banking regulations as they do not accept traditional deposits. Rather shadow banks borrow short-term, leverage themselves considerably and often lend to risky, illiquid and long-term assets (Acharya & Oncu (2011)). The Global Financial Crisis (GFC) of 2008 brought to fore the systemic risk of this sector as it became the target of rollover risk and asset-liability mismatches (ALM) during financial stress (Report on Currency and Finance, RBI, 2010)[1]. Since then, the literature, both in academia and policy domain, considers the implications of financial shocks originating in the shadow banking sector, its financial stability implications and its macroeconomic impact on the real variables (*e.g.* Gennaioli et. al. (2013), Moreira & Savov (2017)). In contrast, in this paper, we confine our focus to understand the role, shadow banking system plays, to percolate and propel the real shock (idiosyncratic and sectoral) in the rest of the real economy through the bank-shadow bank interactions.

The primary focus of the paper is to build a theoretical model in this context. Hence, the understanding and the takeaways of this paper are general. However, for this study, our model reflects on the activities of non-bank-financial-companies (NBFCs) registered in India which "constitute a major segment of shadow banking system alongside other entities such as Insurance companies and Mutual Funds"[2]. As pointed out by Acharya et. al. (2013), NBFCs in India, unlike western shadow banks, provides an alternative for conventional lending by scheduled commercial banks (SCB) in "non-urban parts of India". While NBFCs stand third (after banks and mutual funds) and account for around 9 per cent of total assets of its domestic

[1]https://rbi.org.in/Scripts/AnnualPublications.aspx?head=Report+on+Currency+and+Finance

[2]http://www.bis.org/review/r130204g.pdf

financial sector on 2014, its importance in the financial hierarchy is derived from its role in providing small and fragmented loans (Neelima & Kumar (2017))[3]. Besides the broad similarities with global shadow banks, certain features make Indian NBFCs unique. For instance, a small portion of NBFCs in India accepts deposits. Moreover, NBFCs are believed to have superior local and sectoral information in their niche area. Finally, scheduled commercial banks (SCBs), which plays a role of a competitor to shadow banks in other countries (Hanson et. al. (2015)), park a fraction of their funds to the NBFCs to take advantage of sectoral and local knowledge in certain industries. This leads to a bank-NBFC interlinkage (See Section 2) that accounts for a large portion of credit flow in the labour-intensive small and medium enterprises. Therefore, a negative shock in a sector where NBFCs have a large exposure can impact quite a few SCBs and this could, in turn, impact the productions and factor prices of the other sectors through supply chains and credit channels. As a consequence, public policies play a proactive role in appropriately addressing these concerns at their infancy. In India, policy research on this part is limited, mainly on account of granular and long-time series data availability. In the backdrop of the pandemic shock, an analysis on how NBFCs can propel a sectoral or an idiosyncratic shock to the real variables of the economy could be an important addition to the literature and useful for optimal policy design. This paper attempts to bridge this gap by developing a model that emulates the key characteristics of NBFCs and simulates using parameters that are closely aligned with the Indian economy.

Our model captures three salient features of the NBFC sector. First, NBFCs are financed by SCBs in our model since the major chunk of the NBFC sector is of non-deposit taking type. Second, NBFCs venture into small and risky firm loans. It is costly for well-regulated SCBs to scrutinize the risk of each fragmented projects and extend the loans to the small agents. That gap or the excess demand for the loan is fulfilled by the NBFCs (Acharya et. al. (2013)). The third important feature of the NBFC sector as evidenced in section 2, is sectoral concentration. One particular set of NBFCs finance only to a specific sector(s) and do not spread the operation across all the sectors. However, since NBFCs are financed by SCB which has

[3] https://rbidocs.rbi.org.in/rdocs/Bulletin/PDFs/01AR101017F2969F6115EB4B5992BD73976F9A905D.PDF

operations in other sectors, the effect of NBFC lending is spread across different sectors. Also, the effect of the sectoral risk faced by NBFCs affects the SCB's lending rate. We capture this crucial feature of NBFC elaborately in the extension of the baseline model (section 5).

This paper develops a baseline static partial equilibrium model to understand the impact of the shock in the sector where NBFCs operate (NBFC-sector) on the real variables. The model deliberately abstracts away from the balance sheet imbalance problem and focuses on understanding the real variable channels of NBFC-shocks using an otherwise straightforward partial equilibrium model. We include the policy interest rate (or, policy stance) as an exogenous parameter in the model in a stylized way. There is a positive relationship between the policy rate and the interest rate charged by the SCBs. However, NBFCs' borrowing pattern from SCBs has an additional effect over and above the policy rate. We show that the shock in the (non-deposit taking) NBFC sector can influence real variables such as the real interest rate of the scheduled commercial bank, real wages, unemployment rate etc. Any sudden negative shock in the loan recovery of NBFCs can lead to a fall in real wages and a rise in unemployment.

To investigate the channels we construct a two-sector model, one is a primitive sector and the other is a capital good producing large manufacturing sector. By construction, there are several dissimilarities between the two sectors. The former sector consists of many small firms that produce the intermediate good. The final consumable good of sector 1 is produced by a *bundling* all the intermediate goods together. Small firms use labour as their means of production. Their financial need which emerges to finance the initial capital is fulfilled by the NBFCs. Whereas the latter sector invests labour and capital to produce more capital good and is financed by the commercial bank. The labour market of sector one is frictionless, but the second sector faces search and matching friction to employ additional labour. Due to the unsuccessful production process, the repayment of the interest payment is stochastic in the primitive sector. Therefore, in this model, NBFCs face a risk of loan repayment which commercial bank does not. The repayment risk of the system is absorbed by the NBFCs charging a higher interest rate to the successful production units. We use Dixit-Stiglitz type set up to model sector 1. Therefore, the number of intermediate firms are endogenously determined, and those many firms demand NBFC loans. However, not all of those are the firms who complete the production and repay the loan.

A random proportion of firms receive an adverse shock and fail to complete the production. Thus, the failed firms crowd the loan market in addition to the successful firms which drives the interest rate high. That makes the capital costly also for the firms in sector 2. Thus, job creation or vacancy posting in sector 2, where the labour market faces Diamond-Mortensen-Pissarides (DMP) type frictional labour market, decreases. To counter the fall in capital formation and job creation, the model suggests the reduction of the policy interest rate and policy deposit rate. Additionally, this baseline model is also equipped to address the issue of structural risk.

One of the important features of the NBFC market is, NBFCs are clustered in a few specific sectors (Acharya et. al. (2013)). Therefore, sectoral risk can influence the interest rate charged by the NBFCs. In an extension of the baseline model, we capture the sectoral risk in the existing set up using a Melitz (2003) type framework. The results suggest if the NBFCs are financing in sectors where sectoral risk is high, the interest rate charged by SCB can also increase and crowds out the capital formation and job creation in sector 2. However, the model also explains why this result can be ambiguous when both the wages are determined endogenously. In section (6) we illustrate both, baseline and the model extension, using a numerical exercise and demonstrate the results for India specific parameters.

The rest of the paper is organized as follows. Section 2 gives a brief description of the characteristics of the Indian NBFCs in the context of the present paper. Section 3 describes the baseline model. We characterize the equilibrium of the baseline model and report the comparative statics results in Section 4. We introduce sectoral risk to the baseline model and identify the impact of change in sectoral risk in Section 5. Section 6 contains the numerical illustration of the theoretical model. We summarize the results, discuss the possibilities of further extensions and conclude the paper in section 7.

2 NBFC Characteristic in India

In India, there is a large number of NBFCs registered with the Reserve Bank and they operated through a network of branches and supply credit to many niche segments (Gandhi (2014))[4]. Among these non-deposit taking NBFCs, systemically important (asset size more than Rs.500 crore) NBFCs dominate the segment. In the fund disbursements, among 11 activity-wise classifications listed by Reserve Bank of India, investment and credit to companies account for the major share of NBFC credits in India (Figure 1). Banks lend to NBFCs directly and through debentures and commercial paper (CPs) issued by these companies. In view of the vital role of NBFCs in fund allocation, RBI has also eased norms to allow co-origination of priority sector loans by banks and NBFCs [5]. Considering its importance in financial stability, RBI publishes, overall bank exposure to NBFCs, including their investment in in CPs and debentures in its reports[6]. In this paper, we also focus on the bank-NBFC interlinkages 3 by taking into account the loans disbursed for the production purpose (abstracting from personal loans) and attempt to model the perturbances due to a negative productivity shock.

The bi-yearly Financial Stability Report publishes its finding on NBFC-vulnerabilities and system-level stress tests. There are a few empirical studies relating to Indian NBFCs also. Acharya et. al. (2013) analyse the growth of a shadow banking system in India and argues that Indian NBFCs are quite different from their emerging market counterpart. They are relatively well-capitalized, but bank lending forms a significant part of NBFCs' liabilities [7]. This characteristic is one of the key assumptions of our model too. Recently RBI (2020) highlighted that the market financing conditions for NBFCs due to COVID-19 related disruptions and mentioned the role of policy interventions to ensure the flow of funds to small and medium-sized NBFCs to minimise systemic risks.

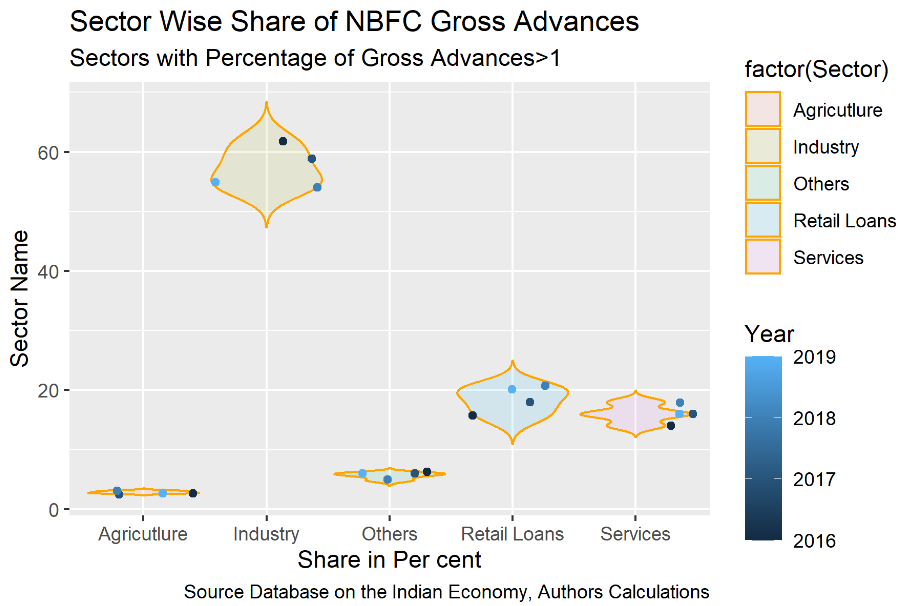
[4]https://rbidocs.rbi.org.in/rdocs/Bulletin/PDFs/04BSC080914.pdf

[5]https://www.rbi.org.in/Scripts/NotificationUser.aspx?Id=11991&Mode=0

[6]For instance, Table VI.8 reports Bank Lending outstanding to NBFCs in its Report on Trend and Progress (latest issue: https://rbi.org.in/scripts/PublicationsView.aspx?id=20272)

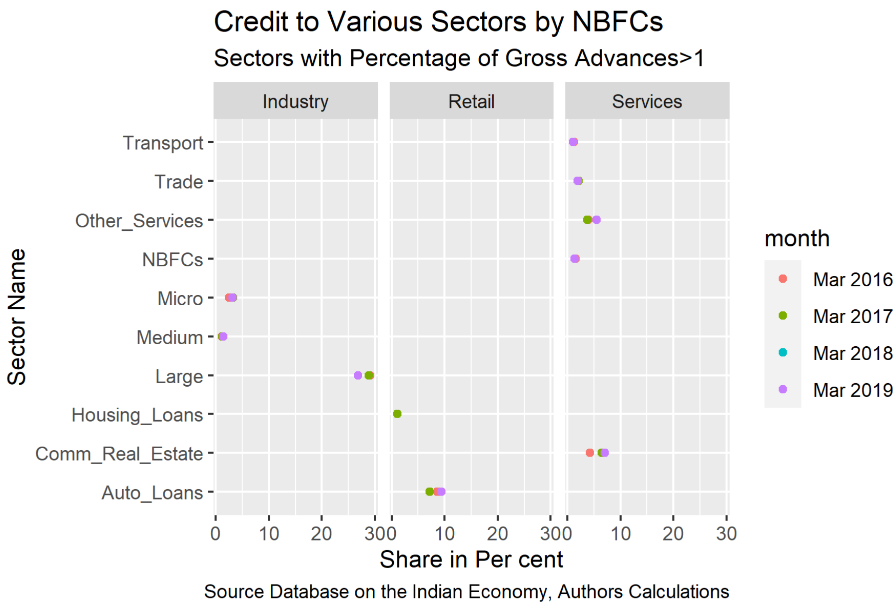
[7]In his speech Acharya (2017) mentioned this feature of Indian NBFCs too. https://rbidocs.rbi.org.in/rdocs/Bulletin/PDFs/01SP111217CBEF9077A25C48329B484120A3EF9B2F.PDF

Figure 1: NBFCs Sectoral Credit



The primary challenge while analysing Indian NBFC data is the paucity of long, granular, high-frequency data. However, eyeballing the available data makes certain features of the NBFC sector quite evident. Figure 1 demonstrates sector wise share of NBFC advances and indicates that most of the NBFC funds find their way to the industrial sector, which accounts for around 60 per cent of total NBFC-advances. All industrial segments (e.g. medium and small) receives credit flow from NBFCs. They also finance retail and services sectors, though their combined share is much lower than that of industry. Automobile loans, commercial real estate, trade and transportation are some of the sectors in retail loans and services (Figure 2). There are several other intermediate and consumer-good sectors that benefit from NBFC finances, albeit accounting for a small portion of total advances (Annex figure 10). These figures support two important features of our model. First, the share of NBFC advances to different sectors has remained stable. Second, NBFC-credit is key source of funds to many medium, small and micro enterprises. An analysis of KLEMS (India) data indicates that these sectors are often labour intensive and generates considerable employment (Annex Figure 11).

