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Regulatory requirements and commercial banks' lending rate: some theoretical perspectives

Abstract

This paper demonstrates theoretically how the regulatory requirements could impinge on banks' balance sheet and thus, influence their optimal lending rate response to the policy interest rate. In such a situation, for the policy rate to be effective in the transmission mechanism, a calibrated approach may be required; changes in the policy rate to be accompanied by changes in the regulatory parameters to achieve desired changes in the banks' lending rate. In the course of analysis, three critical insights emerged. One, there can be a trade-off between regulation and effectiveness of transmission mechanism and competitiveness of the loan market. Two, there can be a situation for banks to engage in subsidization of loans against investment in risk free government securities. Three, the capital market could be linked to monetary transmission mechanism if banks were subject to a required return on their capital base. Theoretical insights of the paper have implications for bank regulation and policy purposes.

Introduction

For an effective transmission mechanism for monetary policy through the interest rate channel, it is necessary that commercial banks in a country should adjust their interest rates on loans (or the lending rates) in tandem with the central bank's policy short-term interest rate (or the policy rate). However, it is not uncommon to find commercial banks not responding to policy signals in many countries. Numerous studies have explained the rigidity in banks' lending decisions due to market imperfection and non-pricing objectives (Pringle, 1974; Hancock, 1986), capital decisions (Pringle, 1974; Taggart and Greenbaum, 1978), credit rationing due to information asymmetry and moral hazard (Stiglitz and Weiss, 1981; Hannan and Berger, 1991; Neumark and Sharpe, 1992), product diversification (Hanweck and Ryu, 2005; Allen, 1988; Saunders and Schumacher, 2000), relationship banking (Mayer, 1988; Sharpe, 1990; Boot et al., 1993; Aoki, 1994), bank specific characteristics such as size and ownership (Demrguc-Kunt and Huizinga, 1990; Angbazo, 1997) and monetary targeting (Thakor, 1996). Some early studies also focused on interest rate regulation and the capital constraints faced by the banks (Mingo and Wolkowitz 1977; Goldberg, 1981; Lam and Chan, 1985). Over the years, the regulatory environment has changed significantly. In developed economies, banks are free to price assets and liabilities due to interest rate deregulation and monetary policy works through the interest rate channel. Developing and emerging market economies have embraced financial reform and freed banks to price their assets and liabilities. At the same time, banks in the latter economies have to contend with various quantitative regulatory and prudential norms pertaining to reserve requirement, statutory liquidity, deployment of credit to certain sectors, risk weighted capital ratio and loan loss provisioning. It is not known, either theoretically or empirically, how these regulatory parameters could affect banks' optimal lending rate response to the policy rate. Thus, the study is motivated for a theoretical analysis on the subject. Deriving from the standard theory of banking firm (Matthews and Thompson, 2005; Santomero, 1984; Slovin and Sushka, 1983; Sealey and Lindley, 1977; Wood, 1975; Baltensperger, 1980, Mingo and Wolkowitz, 1977, Goldberg, 1981; Klein, 1971; Zarruk and Madura, 1992 among others), we demonstrate that the regulatory requirements could impinge on banks' balance sheet and thus, complicate optimal decision relating to their lending rates. Currently, there is a great deal of discussion going on whether to regulate banks more or less deriving from the lessons of the recent global crisis. In this context, these theoretical insights of the paper will contribute to the literature and provide insights for policy purposes. The rest of the paper comprises theoretical analysis followed by the conclusion.

1. Theoretical analysis

Let a representative bank has a simplified balance sheet as postulated in equation (1). Deposits (D) cost interest rate (r_D) and loans (L) and investment (G) fetch interest rate (r_L) and yield (r_G), respectively. The bank maintains reserve balances (R) with the central bank and statutory liquidity (SLR) by investing in government securities (G) as frac-

tions of deposits 'θ' and 's', respectively[1]. The bank complies with prudential norms such as the capital to risk weighted asset (Loans) ratio (k). Unlike the government securities, loans involve credit risk due to loan defaults at the rate of 'δ' on its advances and make provisions for default loans, $\varpi(\delta L)$; $0 \le \varpi \le 1$ set by the regulator. The bank treats provisions as a cost item. The bank can borrow from the central bank and the inter-bank market to manage short-term liquidity needs costing the interest rate r_B. Such borrowing could be subject to a limited amount and we assume it proportional to deposit (D). It is assumed that the bank incurs fixed operating costs. The bank's balance sheet constraint entails that