Figure 2: NBFCs Credit to Different Sectors

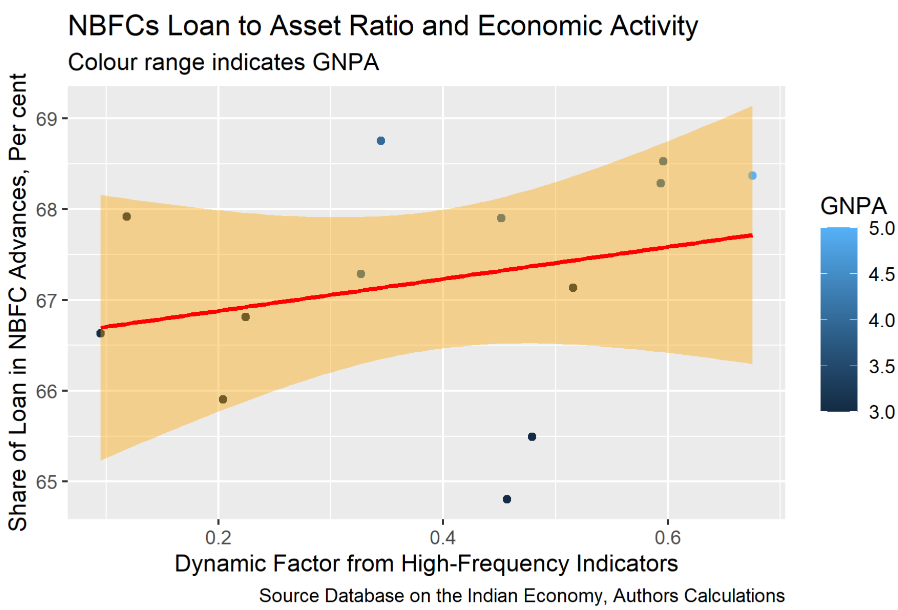


Turning to the liability side of the NBFC balance sheet, the major heads include bank borrowings, debentures and the issue of commercial papers (CPs). NBFCs in India are closely integrated with other entities in the financial sector. For instance, as noted in Acharya et. al. (2013), banking credit plays an important role in the NBFC liability side, which account for around 20 per cent of NBFC liabilities. Debentures, on the other hand, account for around 30 per cent of NBFC liabilities which appears to be active during the period of muted economic activity. The third important source of NBFC funding in India is the CP market. NBFCs' CP issuance account for around a quarter of the total CP issuance and constitutes around 20 per cent of NBFC liabilities. Though its share has declined significantly in 2020 the current year has seen aggressive fund rising by NBFCs through the CP routes. The Financial Stability Report (FSR) of the Reserve Bank of India discloses these features of NBFC liabilities on a half-yearly basis. FSR indicates that NBFCs are intertwined with Asset Management Companies - Mutual Funds (AMC-MF), Public Sector Banks, Insurance Companies and Private Sector Banks [8]. These inter-linkages point to the fact that if the impact of a negative

[8] See Chapter II, Fianacial Stability Report 2019, Reserve bank of India (Chart 2.21, https://www.rbi.org.in/Scripts/PublicationReportDetails.aspx?UrlPage=ID=952)

productivity shock to the NBFC sector is not appropriately addressed, it may lead to a spillover through the financial system to the other sectors. This feature forms a crucial part of our model for evaluating the impact of a negative productivity shock through the banking channels. For instance, the banking sector is linked through its deposits in the NBFCs. Indian mutual funds also invest in non-convertible debt (NCDs) and debenture issued by NBFCs. Commercial banks too lend to NBFCs through CPs and debentures in India. A negative shock that impacts the cash flows (or, incomes) of NBFCs could impact the banking sector, mutual funds and fund allocations in the CP markets. Instead of the relative small share of NBFCs in total resources allocation, this inter-linkage could be a potential source of output and employment fluctuations.

Figure 3: NBFC-Loans and Economic Activity



NBFC credits are pro-cyclical with the economic activity of India. Figure 3 refers to the fact that an increase in the share of NBFC loans during periods of the upturn in economic activity, which is in contrast with the general idea on the activity of shadow banks in the literature (Meeks et. al. (2017)). As an economic activity indicator, we have used a dynamic factor extracted from 15 high-frequency indicators representing industrial activities in India (Bhadury et. al. (2020)) to represent non-agricultural sectors activity levels. Moreover,

Figure 4: NBFC Investment and Economic Activity

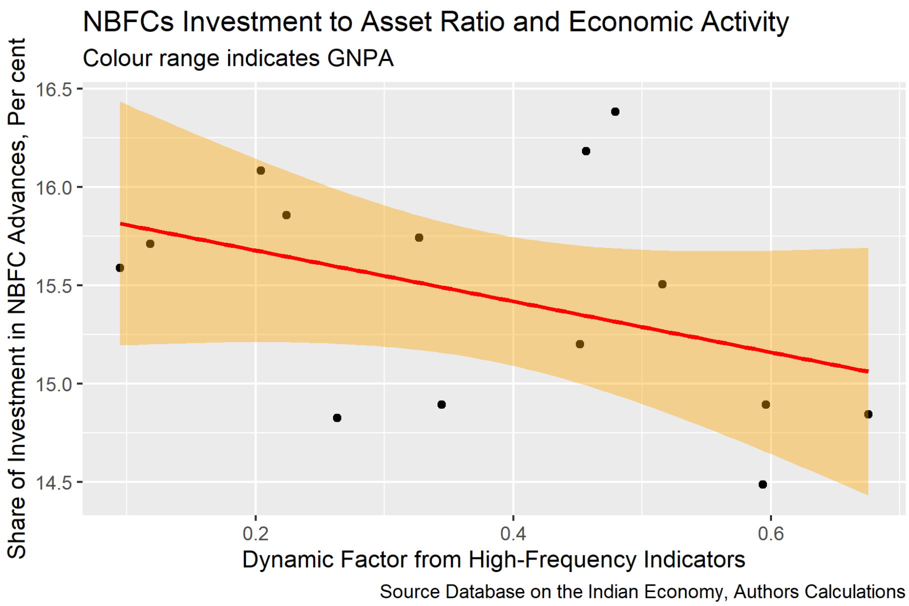


Figure 4 uses data between 2016 and 2019.

the gross non-performing assets also indicate a decline during the boom period. NBFCs also invest a portion of their assets in securities and other financial market products. Figure 4 plots NBFC investment in such securities, and the scatter plot suggests a negative relationship with an increase in economic activity.

Going further deep, we attempt to check the relation between the SCBs contribution on NBFCs liability and the cycle of economic activities. Figure 5 plots banks deposit as a percentage of NBFCs' liability goes up during high activity period [9]. These findings are consistent with the literature (Borio, Furfine & Lowe (2001)) that credit is pro-cyclical in general and for India (RBI, Annual Report 2015, 2019)[10]. However, the concern arises mainly because of the stance of literature which suggests a booming credit cycle or financial cycle could fuel an asset price bubble (Drehmann (2013), Reinhart & Rogoff (2009)). Though we do not consider a financial bubble, a negative productivity shock could lead to defaults to certain NBFC-loans,

[9] Figure 12 in Annex indicates the NBFCs dependence on debenture issuance goes up during the low economic activity period.

[10] (1) https://rbidocs.rbi.org.in/rdocs/AnnualReport/PDFs/0RBIAR2016CD93589EC2C4467793892C79FD05555D.PDF and (2) https://rbidocs.rbi.org.in/rdocs/AnnualReport/PDFs/0ANNUALREPORT2018193CB8CB2D3DEE4EFA8D6F0F6BD624CEDE.PDF

Figure 5: Banks' dopotist to NBFC

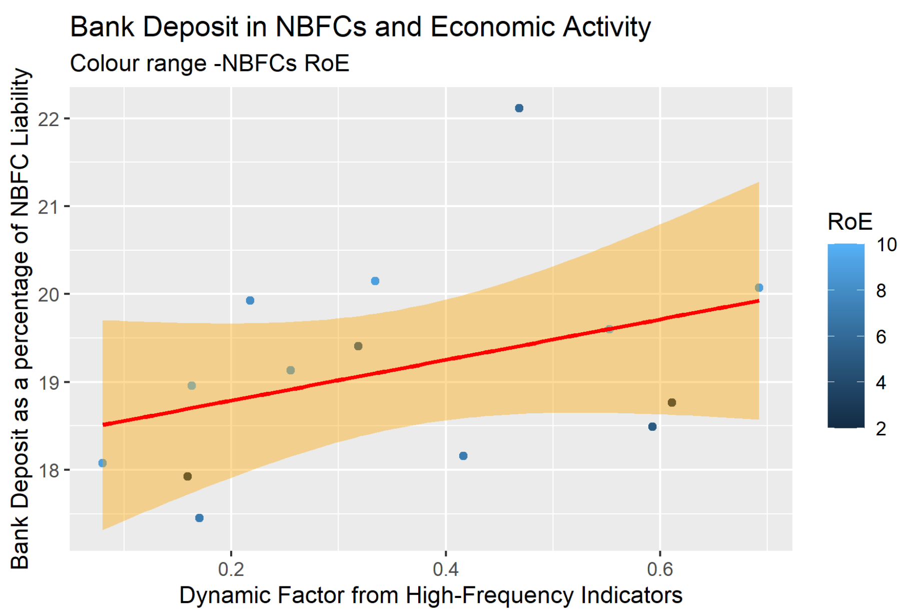


Figure 5 uses data between 2016 and 2019.

which may spillover through NBFC-bank interlinkages to the banking sector. This may not only adversely impact the credit-sensitive micro and small-scale industries but also large scale industries that depend on bank credit.

3 The Model

3.1 Description and Timeline

This section presents a stylized partial equilibrium model to describe the link between dual-financial institutions and real sector outcomes. We consider two loan providing financial institutions, namely scheduled commercial banks (henceforth, SCB) and non-bank financial institution (henceforth, NBFC). SCB is a deposit-taking financial institution. That is, SCB accepts deposit and provide loans by complying banking regulations. Whereas, we model NBFC as a non-deposit taking financial institution which borrows from SCB to lend money, and earns interest [11]. By assumption, SCB does not provide any small and fragmented loans. The assumption may be understood as following, small firms lack necessary collateral, or they are exposed to too risky and fragmented loans. Whereas, SCBs are bounded by strict banking regulations. We discuss the theoretical intuition behind this assumption in section 3.4. NBFC provides loan to small firms but can charge a different interest rate than SCB. SCB lends to the large firm and the NBFC.

In the real side of the economy, there are two goods: X_1, which is produced by intermediate inputs, and X_2 which is produced by labour and capital. The intermediate inputs, indexed as y_i where $i = \{1, 2, ..., n\}$ are produced by small firms. To produce y_i, labour is the variable input, and the fixed input is capital good which is needed to initiate the production. Small firms take a loan from NBFCs to finance the initial capital expenditure. X_2 is produced by the large firms (Pissarides type), and its production process uses two variable inputs, namely labour and capital. Large firm's capital investment is financed by SCB. X_2 is used as the only capital good in the system (the usage of X_2 can be both as a consumption good and capital good). Whereas X_1 is purely consumption good. The prices are P_1 and P_2 respectively. These are assumed as exogenous to the model[12].

Although this stylized model is a static model, there is a specific sequence of events. This sequence of events introduces the uncertainty in this otherwise standard model. There are two stages in the model. In the first stage, endogenous variables are determined for any n (number of intermediate input producing firms). In the second stage, the production process starts, and intermediate input producing firms of sector 1 face idiosyncratic shocks. Not all small and fragmented intermediate input producing firms can finish the production successfully (which we elaborate in subsection 3.2). Once the shock is observed, the number of successful firms is determined. Thus, by backward induction, the equilibrium value of all endogenous

[11]For model simplicity, we refrain from considering other sources of liquidity to NBFC in the basic structure for the model, such as corporate papers. The direction of the results should remain unaltered with those extensions.

[12]This assumption is not binding by no means. We want to abstract from the price channel and try to keep the intuition of the model as clean as possible. We may interpret this assumption as: both the products are internationally traded and hence, prices are internationally fixed.

variables are realized.

3.2 Production in Sector 1

The production function for producing X_1 is of standard CES form and is specified as the following,

$$X_1 = \Big(\sum_{i=1}^{n} y_i^{\rho}\Big)^{1/\rho} \tag{1}$$

where $0 < \rho < 1$. Each intermediate good producing firm needs α unit of initial fixed capital. Note that, capital good is produced in sector 2. Therefore, the cost of the initial capital is $P_2\alpha$. NBFCs give mortgage free loan for this initial capital to the firm. Each unit of y_i is produced by β/φ_i unit of labour, where $\varphi_i \in \{0, 1\}$. The interpretation of φ_i which is a stochastic parameter is crucial in this hypothetical economy. If φ_i realizes the value 1 then the firm can produce one unit of output using β unit of labour, but if φ_i takes the value 0 then the firm needs an infinite amount of labour to produce one unit. In other words, if the firm receives an idiosyncratic bad shock, then the firm has to leave from the production operation even after investing for the fixed cost of capital.

The demand for y_i is derived from equation (1) as

$$y_i = \frac{p_i^{-\sigma}}{\sum_{i=1}^{n} p_i^{1-\sigma}} P_1 X_1 \tag{2}$$

where $\sigma \equiv \frac{1}{1-\rho}$ and p_i is the price of i^{th} intermediate input. Given the demand function noted in equation (2), the price elasticity of demand for y_i with is σ. Therefore, the price of the intermediate input is determined as

$$p_i = \frac{\beta w_1}{\varphi_i} + \frac{p_i}{\sigma}. \tag{3}$$

In case of an idiosyncratic negative shock, the marginal cost as well as the price of the i^{th} intermediate input becomes prohibitively high (infinite). When the firm does not get a bad shock, the price of the i^{th} intermediate good is more than the marginal cost of production (as, $\rho < 1$). The unit profit mark up over unit cost is $\frac{p_i}{\sigma}$. So, $\frac{y_i p_i}{\sigma}$ is the total profit, the firm i makes. Since, any firm secures only zero profit in a monopolistically competitive market,

$$y_i = \varphi_i \frac{\rho\sigma}{\beta w_1} P_2 \alpha r_N. \tag{4}$$

r_N is the rent NBFC charges from the intermediate firms. Here, i^{th} firm can produce non-zero output only if it does not receive a bad shock. Therefore, the labour demand is sector 1 is

$$L_1^d = \varphi \frac{\rho}{1-\rho} \frac{r_N}{w_1} P_2 \alpha. \tag{5}$$

where, $\varphi \equiv \sum_{i=1}^{n} \varphi_i$. Note that, φ takes the value n, if none of the firms face negative shock, otherwise $\varphi = n - \tilde{s}$, where $\tilde{s}$ represents the number of the firms which receive a negative productivity shock.

Given the real wage of the Sector 1 which we solve in the later section, the labour market clearing condition for Sector 1 determines the number of intermediate input producing firms operates into the market.

$$n = \frac{1-\rho}{\rho} \frac{\frac{w_1}{P_2} L_1}{\alpha r_N} + \tilde{s} \tag{6}$$

The capital demand of the sector 1 is αn. The rent at sector 1 is determined by the NBFCs'.

3.3 Production in Sector 2

Firms in sector 2 are of unit measure and produce capital good. Firms face a homogeneous of degree one production function where the factor inputs are capital and labour (expressed as, $F(K_2, L_2)$). Firms in this sector borrow from SCB for their capital expenditure. Firms hire a worker from a frictional labour market by posting a costly vacancy. Once the firms get matched with workers, wage is determined by Nash bargaining between worker and firm.

The firm's nominal working profit per labour is,

$$\pi \equiv P_2 f(k) - w_2 - r_B P_2 k - \delta P_2 k \tag{7}$$

Where, $k \equiv K_2/L_2$ is the per capita capital, w_2 is the wage paid by the firm in sector 2, r_B is the interest rate set by SCB and δ is the rate of depreciation. $f(k)$ is monotonically increasing, concave and follows the

Inada conditions.

3.3.1 Wage determination in Sector 2

The frictional labour market in Sector 2 hinders firm and worker to match readily. Each firm and worker enter sector 2 as a vacant firm and an unemployed worker, respectively. Given L_2 is the total labour force available to sector 2, firms post vL_2 vacancy to get labour for the production (that is, v proportion of labour force of sector 2 is the posted vacancy in this sector). Similarly, u is the proportion of unemployed in the labour force of sector 2. Given v and u are the vacancy rate and unemployment rate, the matching function which describes the matches between firm and worker is given by,

$$m = m(u, v) \tag{8}$$

where m is increasing in each of its element, concave and homogeneous of degree one [13]. The rate of getting job by worker is $m(1, \theta)$ and the rate of getting worker by firm is $m(\theta^{-1}, 1)$, where $\theta \equiv \frac{v}{u}$, is conventionally known is *market tightness*. After getting matched the firm and worker set wage and start producing. The idiosyncratic job breaking rate is denoted as λ. Job arrival rate to the worker, worker arrival rate to the firm and job break rate follow Poisson process.

The value of a filled vacancy is J_F and the value of a vacant job is J_V. Following equations determine J_F and J_V in Bellman form.

$$r_B J_F = \pi - \lambda(J_F - J_V) \tag{9}$$

and

$$r_B J_V = -P_2 d + m(\theta^{-1}, 1)(J_F - J_V) \tag{10}$$

where d is the real cost of posting a vacancy. The firm in sector 2 does not need to borrow to finance this cost. $\big(J_F - J_V\big)$ shows the surplus generated by a filled job over a vacant job. Therefore, equation (9) shows that the return value from a filled job to a firm is operating profit from one worker minus the possible expected

[13] These are standard assumptions of DMP matching function. See, Pissarides (2000)

loss of surplus due to an idiosyncratic job break. Similarly, equation (10) describes that a vacant post incurs a cost of $-dP_2$, but it has an expected surplus from a productive match with a worker. Free entry and exit of firms guarantees $J_V = 0$ in equilibrium. Therefore, from equation (10),

$$J_F = \frac{P_2 d}{m(\theta^{-1}, 1)}. \tag{11}$$

We rearrange equation (9) and use equation (7) to express J_F as the following,

$$(r_B + \lambda) J_F = P_2 f(k) - w_2 - P_2 k r_B - \delta P_2 k \tag{12}$$

The firm determines the desired level of k by maximizing J_F with respect to k. That results into the familiar first order condition of marginal product of per capita capital is equal to the marginal cost of it, plus the rate of depreciation. That is,

$$f'(k) = r_B + \delta \tag{13}$$

Clubbing equation (11) and equation (12) we get,

$$P_2\Big(f(k) - (r_B + \delta)k\Big) - w_2 - \frac{P_2 d}{m(\theta^{-1}, 1)}(r_B + \lambda) = 0 \tag{14}$$

Similar to the firm the value functions for employed worker and unemployed worker are denoted as V_E and V_U. A worker earns w_2 as flow income while employed and we assume the flow return while unemployed is a fraction $(0 < \tau < 1)$ of the wage of sector 1 [14]. The surplus generated from a work is $\big(V_E - V_U\big)$. For the employed workers, the flow value of being employed thus consists of flow income minus the expected surplus loss from a possible job loss. Similarly, the flow value of being unemployed is w_2 plus the expected surplus gain from a possible productive match with the firm. Hence the Bellman form of the value functions are expressed as,

[14] It can be seen in the following ways. The wage in sector 1 which has a competitive labour market, provides almost the subsistence level wage in a labour abundant country. Or, a labourer who appears for a sector 2 job, can always get a job in sector 1 because of free entry in sector 1 with an *iceberg* cost of movement. Hence, sector 1 wage plays as the base of outside flow income while not employed in sector 1.

$$r_B V_E = w_2 - \lambda(V_E - V_U) \tag{15}$$

and,

$$r_B V_U = \tau w_1 + m(1,\theta)(V_E - V_U). \tag{16}$$

Once the firm and worker match, the wage is set by Nash bargaining where the both the agents bargain over the surplus they generate from the match. Given $0 < \varrho < 1$ be the bargaining power of the worker w_2 is determined as,

$$w_2 = \arg\max_{w_2} \ (J_F - J_V)^{1-\varrho}(V_E - V_U)^{\varrho}. \tag{17}$$

The above maximization exercise with standard algebraic manipulation using equations (11) and (15) finds the wage of sector 2 as the following,

$$w_2 = (1-\varrho)\tau w_1 + \varrho P_2\big(f(k) - (r_B + \delta)k + \theta d\big). \tag{18}$$

Equation (18) is intuitively appealing. When the bargaining power of the worker is less, the wage in sector 2 becomes closer to sector 1 wage. On the other hand, if the bargaining power of the firm is limitingly zero, then almost the entire part of operating profit after interest payment goes to the worker as wage.

3.3.2 Steady State Factor Demand of Sector 2

The steady state unemployment rate in the DMP style model is defined as, the unemployment rate for which the outflow from unemployment and inflow into unemployment are equal [15]. Therefore, the steady state unemployment rate is,

$$u^* = \frac{\lambda}{\lambda + m(1,\theta)}. \tag{19}$$

[15] See, Pissarides (2000)

Thus, equations (13), (14), (18) and (19) solve for per capita capital demand, wage in sector 2, market tightness and equilibrium unemployment rate in sector 2 *as a function of* r_B. Given the solution of u^*, the solution for the productive labour force in sector 2 is $(1-u^*)L_2$. Therefore, aggregate capital demand for sector 2 is $k^*(1-u^*)\bar{L_2}$ [16].

3.4 Interest Rate Determination of SCB

SCB lends to NBFCs and the firms of sector 2 and earns interest income. We make certain simplifying assumptions to model the SCB. The SCB accepts deposit and can lend a given fraction (policy determined) of the deposit. To the deposit holders, SCB pays back interest which is predetermined by central monetary authority[17]. There is a cost associated with running the operation of SCB and that is assumed as the quadratic function of the total lending amount by the SCB. The assumption about the structure of the regulated banking market is as follows. SCB cannot set a monopoly interest rate, although baking regulation does not allow free entry and free exit. Therefore, it can preserve its profit but cannot be a "price setter". SCB is not allowed to charge discriminatory interest rates. The interest rate that SCB charges to its borrowers, is derived from the profit maximizing exercise of SCB. Following is the optimization problem to SCB.

$$\text{Maximize } \pi_B = r_B P_2 K_B - \bar{r} D - \frac{\kappa}{2} P_2 K_B^2 \tag{20}$$

with respect to K_B and subject to

$$K_B = K_1 + K_2 \tag{21}$$

$$D = \psi P_2 (K_1 + K_2). \tag{22}$$

[16] In a partial equilibrium framework like this, it *cannot* be interpreted as, the labour force participation of these two sectors adds up to the entire adult work-age population of the country. We may think of the total eligible people for these two sectors and may assume, the total number of people working in these two sectors are hypothetically given.

[17] It can be understood as the depositors' interest rate is closely linked with the announced rate by Central Bank and that is not determined through market forces.

where $0 < \bar{r} < 1$, $\psi > 1$ and $0 < \kappa < 1$. K_B is denoted as aggregate SCB lending. It is assumed that credit market clears. Aggregate deposit what SCB collects is denoted as D, on which SCB pays $\bar{r}$ interest.

The above maximization problem solves for r_B as,

$$r_B = \bar{r}\psi + \kappa(K_1 + K_2). \tag{23}$$

At this point, it is worthwhile to discuss the assumption of SCB's lending to NBFC. Lending directly to the small intermediate input producing firms would be less profitable to SCB. Here, we put two arguments in favour of that without making the model more cumbersome. First, there is uncertainty about the interest payment of intermediate input producing firms. This does not exist in the case of lending to NBFC by SCB because the random shock is absorbed by NBFCs. Given the profit function specified in equation (20), the variable cost would remain unaltered. However, revenue would be reduced by the proportion of the firms who would be unable to repay the interest. Since, SCB cannot charge discriminatory interest rate (and, thus, maximizes profit with respect to K_B), therefore r_B would also remain the same as equation (23). However, the profit of SCB would fall to the extent of expected non-repayment of interest by intermediate input producing firms.

Secondly, the variable cost structure for generating loan, described in this section, results in a positive profit for SCB after setting the interest rate which is given by equation (23). In section 3.1 we mentioned that banking related regulations can be binding for the SCB to provide loans to the small intermediate firms. On account of maintaining the banking regulation, let us assume that SCB has to incur some fixed cost based on *number* of loans bank disburse. For example, before disbursement of the loan SCB has to hire some mechanism to gather information about the borrower. The fixed cost per loan does not change with the *amount* of loan the bank is disbursing. The SCB pay that cost from the profit earned by setting the interest rate as stated in equation (23). In the case of NBFC's operation, SCB is lending to a lesser number of entities as compared to the case where SCB provides loan directly to the small intermediate input producing firms. Therefore, it is a dominant strategy for the bank to lend to NBFC rather than lending directly to the intermediate firms. we abstract from going into analytical detail of either of the two cases here. We refrain from elaborating the model by incorporating those because the results remain the same in this simple set up while keeping the brevity of the model intact.

3.5 Interest Rate Determination of NBFC

NBFCs borrow from the SCB and lend it to intermediate input producing firms of Sector 1. Intermediate firms finance their initial capital requirement by that loan. The initial capital itself works as "hypothecation" or "mortgage" to NBFCs. The interest rate that NBFCs charge is announced before the commencement of any production activity. Therefore, NBFCs announce the interest rate in an uncertain environment which arises due to possible negative shocks to the intermediate input producing firms.