$$L + G + R = K + D + B . \qquad (1)$$

Incorporating the regulatory parameters θ, s, and k, we have

$$D = \frac{(1-k)}{(1+b-s-\theta)} L . \qquad (2)$$

The parameters θ, s, and k satisfy the condition $0 \le, \ s, \ k, \ \theta < 1$. Under normal circumstances, a bank cannot borrow as much as its deposit liabilities and thus, $0 \le b < 1$. The objective function of the bank, i.e. maximize profit, can be specified as:

$$Max(\pi) = (1-\delta)r_L L + r_G G - r_D D - r_B B - \mu\delta L . \quad (3)$$

After incorporating (2) and the regulatory parameters and borrowing norm in the objective function (3), the latter solves to a function of L:

$$Max(\pi) = (1-\delta)r_L L - (r_D + br_B - sr_G) \times$$
$$\times \left(\frac{1-k}{1+b-s-\theta}\right) L - \mu\delta L . \qquad (4)$$

From the first order condition with respect to L, we can derive

$$r_L = \left(\frac{1}{1-\frac{1}{e}}\right)\left(\frac{1}{1-\delta}\right)\left[\left(\frac{1-k}{1+b-s-\theta}\right)(r_D+br_B-sr_G)+\mu\delta\right] . (5)$$

In equation (5), the terms $(1-k)$, $(1-\delta)$ and $(1+b-s-\theta)$ are positive but less than unity. For optimal solution to the lending rate (r_L), loan demand should be downward slopping and the interest elasticity of loans (e) should be greater than unity in line with the second order condition[2]. However, for the lending rate to be positive, the term $(r_D + br_B - sr_G)$ should be positive. If this term is negative, then the term ($\mu\delta$) relating to provisioning requirement of loans should outweigh the term relating to $(r_D + br_B - sr_G)$. Otherwise, we can relax the assumption of fixed operating cost to bring in the term marginal cost of loans to make the lending rate positive[3]. However, the assumption of marginal operating cost will not affect the marginal response of lending rate to the policy rate, which is our main concern. For our purpose, the linkage between the r_L and the policy interest rate (r_P) can be established by linking the latter to deposit interest rate and government securities yield:

$$r_D = a_D + \mu_D r_P , \qquad (6)$$

$$r_G = a_G + \mu_G r_P . \qquad (7)$$

Assuming that banks borrow only from the central bank at the policy rate, $r_B = r_P$, and using (6) and (7), the marginal response of the lending rate can be derived as:

$$\frac{\partial r_L}{\partial r_P} = \left(\frac{1}{1-\frac{1}{e}}\right)\left(\frac{1}{1-\delta}\right)\left(\frac{1-k}{1+b-s-\theta}\right)(\mu_D+b-s\mu_G) . (8)$$

In equation (8), $(1-k)$, $(1-\delta)$ and $(1+b-s-\theta)$ terms are positive but less than unity. Thus, for

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[1] The various assumptions in our analysis could relate to the real world in some developing and emerging market economies. Illustratively, in a leading emerging market economy like India, banks are required to have cash reserves and statutory liquidity in terms of investment in risk free government and other approved securities and comply with prudential norms relating capital, provisioning and risk weights to loans as stipulated by the authorities. At the same time, banks are also subject to limits on borrowing. In the interbank market, on a fortnightly average basis, banks borrowing should not exceed 100% of Tier I and II capital. However, on any particular day, banks can borrow 125% of their capital.

[2] The second order condition entails that $\frac{d^2\pi}{dL^2} < 0$. This will be satisfied if $(1-\delta)\frac{dr_L}{dL}\left(1-\frac{1}{e}\right) < 0$, for a downward slopping loan demand function, i.e., $\frac{dr_L}{dL} < 0$ and interest elasticity of loan demand $e > 1$.