It is assumed that NBFCs are operating in a perfectly competitive environment and making zero profit [18].

Given r_B is the commercial bank's rate of interest, NBFCs' have to pay back $(1 + r_B)K_1$ to the bank. That is the cost, which is borne by the NBFCs, $r_B K_1$. Here, K_1 is the aggregate demand of initial capital from sector 1 which is supplied by NBFCs. As we described in subsection 3.1, $K_1 = P_2 \alpha n$.

However, due to idiosyncratic stochastic negative productivity shock to the intermediate input producing firms, few firms are not able to produce and sell the product. In that case, those firms will be unable to pay back the interest to NBFCs [19]. Keeping this uncertainty into consideration, NBFCs charge a premium over its cost of borrowing to break even. Thus, the zero profit condition shows,

$$r_N = \phi^e r_B \tag{24}$$

where $\phi^e \equiv E(\frac{n}{n-\tilde{s}}) \in [1, \infty)$. Here ϕ^e shows the expected ratio of total intermediate input producing firms to successful intermediate input producing firms. That ratio also indicates to the expected fraction of (inverse of) good loans out of the total number of loans provided by NBFCs. Clearly, r_N is higher than r_B. That is, NBFCs charge a higher interest rate than its cost of borrowing to hedge against the expected loss from

[18] It can also be seen as a perfect insurance market among risk-neutral NBFCs: "gainers finance the loss of losers" and break even without seeking any extra rent.

[19] NBFCs do not have the "Lender of Resort" facility from the central bank.

uncertain cost recovery.

Recall equations (6) and (24). The number of productive firms in the intermediate input producing sector, $n - \tilde{s}$, can be expressed as,

$$n - \tilde{s} = \frac{1-\rho}{\rho} \frac{L_1}{\alpha \phi^e r_B} \frac{w_1}{P_2}. \tag{25}$$

Note that, higher the mark up NBFCs charge above the interest rate of SCB lesser the successful productive intermediate firms remain in the market. Earlier we defined ϕ^e as $E(\frac{n}{n-\tilde{s}})$. For the ease of interpretation, we assume that $\tilde{s}$ can be expressed as the proportion of n [20]. That is, $\tilde{s} \equiv sn$, where s is a stochastic parameter with the bound of $[0, 1)$. Therefore, ϕ^e becomes $E(\frac{1}{1-s})$. This says, the expected number of firms out of which one firm survives, is ϕ^e.

Now, we can rewrite number of intermediate input producing firms as,

$$n = \frac{1-\rho}{\rho} \frac{L_1}{\alpha r_B} \frac{w_1}{P_2} \Big[\frac{\frac{1}{1-s}}{E(\frac{1}{1-s})} \Big]. \tag{26}$$

4 Equilibrium and Comparative Statics

The model closes with the two-sector earning equivalence condition. Here, the condition is defined as the infinite present value of income stream for working in sector 1 is the same as the infinite present value of being unemployed in sector 2. This is because, by assumption, everyone joins sector 2 as unemployed in contrast to sector 1, where one can readily get a job while entering. In notation, $\frac{w_1}{r_B} = V_U$. This equivalence condition expresses w_1/P_2 in terms of θ after some straightforward simplification. That is, the real wage in sector 1 can be written as,

$$(1-\tau)\frac{w_1}{P_2} = \frac{\varrho}{1-\varrho}\theta d \tag{27}$$

[20] Relaxing this assumption does not defy the results of the paper but increase the complexity of computation to a large extent.

Now, the model is solvable for all the endogenous variables in terms of the given parameters.

Definition 1. *An equilibrium in this model is a set of solution* $\{r_B^*,\, k^*\}$ *which satisfies the demand for capital for the firms in sector 2 and maximizes profit of the SCB given s, such that,* for $\{r_B^*,\, k^*\}$, $\{n^*, r_N^*, \frac{w_1}{P_2}^*, \theta^*, u^*, \frac{w_2}{P_2}^*\}$ have non-zero positive equilibrium outcome and,

i) $\{\theta^*,\, \frac{w_2}{P_2}^*\}$ *solves the market tightness and the wage rate that maximizes the Nash bargaining surplus and satisfies the free entry condition for the firms in sector 2,*

ii) $\{u^*\}$ *solves for the steady state unemployment rate in sector 2,*

iii) $\{n^*,\, \frac{w_1}{P_2}^*\}$ *solves for the number of intermediate input producing firms and the wage rate which satisfies the zero profit condition for intermediate input producing firms in sector 1 and the earning equivalence condition between the two sectors, and,*

iv) $\{r_N^*\}$ *solves for the interest rate charged by the NBFCs.*

Table 1 summarizes the structure of the model. The simultaneous solution of the equations describes the equilibrium of this stylized model. We also specify the needed functional forms which are widely used in the literature, for the production function and the matching function.

Using the matching function mentioned in the table (1), we solve w_2 and θ and hence, u^* as a function of k and r_B. Now, replacing n, $\frac{w_1}{P_2}$, u^* and θ, into the equation of "*interest rate of SCB*" (as mentioned into the table (1)), it can be expressed as a reduced form equation,

$$S^B\Big(\underset{-}{k}, \underset{+}{r_B};\ \underset{-}{\psi}, \underset{-}{\bar{r}}, \underset{-}{s}, E\big(\underset{+}{\frac{1}{1-s}}\big), \mathcal{A}\Big) = 0. \tag{28}$$

A detailed description of the algebraic steps to get the reduced form equation are provided in the appendix. The sign below the variables and the parameters signify the sign of the partial derivatives of the function S^B with respect to that particular variable or parameter. In the equation (28) we explicitly specified the policy parameters, stochastic parameter and the expectation of the stochastic parameter only. We identify these as parameters of interest. Where $\mathcal{A}$ is the set of all other parameters present in the reduced form equation (28).

Table 1: Model Summary

Equation	(Definition)
$X_1 = \left(\sum_{i=1}^{n} y_i^{\rho} \right)^{1/\rho}$	(output of X_1)
$p_i = \frac{\beta}{\varphi_i} \frac{w_1}{\rho}$	(price of intermediate input)
$K_1 = n\alpha$	(demand of capital in Sector 1)
$y_i = \frac{\varphi_i}{\varphi} \frac{L_1}{\beta}$	(output of of intermediate input)
$X_2 = F(L_2, K_2) = L_2^{\vartheta} K_2^{1-\vartheta}$	(output of X_2)
$m = \frac{uv}{u+v}$	(matching function)
$k = \left(\frac{1-\vartheta}{r_B+\delta}\right)^{\frac{1}{\vartheta}}$	(per capita capital demand in sector 2)
$P_2\big(f(k) - (r_B + \delta)k\big) - w_2 - P_2 d(1+\theta)(r_B + \lambda) = 0$	(beverage curve)
$w_2 = (1-\varrho)\tau w_1 + \varrho P_2\big(f(k) - (r_B + \delta)k + \theta d\big)$	(wage in sector 2)
$u^* = \frac{\lambda}{\lambda + \frac{\theta}{1+\theta}}$	(steady state unemployment rate)
$K_2 = \left(\frac{1-\vartheta}{r_B+\delta}\right)^{\frac{1}{\vartheta}} (1-u^*)\bar{L_2}$	(*agg* demand for capital in sector 2)
$r_B = \psi \bar{r} + \kappa\big(n\alpha + k(1-u^*)\bar{L_2}\big)$	(interest rate of SCB)
$r_N = \phi^e r_B$	(interest rate of NBFC)
$\phi^e = E(\frac{1}{1-s})$	(inverse of expected fraction of successful loan)
$(1-\tau)\frac{w_1}{P_2} = \frac{\varrho}{1-\varrho}\theta d$	(earning equivalence condition)
$n = \left(\frac{1-\rho}{\rho} \frac{\varrho}{1-\varrho} \frac{L_1 d}{\alpha(1-\tau)}\right) \frac{\theta}{r_B} \left[\frac{\frac{1}{1-s}}{E(\frac{1}{1-s})}\right]$	(size of the intermediate input industry)

We rearrange the equation of "*per capita capital demand in sector 2*" equation (as mentioned into the table (1)) and express that as,

$$D^k(\underset{+}{k}, \underset{+}{r_B}; \mathcal{B}) = 0. \tag{29}$$

As we specified the signs of the partial derivatives of the equation (28), we mention the same for equation (29) too. $\mathcal{B}$ is denoted as the set of all the parameters present in the equation of "*per capita capital demand* *in sector 2*". We do not explicitly mention any specific parameters here because the parameters present in this equation are neither the policy parameters nor the stochastic parameters. Hence, we do not consider those as the parameters of interest in the present context.

The equations (28) and (29) in (k, r_B) plane are represented as an upward sloping and a downward sloping schedule, respectively. The intersection point of the two schedules which can be guaranteed by certain non-imposing parametric specification shows the equilibrium of the model for a given realized value of s. We depict the equilibrium in figure (6) as (k^*, r_B^*).

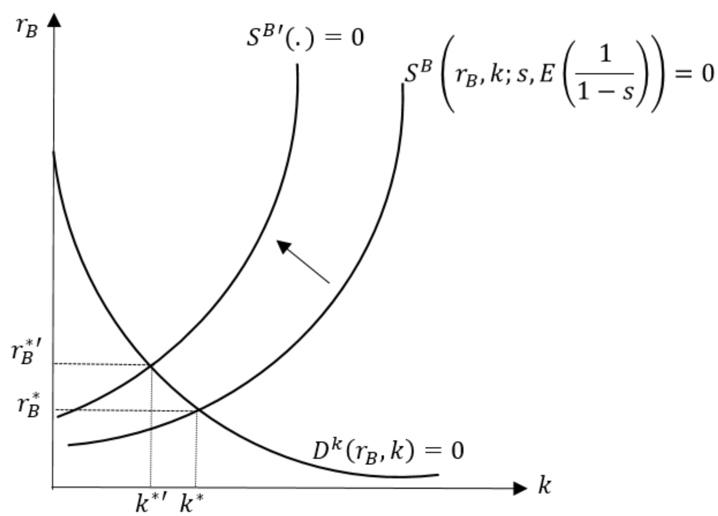


Figure 6: Equilibrium Solution for r_B and k

4.1 Comparative Statics Results

4.1.1 Short term Idiosyncratic shock

For a negative shock in the loan defaulter proportion among the intermediate input producing firms, that is, for a higher realized value of s, $S^B(\cdot) = 0$ curve in figure(6) moves upward to $S^{B\prime}(\cdot) = 0$. This causes a fall in equilibrium k (as $k^{*\prime}$) and a rise in equilibrium r_B (as $r_B^{*\prime}$). In our stylized model, this negative shock can be considered as the short term idiosyncratic shock.

The impact of a rise in s is the fall in $\frac{n-\tilde{s}}{n}$, that is, a decrease in the share of firms who have successfully repaid the borrowing amount from NBFCs. This implies the borrowing amount taken from SCB by NBFCs is larger than the repayment to NBFCs. Given the larger capital demand from sector 1 as compared to repayment, the price of a loan, that is r_B, increases. That causes the fall in k and the rise in r_N. This implies a shrink, both in the size of sector 1 and sector 2. That has its obvious negative impact on employment and real wages. Equilibrium market tightness in sector 2 (θ^*) depends positively on k^* and negatively on r_B^* (See appendix for the mathematical expression). Therefore, a negative NBFC shock leads to a fall in θ^* due to lack of vacancy posting (in other words, job creation). That causes a rise in the unemployment rate in sector 2 and a fall in the real wage of both sector 1 and 2. Additionally, due to a rise in the interest rate and a fall in market tightness, there is a second round contractionary effect on n, that is, the number of intermediate input producing firms. So, a short term idiosyncratic NBFC shock can have a real sector impact via the interest rate channel of the SCB, and more importantly, that can transmit into capital formation, unemployment and wage rate of the two sectors.

Proposition 1. *A random negative idiosyncratic shock in the loan recovery of NBFCs' leads to*

i) rise in real interest rate of both SCB and NBFCs,

ii) fall in the capital input of sector 2 and the real wage of both the sectors,

iii) increase in unemployment, and,

iv) fall in output of both the sectors.

4.1.2 Structural Shock

We consider the change in the distributional parameter as the structural shock. The difference between short term idiosyncratic shock and structural shock is, in the case of short idiosyncratic term shock we considered a change in the observed value of the random parameter, s, whereas, for the structural shock, the expected value of the random parameter is changed. That is, in the context of the present model, we change ϕ^e to see the effect of structural change. As it is explained in subsection (3.5), ϕ^e is the expectation of the total number of loans to good loans ratio provided by NBFCs. This shows on average out of how many loans one good loan happens. Since it is "on average", it puts light on the long run or the structural issue. If this ratio increases then it implies structurally the return is less in the sector where NBFCs operate. Therefore, the difference between the interest rate charged by NBFCs and SCBs increases because NBFCs are now operating in a market where inherently return is less. If r_N increases n falls. That leads to lesser demand for the loan by NBFCs to SCBs. Hence, r_B also decreases due to the lesser demand for the loan from sector 1. Moreover, due to less r_B, the equilibrium per capita capital in sector 2 increases causing more job creation in sector 2. The unemployment rate falls. As a second round effect, the drop in n is moderated by the decrease of r_B and increase in θ.

In figure (6), $S^B(.) = 0$ curve shifts down for an increase in $\phi^e (\equiv E(\frac{1}{1-s}))$ for any given observed value of s. That leads to an reduction in equilibrium r_B^* and increase in equilibrium k^*, for any given observed value of s. As r_B^* falls and k^* rise, market tightness in sector 2 and real wage in both the sectors go up. Since these results are true for any observed value of s, that implies the expected values of θ, w_1/P_2 and w_2/P_2 also increase.

4.1.3 Policy Shock

Intuitively the effects of policy decisions are straight forward in this hypothetical model. The reduction in policy rate $\bar{r}$ has a positive impact on k and a negative impact on u. Therefore, to counter an increase in s, policy maker may go in the line of reducing the policy rate. We explain the effect of the policy shock in light of this hypothetical model. $\bar{r}$, that is, the policy interest rate, and r_B, that is, the SCB's lending interest rate, are positively related. In this model, the first round rate transmission depends positively on another policy variable, ψ, that is a proxy of the reserve requirement. Higher the value of ψ, greater the unused fraction of the deposit which SCB cannot lend. As discussed in section (3.4) $\psi > 1$. That implies, higher value of ψ escalates the policy transmission (see, equation(23)). Therefore, both $\bar{r}$ and ψ push r_B to the upward direction. However, that increase in r_B becomes moderated by the fall in k, n and $(1-u^*)$, because a rise in r_B makes loan costlier for the firms, both in sector 1 and in sector 2 (which leads to lesser employment generation also). The extent of the moderation in r_B depends crucially on the magnitude of κ, which is a proxy for marginal cost of lending (*mclr*) for SCB. If the *mclr* is high for the SCB, then the increase in r_B due to a rise in policy rate (or, reserve requirement) can be moderated to a large extent. That causes a weaker policy transmission. In this well-established result, the contribution of this paper is the extent of the r_B moderation is large due to the NBFC channel (affecting n) and labour market imperfection (affecting u^*). That is, these two channels, additionally, explain the weaker policy transmission. If ρ is small, the NBFC channel has a large impact on the moderation of r_B after a policy shock. Similarly, higher labour market friction (due to either high λ or d, in this model specification) also weakens the policy transmission.

5 Model Extension: Sectoral Risk and Transmission

Indian NBFCs has a distinct characteristic. Operation of each NBFC is specifically restricted to a particular sector [21]. This serves the purpose of filling up the capital deficiency of particular sectors. However, if the sector as a whole faces a shock, then that translates to the banking system. In the baseline model described above, we dealt with the idiosyncratic shocks to the small firms who are associated with NBFCs. The interest rate charged by NBFCs is internalizing that risk and charging a higher interest rate. This was ensuring the repayment mechanism to SCBs remains unaffected. Here, we extend the baseline model and consider sectoral risk which is embedded in the economic system. All intermediate input producing small firms are subject to sectoral risk.

We introduce the sectoral shock in sector 1 using Melitz (2003) framework in our baseline model. The intermediate input producing firms incur a sunk cost, f, before learning about the sectoral productivity. We can understand f as en entry cost. This cost is incurred in terms of labour of sector 1. Firms finance that

[21] Section 2 and Acharya et. al. (2013) provide evidence to the sectoral concentration of NBFCs' operations. This feature of the NBFC operation exposes them to the sectoral risk.

cost by borrowing from the NBFCs. As in our baseline model, firm i uses $\frac{\beta}{\psi_i}$ units of labour where β is the same for all firms but the realization of ψ_i is firm-specific. However, in this extension, β is a stochastic parameter, defined over a non-zero, continuous and bounded domain ($e.g.\mathcal{B} \equiv [\underline{\beta}, \overline{\beta}]$, where $\underline{\beta} \geq 0$ and $\overline{\beta} > 0$), and realizes its value from a probability distribution G. Firms find the realized value of β after entering the market. Otherwise, the production process remains the same as earlier. That is, firms incur a fixed cost α in terms of capital good (X_2) to produce the output and that cost, as mentioned in the earlier version of the model, the fixed cost is covered by borrowing from NBFCs. Therefore, the total cost of producing y_i unit of intermediate good is $P_2\alpha r_N + w_1\frac{\beta}{\varphi}y_i$. The production technology for producing X_1 also remains unaltered as described in equation (1). Therefore, the demand for y_i is same as in equation (2) and price determination for intermediate input producing firms also remain unchanged as mentioned in equation (3). Now, the profit of intermediate input producing firm i after making y_i unit of output is, $\pi_{1i}^I \equiv \frac{p_i y_i}{\sigma} - P_2\alpha r_N$. Since, price, p_i, depends on β (see equation (3)), therefore, π_{1i}^I is also a function of β. If $\pi_{1i}^I(\beta) \geq 0$ then firms can finish the production. Hence, the cut-off β^* is such that,

$$\pi_{1i}^I(\beta^*) = 0. \tag{30}$$

The effective probability density function for the labour intensity of the intermediate input producing firms, thus, becomes, $\tilde{g}(\beta) = \frac{g(\beta)}{G(\beta^*)}$ for $\beta \leq \beta^*$, and $\tilde{g}(\beta) = 0$, otherwise. That is, if β remains below the cut-off β^*, then the firms generate positive profit and continue production. However, if the realized value of β is higher than the cut-off β^*, then the profit of the firms go below zero and no firms commence production. We name the states as a "bad season" if $\beta > \beta^*$ and "good season" if otherwise.

We refrained from mentioning the price of X_1 in section 3.2 because it was not used in the baseline model. In this version of the model, we specify the price of X_2, which takes the standard form as in the literature. That is,

$$P_1^{1-\sigma} = \sum_{i=1}^{n} \left(\int_{\beta \in \mathcal{B}} p_i(\beta)^{1-\sigma} \tilde{g}(\beta) d\beta \right). \tag{31}$$

All the successful firms (that is, for which $\varphi = 1$) sets equivalent price because they are all homogeneous and faces the same value of β. Following the same notation mentioned in the baseline model, the number of successful firms is $(n - \tilde{s})$. Therefore, we rewrite the price expression specified in equation (31) after making a few straight forward simplifications as,

$$P_1 = (n - \tilde{s})^{\frac{1}{1-\sigma}} \frac{w_1}{\rho} \bar{\beta}. \tag{32}$$

Where, $\bar{\beta}^{1-\sigma} \equiv \int_{\beta \in \mathcal{B}} \beta^{1-\sigma} \tilde{g}(\beta) d\beta$. This $\bar{\beta}$ can be interpreted as an index of labour intensity. Since, good 1 is sold in a competitive product market, the revenue has to be exhausted among its factor inputs, if production takes place. In other words, the market clearing condition is, $P_1 X_1 = w_1 L_1 + (n - \tilde{s})(P_2 \alpha + P_2 f) r_N$. Note that, the sunk cost was incurred in capital good and hence, that good itself can be used as the mortgage. The cost of f is financed by NBFCs. Therefore, firms have to make the interest payment to NBFCs in case of successful completion of production. Now, we can express π_{1i}^I in terms of parameters and factor prices, but independent of i. Using equation (2), equation (3) and equation (32) into the expression of π_{1i}^I for the successful firms (that is, $\varphi = 1$), we get

$$\pi_1^I(\beta) = \left(\frac{\beta}{\bar{\beta}} \right)^{1-\sigma} \frac{w_1 L_1 + (n - \tilde{s})(P_2 \alpha + w_1 f) r_N}{\sigma (n - \tilde{s})} - P_2 \alpha r_N. \tag{33}$$

The free entry condition ensures,

$$G(\beta^*) \int_{\beta \in \mathcal{B}} \pi_1^I(\beta) \tilde{g}(\beta) d\beta = P_2 f r_N. \tag{34}$$

The above two equations are crucial for solving cut-off productivity, β^*, as defined by equation (30). Given r_N and $\frac{w_1}{P_2}$, we reach the following equation which implicitly solves the β^* after few algebraic manipulations.

$$
\begin{aligned}
G(\beta^*)\left[\left(\frac{\beta^*}{\bar{\beta}}\right)^{\sigma-1}-1\right]&=\frac{f}{\alpha},\\
\Rightarrow\int_{\underline{\beta}}^{\beta^*}\left(\left(\frac{\beta^*}{\beta}\right)^{\sigma-1}-1\right)g(\beta)d\beta&=\frac{f}{\alpha}
\end{aligned}
\tag{35}
$$

Equation (35) solves the β^*. The left hand side of the equation (35) is positively related to β^* because $\sigma > 1$ and the right-hand side of that equation does not vary with respect to β^*. Note that, β^* has a negative relation with the fixed cost, α and has a positive relationship with the sunk cost. We will discuss the effect of G on β^* later.

In addition to β^*, another variable of interest which we need to characterize is n. Combining equations (33) and (34), we determine the equilibrium number of intermediate input producing firms, n in terms of given parameters and $\frac{w_1}{P_2}$, r_N and β^*.

$$
n=\frac{\frac{w_1}{P_2}L_1}{\left[f\left(\frac{\sigma}{G(\beta^*)}-1\right)+\alpha(\sigma-1)\right]r_N}+\tilde{s} \tag{36}
$$

In this model extension, we get equation (36) in place of equation (6) of the baseline model [22]. If we set f equals to zero then we get back the exact formulation of equation (6). It is intuitive that lesser *chance* of realising lower marginal cost (i.e., lower value of $G(\beta^*)$) causes lesser number of firms to enter in the market. Equation (36) also indicates the same. Even for same β^*, a riskier sector 1[23] would attract lesser number of intermediate input producing firms. This feature was absent in the baseline model as explained in the previous subsections. This is a the standard Melitz (2003) type result. The interest rate charged by NBFCs, r_N, brings the only departure from the Melitz-type set up. In the next section we characterize r_N in this changed model formation and understand additional channels which are impacting n due to the operation of NBFCs.

[22]Note that $\sigma - 1 = \frac{\rho}{1-\rho}$.

[23]If $G_1(\beta^*) \leq G_0(\beta^*)$ for all β^* and $G_1(\beta^*) < G_0(\beta^*)$ at least for one β^* then we define, that sector 1 is riskier which faces the labour intensity distribution, G_1.

5.1 Interest Rate Determination

In this subsection, we explain the determination of the equilibrium interest rate of both NBFC and SCB in the context of this extension. The model structure for loan recovery is kept unchanged. That is, the assumption for the perfect insurance market among NBFCs remains intact. This holds for both sectoral risk and firm-wise idiosyncratic risk in sector 1. Broadly, the major results remain unchanged even if we introduce a certain level of financial friction [24].

As the baseline model, SCB lends to NBFCs and the large firm of sector 2. In a "bad season", NBFCs finance only the sunk cost to intermediate input producing firms, because none of the intermediate input producing firms in sector 1 can commence production. Otherwise, NBFCs finance both the sunk cost and the fixed cost. Since, it is unknown beforehand whether the *season* is "good" or "bad", NBFCs arrange the entire fund from SCB to finance both the seasons. Thus, borrowing from SCB for sector 1 is not state-dependent. The cost of creating a loan also remains the same as in the baseline model because in terms of provisioning SCB has to make the entire fund (independent of *state*) available for loan [25]. Therefore, the SCB's profit-maximizing interest rate remains the same as in the baseline model, described in equation (23). Following is the relevant equation for this extension,

$$r_B = \bar{r}\psi + \kappa\left[(\alpha + f)n + (1 - u^*)\bar{L_2}k\right]. \tag{37}$$

Now, consider the interest determination of NBFCs. If $\beta > \beta^*$ then intermediate input producing firms borrows only the sunk cost from the NBFCs and as we assumed perfect insurance market, firms meet the repayment obligations too. The free entry condition in equation (34) ensures the repayment of the sunk cost even in the *bad season*. Given $\beta \leq \beta^*$ the intermediate input producing firms starts production and

[24] Interested reader can contact the authors for an online appendix where we introduce a certain degree of financial friction and present another version of this extended model. There we assume that in case of "bad season" NBFCs fail to return the loan to SCB and SCB carries the entire burden of loan default in "bad season". However, the broad understanding and the results of the model hold the same.

[25] We relax this assumption to check the robustness of the results and find the main spirit of the result remains unchanged. Interested readers can contact authors for the online appendix.

hence, incur both sunk cost and the fixed cost of production which are financed by NBFCs. Analogous to the baseline model, due to idiosyncratic shocks $\tilde{s}$ firms fail to complete the production. As discussed in section (5), keeping the model inline with the baseline model we assume $\tilde{s}$ firms face idiosyncratic shock and do not repay the loans. Therefore, whatever be the state, *good or bad*, n firms take the loan to finance the sunk cost and $(n - \tilde{s})$ firms make the repayment. However, in *good season* (i.e. $\beta \leq \beta^*$) firms take additional loan to finance the fixed cost as well, and $(n - \tilde{s})$ firms repay the loan. We reinstate the simplifying assumption of number of failed firms which we made in the baseline model. That is, the number of failed firms is the constant s proportion of the total number of intermediate input producing firms. As we discussed earlier section 3.1, NBFCs declare the interest rate at the beginning of the period, before getting the information of actual number of failed intermediate input producing firms. Therefore, they consider the expected ratio of successful firms (or, failed firms) to total firms. Thus, ensuring zero profit in the competitive NBFC sector, the interest rate, r_N, charged by NBFCs becomes,

$$r_N = E\left[\frac{1}{1-s}\right] r_B \frac{\alpha + f}{\alpha G(\beta^*) + f} > E\left[\frac{1}{1-s}\right] r_B > r_B. \tag{38}$$

If we set $G(\beta*) = 1$ (i.e. if there is no “bad season”), the zero-profit ensuring interest rate charged by NBFCs of this model extension matches exactly with the baseline model. Interestingly to note that here r_N is higher than the baseline model for any given r_B. Equation (38) shows that, an increase in α causes a rise in r_N, but in case of f the relation is inverse. Also, *ceteris paribus*, a fall in $G(\beta^*)$ induces a rise in r_N.