[3] This assumption about operating cost will not affect theoretical insights. Illustratively, let this assumption is relaxed by postulating that operating costs as a linear function of the bank's core business activities defined as the sum of loans, investments and deposits; $C = a + c(L+G+D)$. The cost function can be simplified to a function of L such as $C = a + c\left[1 + \frac{(1+s)(1-k)}{1+b-s-\theta}\right]L$ using the balance sheet constraint and thus, the lending rate equation will have another term marginal cost, $c\frac{(1+s)(1-k)}{1+b-s-\theta}$ in the right side. Since the marginal cost is not dependent on the policy rate, the $\frac{\partial r_L}{\partial r_P}$ will not be affected.

$\frac{\partial r_L}{\partial r_P} > 0$ the terms $(\mu_D + b - s\mu_G)$ and the loan demand condition reflected in the interest elasticity of loan (e) will play a crucial role. Several interesting insights arise here.

First, let parameters θ, s, k and δ and μ_D and μ_G ensure the second, third and fourth terms in (8) to be positive. However, for a positive $\frac{\partial r_L}{\partial r_P}$, the parameter '$e$' should exceed unity. Otherwise, a negative $\frac{\partial r_L}{\partial r_P}$ can occur due to inelastic loan demand, i.e., $0 < e < 1$. Interestingly, for $e = 1$, the $\frac{\partial r_L}{\partial r_P}$ will be indeterminate and for $e = 0$, $\frac{\partial r_L}{\partial r_P}$ will be zero. Perfect interest elasticity of loans $e = \infty$ will lead to a positive $\frac{\partial r_L}{\partial r_P}$ when the $(\mu_D + b - s\mu_G) > 0$.

Second, consider the case with no borrowing ($b = 0$) and $e > 1$. The sign of $\frac{\partial r_L}{\partial r_P}$ will depend upon $(\mu_D - s\mu_G)$. One scenario could be $\mu_D = \mu_G = 1$; the perfect adjustment of r_D and r_G in tandem with r_P. Then, changes in r_P can bring about a positive $\frac{\partial r_L}{\partial r_P}$. The magnitude of $\frac{\partial r_L}{\partial r_P}$ will depend upon the regulatory parameters θ, s, k, δ and loan elasticity (e). Alternatively, under imperfect market conditions, the r_G could adjust sluggishly than the r_D, i.e., $\mu_G < \mu_D$ so that positive $\frac{\partial r_L}{\partial r_P}$ occurs. If $\mu_G > \mu_D$, there may not be a positive $\frac{\partial r_L}{\partial r_P}$. If $\mu_G > 1$, then the SLR parameter (s) could be adjusted to a lower level to ensure that $(\mu_D - s\mu_G)$ is positive. Otherwise, banks may engage in cross-subsidization in terms of reducing r_L and raising the r_G. Another critical situation may arise when $\mu_G = 1$. In this scenario, μ_D, the marginal response of the deposit rate to the policy rate, should be greater than 's' for $\frac{\partial r_L}{\partial r_P}$ to be greater than zero.

Another important insight is that $\frac{\partial r_L}{\partial r_P}$ could be, *ceteris paribus*, lower for perfectly elastic loan demand condition, e = ∞, than for less than perfectly elastic loan situation $1 \le e < \infty$. Thus, a trade-off could exist between effectiveness of regulation and transmission mechanism and the competitiveness of the loan market.

Third, the sign of marginal response of r_L to the provisioning requirement (μ) will also depend upon the parameter 'e':

$$\frac{\partial r_L}{\partial \mu} = \left(\frac{1}{1 - \frac{1}{e}} \right) \left(\frac{\delta}{1 - \delta} \right). \tag{9}$$

Since δ is non-zero positive, $\frac{\partial r_L}{\partial \mu}$ will be non-zero only when $e > 1$. However, the provisioning requirement (μ), *ceteris paribus*, can affect the level of lending rate but not the marginal response of lending rate to the policy rate, $\frac{\partial r_L}{\partial r_P}$.