5.2 Equilibrium and Results

The extension of the baseline model, now, has the system of equations, and simultaneous solution of which guarantees the equilibrium of the model. We did not alter the model set up of sector 2 such that we can align the model with its previous version. However, the possibility of incorporating sectoral shock in sector 2 without tampering with the model in a great deal is discussed in section (7). The definition (1) as a description of the equilibrium remains almost the same with a minor addition. In this extension, the solution of β^* must exist such that all other characteristics of the definition (1) hold.

The general strategy we use to guarantee the solution of the model is as follows. We describe an implicit solution for $\{r_B^*, k^*\}$ such that all four conditions mentioned in definition (1) are satisfied, given any value of β^*. Then, we argue that equation (35) has a solution for β^* given the equilibrium $\{r_B^*, k^*\}$. [26] As in case of the baseline model, we solve θ^*, $\frac{w_1}{P_2}$ and $(1-u^*)$ in terms of r_B and k (described in Appendix 1) and plug those in equation (37). Similarly, we can express n in terms of r_B and k from equations (36). Using these we, thus, express equation (37), completely in terms of r_B and k, given the exogenous parameters, and β^*. After the substitution, now, we get a positive relation between r_B and k, similar to equation (28). Therefore, for an increase in r_B, k also increases to satisfy the equation (37). In other words, the profit maximizing r_B and k for SCB can be expressed as a positively slopped relation, similar to the baseline model. We write that equation in an implicit structural form describing the relation with the variables and parameters as follows.

$$S_1^B\left(\underset{-}{k}, \underset{+}{r_B};\ \underset{-}{\psi}, \underset{-}{\bar{r}}, \underset{-}{s}, E\left(\frac{1}{1-\underset{+}{s}}\right), \mathcal{A}_1\right) = 0. \tag{39}$$

Structurally, equation (39) is similar to equation (28). We use subscript "1" to distinguish the functional form of the latter equation from the former. $\mathcal{A}_1$ contains the set of parameters which constitutes of $G(\beta^*)$ and f in addition to the baseline model parameters. Since we keep the model formation of sector 2 intact, we consider equation (29) as it is. The intersection of equation (39) and equation (29) in $\{k, r_B\}$ plane gives the solution of $\{k^*, r_B^*\}$ which satisfies the definition of the model equilibrium (1), given any β^*. Therefore, the equilibrium value of all the endogenous variables can now be expressed in terms of β^*. Since, in this version of the model equation (35) is independent of $\{k, r_B\}$, β^* can be solved only in terms of exogenous parameters. Thus, the solution of β^* from equation (35) completes the characterization of the equilibrium of this model extension.

As we described the equilibrium in the extended version of the model above, it is worth mentioning that the above discussion on the determination of equilibrium r_B^* and k^* were done for any given observation of

[26] In this version of the model, since equation35 is independent of any other endogenous variables, except β^*, the sequence of solving the model is not particularly important. However, this definition of equilibrium is useful for any other involved extension of this model.

s. The results related to short term shock in NBFC repayment (that is, random fluctuation in s), remains similar to the baseline model. When s observes a higher value, then n rises, but the proportion of successful intermediate firms shrinks. That is demand for NBFC loan in sector 1 increases. This causes a rise in r_B^* and a fall in k, as in the baseline model. The second round effect, as we named it in the baseline model, through n is more pronounced in this model extension. The rise in r_N due to an increase in r_B drags down n to a higher extent in this model extension because of the repayment obligation of sunk cost (see equation (36)).

The effect of the structural shock in this version of the model is also similar to the baseline model. However, the magnitude is different. If we consider an increase in $E(\frac{1}{1-s})$, then r_N increases [27]. That leads to a fall in n. The magnitude of the decrease in n blows up in this model extension because of the sunk cost. That implies, the fall in r_B^* and the rise in k^* also escalates, even after the second round impact through a fall in equilibrium β^* due to an increase in r_N.

5.2.1 Effects of Sectoral Risk

The main aim of extending the baseline model is to understand the impact of the change in sectoral risk. The feature that NBFCs have higher concentration in specific sectors, brings this question alive. Let us consider another labour intensity ($\beta \in \mathcal{B}$) distribution $G_1(\beta)$ for the intermediate input producing firms in sector 1. The relation between $G(\beta)$ and $G_1(\beta)$ is as follows: i) the mean labour intensities are same (i.e. $\int_{\beta\in\mathcal{B}} G(\beta)d\beta = \int_{\beta\in\mathcal{B}} G_1(\beta)d\beta$) and, ii) there exists a $\hat{\beta} \in (0, B)$[28] such that $G_1(\beta) \leq (\geq) G(\beta)$ when $\beta \leq (\geq)\hat{\beta}$. This implies the distribution G_1 is generated from G by shifting the probabilities towards the right tail labour intensity, keeping the mean constant. In other words, G and G_1 satisfy the single crossing properties, while retaining the mean same. This suggests, if $\beta^* < \hat{\beta}$ then the risk of encountering a "bad season" is higher if intermediate input producing firms in sector 1 faces the productivity distribution G_1 as

[27] The intuition and mechanism of that were explained in the base model.

[28] For the purpose of specificity let the $\mathcal{B}$ is defined as $(0, B)$.

opposed to G.[29] Since, our objective is to analyse the effect of increase in sectoral risk, we do not consider the case when $\beta^* > \hat{\beta}$. The effective result is same. If $\beta^* > \hat{\beta}$, then G depicts riskier situation than G_1. So, we consider only the case when $\beta^* \leq \hat{\beta}$.

The equation (35) is the equation of interest in this analysis. LHS of the equation (35) shifts downward in β^* plane, if $G_1(\beta) \leq G(\beta)$, given the same mean. Since, the RHS of the equation (35) is independent of β^*, the new cut-off labour intensity for $G_1(\beta)$, β_1^* , becomes greater than initial β_0^* (the initial equilibrium cut-off productivity of the intermediate input producing sector is defined as β_0^*, considering G as the productivity distribution).

Despite the above analysis shows that higher sectoral risk for sector 1 results into a rise in cut-off labour intensity, β^*, the resultant effect on $G(\beta^*)$ is ambiguous. Given $\beta_0^* < \beta_1^*$, if $G(\beta_0^*) < G_1(\beta_1^*)$ then number of equilibrium intermediate firms increases. Combining larger $G_1(\beta_1^*)$ and higher n^* we get higher r_B^* and lesser k^*, thus, causing a higher equilibrium unemployment and lower real wages in both sector 1 and sector 2. Yet, given $\beta_0^* < \beta_1^*$, if $G(\beta_0^*) > G_1(\beta_1^*)$ holds then the resultant equilibrium number of intermediate firms, n^* falls. These two leads to a fall in r_B^* and increase in k^*. As a result equilibrium unemployment falls and real wage in both the sectors increase. Therefore, given $\tilde{\beta^*} \equiv G_1^{-1}\left(G(\beta_0^*)\right)$, if $\beta_1^* < \tilde{\beta^*}$, then r_B^* decreases and k^* increases . On the other hand, if $\beta_1^* \in [\tilde{\beta^*}, \beta_0^*)$, then r_B^* rises and k^* falls. That is, when NBFCs operate in a riskier sector, then adverse real effects are observed only if the equilibrium cut off productivity falls above $\tilde{\beta}$.

Proposition 2. If NBFCs operate in riskier sectors, then, for a given s,

i) cut-off productivity for the intermediate input producing firms rises (i.e. $\beta_0^* < \beta_1^*$),

ii) equilibrium interest rate charged by SCB and unemployment increase and, per-capita capital in sector 2 and real wages of both the sectors fall, given $\beta^* > \tilde{\beta^*}$. Reverse happens if β_1^* remains within $[\underline{\beta}, \tilde{\beta^*}]$.

[29] Although, the single crossing property fails to satisfy the transitivity assumption, however, for our purpose it is sufficient to compare between two distributions, discretely.

6 Numerical Illustration

In this section we take the theoretical model to numerical estimation. The point of interests are mainly to identify the magnitude of the change in the real sector due to different shocks. Shocks are of three kinds under consideration: short run and structural shocks in line of NBFC repayment and the policy shocks.

6.1 Short-term Idiosyncratic Shock

The table (2) describes all the parametric specification taken for the calibration exercise. Since, we motivate our theoretical model by providing a background of the NBFC scenario of India, majority of of the parametric specifications are also taken from Indian perspective. However, rest of the parameters are are taken from the literature. Each of the parametric specifications source is described in the "source" column. Given the parametric specification the model is solvable [30]. We consider the proportion of firms which are unable to repay to NBFCs (s) follows Beta(0.5, 5) distribution. The mean of the random variable is 0.0901 and the standard deviation is 0.118.

First we estimate the effect of the shock in NBFC repayment to other real sector variables according to the present hypothetical model. If the proportion of firms how are unable to repay to NBFC raise by 1% (we assume the increase is from 9% to 10% in s) which we call as a negative idiosyncratic shock, then interest rate charged by SCB increases by 0.06%. Market tightness (θ) in the capital good producing sector 2 decreases by 0.23%. Unemployment rate (u) increases by 0.03% in the sector 2. Per capita capital in sector 2 drops by

[30] Matlab codes are available on request.

[31] 5 year average capital share of Auto-industry.

[32] State Bank of India

[33] ASI reported wage for contractual worker of India is 325.81 per man day on 2014. We consider 4.5% inflation rate as the growth rate of the wage for last 6 years because India has moved to an inflation targeting economy with a target band of 4% to 6%. Then we make it as annual wage of contractual worker as INR 1,32,378.28 for 2020-21. MGNREGA wage which is a famous employment guarantee program of India, is set as INR 182 for 2020 March (we did not consider the relief package announced due to Covid-19 crisis). This program's upper bound of job days is 100. Therefore, annual maximum guaranteed wage is INR 18200. This we will consider as the base wage or the unemployment benefit. Therefore, our estimated τ is 0.13 for India.

Table 2: Parameter Summary

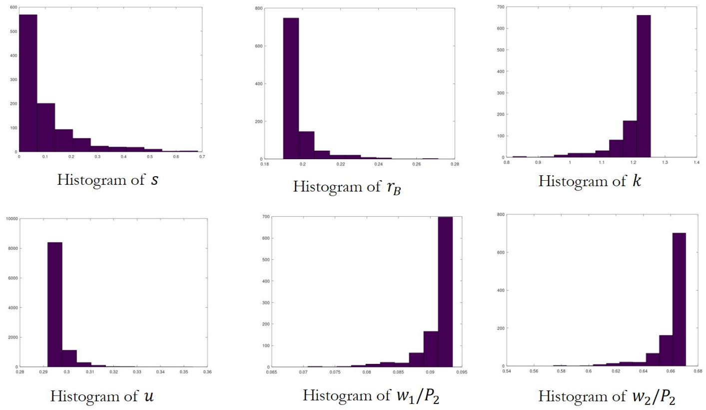
Parameter	Value	Definition	(Source)
σ	1.2	Price elasticity of demand for intermediate input	(Christiano, Eichenbaum & Evans (2005))
α	0.582	Initial capital requirement for intermediate input	(Schmitt-Grohé & Uribe, M. (2004))
β	0.8	Labour intensity of sector 1	(Gabriel, Levine, Pearlman & Yang (2012))
δ	0.03	Rate of depreciation of capital in sector 2	(KLEMS India)
ϑ	0.74	Labour elasticity of producing capital good	(KLEMS India)[31]
κ	0.074	Marginal cost of lending to commercial bank	(SBI[32] 1 year MLCR)
ψ	1.37	SCB's deposit to credit ratio	(RBI NSDP Release)
$\bar{r}$	0.035	Interest rate to depositors	(Saving account interest rate, RBI NSDP Release)
λ	0.15	Rate of firing of job in sector 2	(ASI data. See Banerjee & Mazumder (2019)),
d	0.213	Cost of posting vacancy	(Hall (2017))
ϱ	0.4	Bargaining power of the labour in sector 2	(Gomes (2015))
τ	0.13	Ratio of unemployment benefit in sector 2 and wage in sector 1	(ASI data and MGNREGA wage)[33]
L_1	0.8	Proportion of labour force available in sector 1	Arbitrary

0.39%. Real wage in sector 1 and sector 2 reduce by 0.23% and 0.13%, respectively. Given the probability distribution of s, the distribution of other variables are endogenously determined within the model. Figure (7) summarise the histograms of the distributions of the endogenous random variables. Lower s causes higher k and higher real wages in both the sectors. In case of r_B and u, the relation with s is direct. That is, higher values of s cause higher interest rate charged by SCB and higher unemployment. So, given the distribution of s is left skewed, the distribution of k, W_1/P_2 and W_2/P_2 are right skewed and the distribution of r_B and u are left skewed. This numerical finding supports our Proposition (1).

The standard deviation of per capita capital and market tightness in the sector 2 register a high variance due to the fluctuations in NBFC shock (s). Since, in section (4) we introduce only random fluctuation in repayment to NBFCs the entire variation or spread in other endogenous variables come only through that channel. That implies, given no other shock, NBFC shocks can create relative volatility in r_B, k, u, W_1/P_2 and W_2/P_2 by 4.88%, 5.02%, 1.6%, 3.3% and 1.9%, respectively.[34]

[34]Reported numbers are coefficient of variation.

Figure 7: Distribution of the endogenous variables



6.2 Effect of Policy Shock

Table (3) describes the effect of policy intervention on the endogenous random variables. We perform Kolmogorov-Smirnov test for each of the variables. That is, we test the null hypothesises: "after the policy shock, variable j is generated from same distribution as the initial distribution of j". The null hypothesises are rejected for both 5% and 1% level for all the variables. To check whether the reported mean values are statistically same or not, we perform t-test (Welch's t-test for those whose variances are not statistically significantly same). Similarly, for comparing the variance, F-test is performed for each of the variables. Both of these two tests are performed at 95% confidence interval. In the table (3), double asterisk sign signify that change in parameters are statistically significant compared to its initial parameter characteristics. We find all the deviations in mean for a change in policy parameter(s) are statistically significant.

For a drop in $\bar{r}$ keeping ψ same, average interest rate charged by SCB and unemployment rate fall. Similar effect with lesser magnitude on average r_B and u can be seen for a fall in ψ keeping $\bar{r}$ constant. The effect of change in $\bar{r}$ and ψ on average per capita capital in sector 2, market tightness in sector 2 and real wages of both the sectors is inverse. However, the table (3) suggests that effect of a fall in $\bar{r}$ is higher than the effect of fall in ψ on all the endogenous variables. The standard deviations of k, θ, w_1/P_2 and w_2/P_2 increase as an effect of reduction in the policy parameters, whereas, standard deviations of r_B and u remain statistically same.

Table 3: Effect of change in policy parameters on the endogenous random variables

Variables	$\frac{\Delta\mu_j}{\Delta\bar{r}}$	$\frac{\Delta\sigma_j}{\Delta\bar{r}}$	$\frac{\Delta\mu_j}{\Delta\psi}$	$\frac{\Delta\sigma_j}{\Delta\psi}$
r_B	0.59**	-0.01	0.02**	0.000
k	-4.41**	-0.42**	-0.11**	-0.011
θ	-1.22**	-0.07**	-0.03**	-0.002
u	0.29**	0.00	0.01**	0.000
w_1/P_2	-0.20**	-0.01**	-0.01**	0.000
w_2/P_2	-0.84**	-0.05**	-0.02**	-0.001

Proposition 3. *Given the distribution of the random proportion of the loan recovery of NBFCs' as Beta(0.5,5)*, reduction in $\bar{r}$ or ψ causes

i) fall in average interest rate charged by SCB and average unemployment rate, leaving no significant impact on their standard deviations, and

ii) rise in the average per capita capital input of sector 2 and the average real wage of both the sectors with a small increase in standard deviation.

6.3 Structural Shock

As mentioned in section (4.1.2) we investigate the effect of structural shock in this section using a numerical exercise. Table (4) describes the characteristic of the variables given the distribution of s is changed from Beta(0.5,5) to Beta(1,5). We perform Kolmogorov Smirnov test for all the listed variable to check the null hypothesis: "variables are generated form same distribution". For each of the variables the null hypothesises are rejected with 5% and 1% statistical significance. The difference in the mean and the variance of the random variables listed in the table (4) are statistically different too, for 95% confidence interval.

Note that the mean value of s increases by 0.079 according to table(4). We confirmed that the mean of $\frac{1}{1-s}$ also rises. Therefore, by changing the distribution of s we move to structurally more risky situation for

Table 4: Effect of Structural Change

Variables	$\frac{\Delta\mu_j}{\Delta E\left(\frac{1}{1-s}\right)}$	$\frac{\Delta\sigma_j}{\Delta E\left(\frac{1}{1-s}\right)}$
r_B	-0.005**	0.038**
k	0.063**	0.230**
θ	0.014**	0.069**
u	-0.002**	0.019**
w_1/P_2	0.439**	0.194**
w_2/P_2	0.002**	0.011**

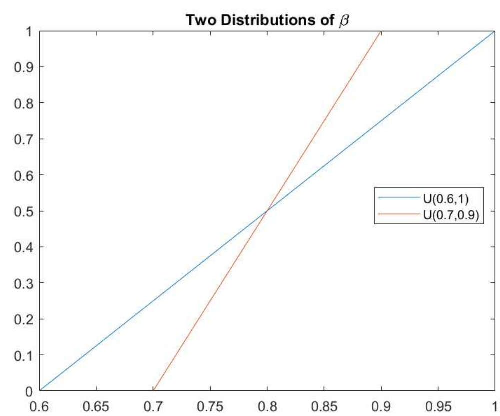
NBFCs repayment than earlier (revisiting discussion of section 4.1.2 numerically). The increase in expected number of intermediate input producing firms per successful intermediate input firm (i.e. rise in $E\left(\frac{1}{1-s}\right)$), causes a drop in average interest rate charged by SCBs and increase in average k with higher standard deviation. Average real wage rate in sector 1 and 2 both go up and average unemployment rate drops. Due to this structural change, the volatility in all the variables go up. In case of k, the spread is highest when the environment is riskier. However, rise in average k is also highest.

6.4 Sectoral Risk

This subsection numerically displays the results after incorporating the sectoral risk in our baseline model (i.e. numerical example for the results derived in section 5.2.1). To make this extension we need to assume a distribution function for β (i.e. $G(\beta)$) and the value of the sunk cost (f). We assume the sunk cost at 0.001. The initial distribution for β is assumed as Uniform(0.6, 1). Therefore, the average labour intensity remains the same as the baseline model assumption declared in Table (2). That is, the average labour requirement for producing one unit of intermediate input in sector 1 is 0.8 unit. This assumption helps us to compare the baseline model with this extension. We retain all other parameter-choices as mentioned earlier in the table (2). Given this distribution of β, the solution for β^*, the cut-off labour intensity, is 0.67. Correspondingly the probability of a “good season”, $G(\beta^*)$, is 0.17. The distribution of the proportion of the failed firms, s, remains as earlier and follows $Beta(0.5, 5)$. As described in section (6.1), endogenous variables become stochastic because of s. In this extension as compared to the baseline model, the average r_B and u increase, and k, $\frac{w_1}{P_2}$ and $\frac{w_1}{P_2}$ go down.

We define the higher sectoral risk in section (5). Here we use a numerical example to demonstrate higher sectoral risk scenario. Let, the new distribution of β be Uniform(0.7,0.9). Note that the mean remains same as earlier. That is, average labour intensity is still 0.8 . However, for all $\beta < 0.8$, $G_1(\beta) < G(\beta)$, where G_1 stands for Uniform(0.7,0.9) and G stands for Uniform(0.6,1). Therefore, Uniform(0.7,0.9) depicts more risky sector 1.

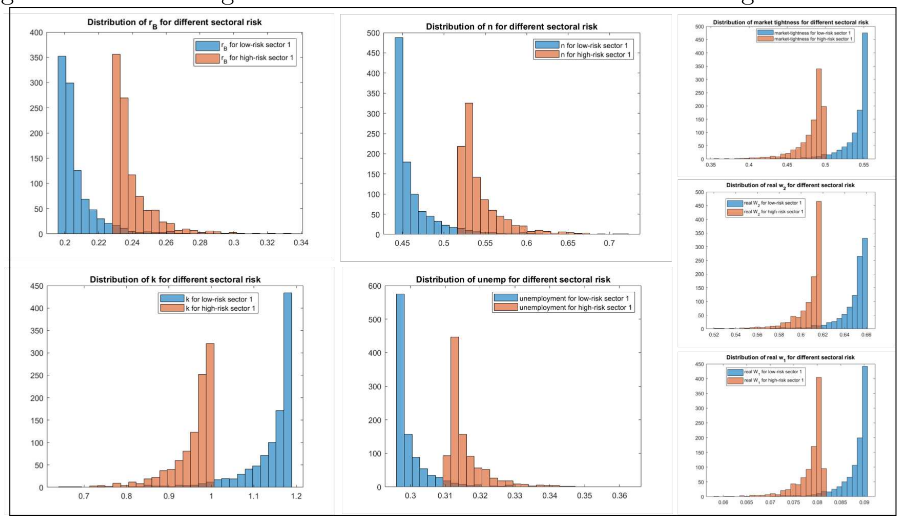
Figure 8: Distributions of β



The new solution for β_1^* is 0.75 and $G_1(\beta_1^*) = 0.25$, given Uniform(0.7,0.9). Note that, in this case $\tilde{\beta}^*$ (defined in subsection 5.2.1) is equal to 0.73 which is less than β_1^*. That is, in this example, $\beta_1^* > \tilde{\beta}^*$. Now, we compare the two situations with respect to the endogenous variables. Following figure (Figure 9) shows the change in the distribution of the endogenous variables given the increase in sectoral risk in that sector where NBFC operates. Or, in other words, if NBFC operates in a higher risk sector then the distribution of the endogenous variables change in the following way (Figure 9).

The distributions for r_B, n and u shift to right, and opposite happen for k, $\frac{w_1}{P_2}$, $\frac{w_2}{P_2}$ and θ when sector 1 is riskier. This result resembles with the proposition (2). The change in the moments of the endogenous

Figure 9: Effect of higher sectoral risk on the distribution of endogenous variables



variables are listed in the following table corresponding to change in $G(\beta^*)$, when the β^*, due to change in distribution of β, is higher than $\tilde{\beta}^*$.

Table 5: Effect of Change in Sectoral Risk

Variables	$\frac{\Delta\mu_j}{\Delta G(\beta^*)}$	$\frac{\Delta\sigma_j}{\Delta G(\beta^*)}$
r_B	0.20^{***}	0.012^{***}
k	-0.46^{***}	-0.018^{**}
θ	-0.22^{***}	0.006^{**}
u	0.11^{***}	0.007^{***}
$\frac{W_1}{P_2}$	-0.04^{***}	0.001^{**}
$\frac{W_2}{P_2}$	-0.16^{***}	0.005^{***}
n	0.30^{***}	0.010^{***}

Table (5) shows that the change in average r_B, u and n with respect to change in $G(\beta^*)$ (given, $\beta_1^* > \tilde{\beta}^*$) are positive and the magnitude of increase for one unit rise in $G(\beta^*)$ is higher for n as compared to other two variables. On the contrary, the mean per capita capital in sector 2, market tightness and real wages shrink for one unit change in $G(\beta^*)$. In terms of magnitude the drop is highest in average k. The change in standard deviations of the endogenous variables are small but statistically significant. It shows that, the variability of all the variables, barring k, inflates due to a rise in sectoral risk of sector 1.

7 Discussion and Conclusion

Post global financial crisis, shadow banks are the focal point of financial stability discussions. Presently they contribute a small fraction of the entire global loan portfolio, but their interlinkage with the broad financial market could make them systemically important. The growing literature on shadow banking signifies its importance in academic and policy research. However, the paucity of long time series data on shadow banks stifles the scope of ample empirical research.

Taking motivation from the Indian experience of shadow bank, we develop a simple theoretical model to identify and understand the channels through which real variables are affected due to shocks in the sectors financed by NBFCs. We primarily use the Indian data for parameterizing the model. Non-Bank Financial Companies (NBFCs) registered under the Companies Act, are commonly known counterpart of shadow banks in India. They operate in the sectors which are sparsely touched by scheduled commercial banks (SCBs)(Acharya et. al. (2013)). The uncertainties faced by the NBFCs influence other sectors of the economy through the banking channels because most of the NBFCs are non-deposit taking and SCBs' park a fraction of the deposits with them. This paper attempts to understand the real channels and consequences of the shocks faced by NBFCs. Our paper is equipped to distinguish the impacts of idiosyncratic shock, structural shock and sectoral shock. We believe, the virtue of the uncomplicated structure of the model would be helpful to understand the interactions of different variables without losing out on the robustness of the results.

The theoretical and the simulation results of the model suggest, a higher realization of the number of failed firms in the NBFC-sector, which we define as an idiosyncratic negative shock, induces an upward spike in the interest rate charged by SCBs. Consequently, the unemployment rate rises and drags down the real wages and per capita capital formation in the economy. A rise in the sector-wide productivity risk (sectoral risk) also increases the interest rate and unemployment rate, but reduces the real wages and per capita capital formation. However, an increase in the average number of failed firms (or, negative structural shock) in the sector where NBFCs predominantly operate, reduces the interest rate charged by SCBs. This is because NBFCs determine the interest rate on the basis of average default rate and there is a positive relation between the two. Therefore, higher average default rate, in turn, discourages firms to enter the market which dampens the demand for loan and the interest rate charged by the SCB. That causes a fall in the unemployment rate and an increase in real wages and per capita capital formation.

The key interest of the paper is to deal with real sector channels and not the financial economy channels. So, we keep the issues related to the imbalance in the balance-sheet of the banks or NBFCs out of the scope of the paper. The change in the loan demand, created by NBFCs, drives the major results of this paper. This simple model provides a basic set up for several possible extensions. For example, when the baseline model is extended in section (5), we keep the structure of the interest rate charged by SCB unaltered. However, an introduction of uncertainty in the loan demand or the repayment of loans by NBFCs to the SCB would open a channel such that the interest rate charged by SCB would be directly affected via sectoral risk in addition to the channel we described in the model. Again, in the model extension, we introduce sectoral risk only in the sector where NBFC operates, keeping the other sector unchanged. However, the model framework provides enough scope to bend that assumption. One neat and insightful way is to introduce endogenous job destruction in sector 2. That will present an opportunity to compare the effect of two different sectoral risks on the interest rate, job creation and per capita capital formation. While we recognize the richness of this possible extension, here we keep our attention directed to understand the effect of different shocks in the NBFC-sector.

The central policy highlight of this paper is that the systemic risk of NBFCs may not be underrated because of their relatively small share in total credit. Shocks to the sectors, where NBFCs operates, could be propagated through NBFC-SCB interlinkages that can get amplified through feedback loops to unemployment and output. The reduction in policy rate may provide a cushion in terms of a positive boost to capita formation and job creation. Although, the NBFC channel and labour market imperfection channel weakens the policy transmission. We, therefore, highlight the need for frequent information and data dissemination relating to this sector for continuous risk evaluation and vigil. We also emphasis on early identification and quick policy intervention in this sector to stop any spillover at an early stage.

References

Acharya, V. V. (2017). Monetary Transmission in India: Why is it important and why hasn't it worked well?. Reserve Bank of India Bulletin, 71(12), 7-16.

Acharya, Viral V., Hemal Khandwala, & T. Sabri Öncü. "The growth of a shadow banking system in emerging markets: Evidence from India." Journal of International Money and Finance 39 (2013): 207-230.

Acharya, V., & Oncu, S. (2011). The repurchase agreement (repo) market. Regulating Wall Street, 319-350.

Banerjee, Purna & Mazumder, Debojyoti. (2019). Skill Differentiated Effects of Exchange Rates on Job Dynamics.

Bhadury, S., Ghosh, S., & Kumar, P. (2020). RBI Working Paper Series No. 03 Nowcasting Indian GDP growth using a Dynamic Factor Model.

Borio, C., Furfine, C., & Lowe, P. (2001). Procyclicality of the financial system and financial stability: issues and policy options. BIS papers, 1(3), 1-57. https://www.bis.org/publ/bppdf/bispap01a.pdf

Christiano, L. J., Eichenbaum, M., & Evans, C. L. (2005). Nominal rigidities and the dynamic effects of a shock to monetary policy. Journal of political Economy, 113(1), 1-45.

Drehmann, M. (2013). Total credit as an early warning indicator for systemic banking crises. BIS Quarterly Review, June.

Gabriel, V., Levine, P., Pearlman, J., & Yang, B. (2012). An estimated DSGE model of the Indian economy.

Gandhi, R. (2014, August). Danger Posed by Shadow Banking Systems to the Global Financial System: The Indian Case. In Address at the Indian Council for Research on International Economic Relations

Conference on Governance and Development: Views from G20 Countries. Mumbai (Vol. 21).

Gennaioli, N., Shleifer, A., & Vishny, R. W. (2013). A model of shadow banking. The Journal of Finance, 68(4), 1331-1363.

Gomes, P. (2015). Optimal public sector wages. The Economic Journal, 125(587), 1425-1451.

Hall, R. E. (2017). High discounts and high unemployment. American Economic Review, 107(2), 305-30.

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

Melitz, M. J. (2003). The impact of trade on intra-industry reallocations and aggregate industry productivity. econometrica, 71(6), 1695-1725.

Moreira, A., & Savov, A. (2017). The macroeconomics of shadow banking. The Journal of Finance, 72(6), 2381-2432.

Meeks, R., Nelson, B., & Alessandri, P. (2017). Shadow banks and macroeconomic instability. Journal of Money, Credit and Banking, 49(7), 1483-1516.

Neelima,K. M.,& Kumar, A. (2017) Non-Banking Finance Companies in India's Financial Landscape, RBI Monthly Bulletin 2017, October.

Pissarides, C. A. (2000). Equilibrium unemployment theory. MIT press.

Pozsar, Z., Adrian, T., Ashcraft, A., & Boesky, H. (2010). Shadow banking. New York, 458(458), 3-9.

Pozsar, Z., Adrian, T., Ashcraft, A., & Boesky, H. (2013). Shadow banking. FRBNY Economic Policy Review, Volume 19, Number 2.

Reinhart, C. M., & Rogoff, K. S. (2009). The aftermath of financial crises. American Economic Review, 99(2), 466-72.

Rothschild, Michael, & Joseph E. Stiglitz (1970). "Increasing risk: I. A definition." Journal of Economic theory 2.3, 225-243.

Schmitt-Grohé, S., & Uribe, M. (2004). Optimal operational monetary policy in the Christiano-Eichenbaum-Evans model of the US business cycle (No. w10724). National Bureau of Economic Research.

Appendix 1

We explain the algebraic solution of the baseline model in .

We mentioned the maximization problem of the firm in the sector 2 in equation (13). The solution of the per capita capital (k) demand is expressed in the table (1). Taking these two together and replacing w_1 (mentioned in the table (1) in equation (18), the wage rate of the sector 2 is determined as,

$$\frac{w_2}{P_2} = \frac{\varrho\theta d}{1-\tau} + b\vartheta k^{1-\vartheta}. \tag{40}$$

Note that, $f(k) - (r_B + \delta)k = \vartheta k^{1-\vartheta}$, and, $m(\theta^{-1}, 1) = \frac{1}{1+\theta}$.

Therefore, equation (14) can be rewritten as,

$$\frac{w_2}{P_2} = \vartheta k^{1-\vartheta} - d(1+\theta)(r_B + \lambda). \tag{41}$$

Combining equations (40) and (41) we solve for θ.

$$\theta = \frac{(1-\varrho)\vartheta k^{1-\vartheta} - d(r_B + \lambda)}{\varrho + (1-\tau)(r_B + \lambda)}. \tag{42}$$

Hence, the solution for the real wage in sector 2, $\frac{w_2}{P_2}$, is

$$\frac{w_2}{P_2} = \varrho\vartheta k^{1-\vartheta} + \frac{\varrho d}{1-\tau}\Big(\frac{(1-b)\vartheta k^{1-\vartheta} - d(r_B + \lambda)}{\varrho + (1-\tau)(r_B + \lambda)}\Big). \tag{43}$$

So, from equation (42) and (43) it is clear that both θ and $\frac{w_2}{P_2}$ can be solved in terms of k and r_B. Using the mentioned matching function (see the table 1), in equation (19) the steady state $u^* = \frac{\lambda(1+\theta)}{\lambda+\theta(1+\lambda)}$. Given that, we found θ in terms of k and r_B, u^* can also be expressed in terms of the same.

Now, replacing n (mentioned in table (1)), u^* and θ in the equation for *"interest rate of SCB"* (mentioned in table (1)) we get,

$$r_B - \psi\bar{r} - \kappa\alpha\Big(\frac{1-\rho}{\rho}\frac{\varrho}{1-\varrho}\frac{L_1 d}{\alpha(1-\tau)}\Big)\Big[\frac{\frac{1}{1-s}}{E(\frac{1}{1-s})}\Big]\frac{1}{r_B}\frac{(1-\varrho)\vartheta k^{1-\vartheta} - d(r_B+\lambda)}{\varrho + (1-\tau)(r_B+\lambda)}$$
$$-\kappa\bar{L_2}k\frac{(1-\varrho)\vartheta k^{1-\vartheta} - (r_B+\lambda)d}{(1-\varrho)(1+\lambda)\vartheta k^{1-\vartheta} + (r_B+\lambda)(\lambda(1-\tau) - d(1+\lambda)) + \lambda\varrho} = 0. \tag{44}$$

The left hand side of the equation (44) is the explicit form of $S^B\Big(\underset{-}{k}, \underset{+}{r_B};\ \underset{-}{\psi}, \underset{-}{\bar{r}}, \underset{-}{s}, E\big(\underset{+}{\tfrac{1}{1-s}}\big), \mathcal{A}\Big)$, mentioned in section 4.

Consider, the equation of "*per capita capital demand in sector 2*", mentioned in table (1),

$$k - \Big(\frac{1-\vartheta}{r_B+\delta}\Big)^{\frac{1}{\vartheta}} = 0. \tag{45}$$

The left hand side of the above equation was mentioned as $D^k(\underset{+}{k}, \underset{+}{r_B}; \mathcal{B})$, in section (4).

Solving equation (44) and (45), we can get equilibrium r_B^* and k^*. Now, for an observed value of s, we can solve θ^*, u^*, $\frac{w_1}{P_2}^*$, $\frac{w_2}{P_2}^*$, n^* and $r^*{}_N$ by putting the solution of $\{k^*, r_B^*\}$. This solves the equilibrium of the model as described in definition 1.

Appendix 2

Equation (42) gives the solution of θ in terms of r_B and k. Using that we get the solution of $\frac{w_1}{P_2}$ as follows from equation (27),

$$\frac{w_1}{P_2} = \frac{1}{1-\tau}\frac{\varrho d}{1-\varrho}\frac{(1-\varrho)\vartheta k^{1-\vartheta} - d(r_B+\lambda)}{\varrho + (1-\tau)(r_B+\lambda)}. \tag{46}$$

Now to see the explicit form of equation (39) we plug n, r_N and $1-u^*$ in equation (37) and we get,

$$r_B - \bar{r}\psi - \frac{(1-\varrho)\vartheta k^{1-\vartheta} - (r_B+\lambda)d}{(1-\varrho)(1+\lambda)\vartheta k^{1-\vartheta} + (r_B+\lambda)(\lambda(1-\tau) - d(1+\lambda)) + \lambda\varrho}\kappa\bar{L_2}k - \left(\frac{\frac{1}{1-s}}{E\left[\frac{1}{1-s}\right]}\right)\frac{\alpha G(\beta^*)+f}{(\sigma-1)\alpha + f(\frac{\sigma}{G(\beta^*)}-1)}\frac{\kappa}{r_B}\frac{w_1}{P_2}L_1 = 0 \tag{47}$$

If we use the expression $\frac{w_1}{P_2}$, as showed in equation (46), in the above equation we can rewrite it as:

$$r_B - \bar{r}\psi - \frac{(1-\varrho)\vartheta k^{1-\vartheta} - (r_B+\lambda)d}{(1-\varrho)(1+\lambda)\vartheta k^{1-\vartheta} + (r_B+\lambda)(\lambda(1-\tau) - d(1+\lambda)) + \lambda\varrho}\kappa\bar{L_2}k - \left(\frac{\frac{1}{1-s}}{E\left[\frac{1}{1-s}\right]}\right)\frac{\alpha G(\beta^*)+f}{(\sigma-1)\alpha + f(\frac{\sigma}{G(\beta^*)}-1)}\left(\frac{1}{1-\tau}\frac{\varrho d}{1-\varrho}\frac{(1-\varrho)\vartheta k^{1-\vartheta} - d(r_B+\lambda)}{\varrho + (1-\tau)(r_B+\lambda)}\right)\frac{\kappa}{r_B}L_1 = 0 \tag{48}$$

This equation is the explicit representation of the equation 39.

8 Annex

Figure 10: Sectoral credit distribution of NBFCs

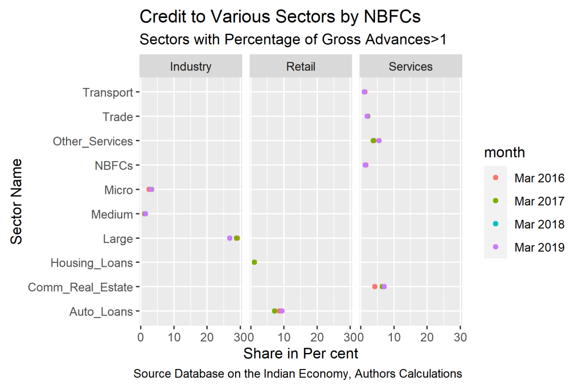
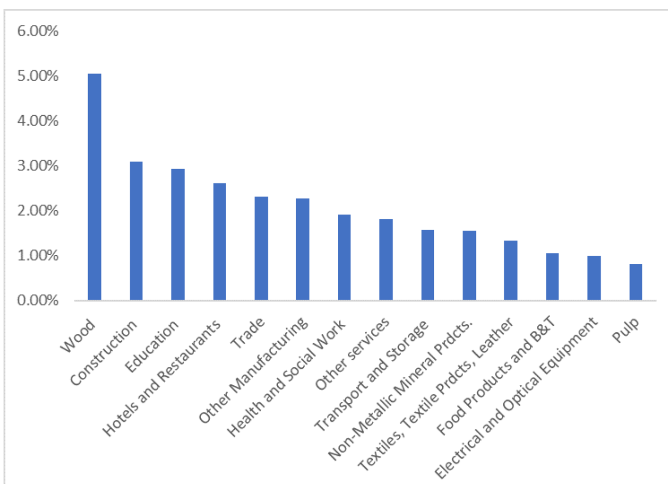


Figure 11: Labour Intensity, Sector-wise Classification



Source: KLEMS, India Data Base and authors calculation

Figure 12: Bank credit growth and capital formation