Fourth, an increase (decrease) in 'k' will induce a similar adjustment in the lending rate, provided we have $0 < e < 1$ or a negative $(\mu_D + b - s\mu_G)$ since

$$\frac{\partial r_L}{\partial k} = \left(\frac{1}{1 - \frac{1}{e}} \right) \left(\frac{1}{1 - \delta} \right) \left(\frac{-1}{1 + b - s - \theta} \right) \tag{10}$$

and

$$\frac{\partial \left(\frac{\partial r_L}{\partial r_P} \right)}{\partial k} = \left(\frac{1}{1 - \frac{1}{e}} \right) \left(\frac{1}{1 - \delta} \right) \left(\frac{-1}{1 + b - s - \theta} \right) \times$$
$$\times (\mu_D + b - s\mu_G). \tag{11}$$

Thus, the loan market imperfection and the spread between the response of deposit and investment rates to the policy rate, *ceteris paribus*, could play a critical role in determining the impact of prudential regulation on banks' optimal lending rate decisions. Fifth, we can simplify the lending rate equation as

$$r_L = \frac{y(c - sr_G)}{(g - s)} + \alpha \tag{12}$$

and derive the marginal response of the lending rate to changes in 's' as

$$\frac{\partial r_L}{\partial s} = \frac{y(c - gr_G)}{(g - s)^2}.$$ (13)

The sign of $\frac{\partial r_L}{\partial s}$ will depend upon y and $(c - gr_G)$; y can be positive if $e > 1$, and the sign of $(c - gr_G)$ will depend upon the responses of deposit and borrowing interest rates to the policy rate.

Furthermore, let us address some issues for policy purposes. First, commercial banks may not face the borrowing constraint. Second, how will the central bank set the policy rate in line with the optimization problem of the commercial banks? What parameters should affect the central bank's decision in this regard? These issues could be addressed as follows.

In the absence of borrowing constraint, the balance sheet constraint faced by the bank could be expressed as

$$\frac{(1 - k)L - B}{1 - s - \theta} = D$$ (14)

and allowing for reserve and liquidity constraint, the objective function could be expressed as a function of L and B:

$$Max(\pi) = (1 - \delta)r_L L - (r_D - sr_G)\left(\frac{(1 - k)L - B}{1 - s - \theta}\right) - $$
$$- r_B B - \mu\delta L.$$ (15)

From equation (15), the two first order conditions with respect to L and B can be solved for the lending rate r_L:

$$r_L = \left(\frac{1}{\left(1 - \frac{1}{e}\right)(1 - \delta)}\right)\left[(1 - k)\left(\frac{r_D - sr_G}{1 - s - \theta}\right) + \mu\delta\right]$$ (16)

and the borrowing interest rate r_B, equal to central bank's policy rate r_P, as

$$r_B = r_P = \left(\frac{r_D - sr_G}{1 - s - \theta}\right).$$ (17)

From equations (16) and (17), we can have

$$r_P = \frac{1}{1 - k}\left[\left(1 - \frac{1}{e}\right)(1 - \delta)r_L - \mu\delta\right]$$ (18)

and the marginal response of r_P with respect to r_L as

$$\frac{\partial r_P}{\partial r_L} = \left(1 - \frac{1}{e}\right)\frac{(1 - \delta)}{(1 - k)}.$$ (19)

Thus, the changes in the policy rate could be determined in terms of three parameters, the interest elasticity of loans (e), the loan default rate (δ) and the capital requirement (k). Furthermore, since $(1 - \delta)$ and $(1 - k)$ are positive, we will have $\frac{\partial r_P}{\partial r_L} > 0$, for $e > 1$. For perfect interest elasticity of loans, $e = \infty$, we will have

$$\frac{\partial r_P}{\partial r_L} = \frac{(1 - \delta)}{(1 - k)}$$ (20)

and $\frac{\partial r_P}{\partial r_L} = 1$, provided $\delta = k$. Otherwise, as long as δ is lower than k, the r_P will have to increase at a faster rate than the r_L. From equation (19) we can also infer that a higher marginal response of the policy rate with respect to the changes in the lending rate will entail higher capital requirement and/or lower loan default. Moreover, if we allow the borrowing to be interest elastic, then we will have

$$\frac{\partial r_P}{\partial r_L} = \frac{\left(1 - \frac{1}{e}\right)}{\left(1 - \frac{1}{e_b}\right)}\frac{(1 - \delta)}{(1 - k)}.$$ (21)

In equation (21), $\frac{\partial r_P}{\partial r_L}$ will be positive for $e > 1$ and $e_b > 1$. Otherwise, alternative scenarios will emerge for different values of these parameters.

The above analysis can be complicated further by postulating that the bank has to engage in financial intermediation objective and satisfy the shareholder with a return (r_k) on their capital ($K = kL$). The objective function with the borrowing constraint scenario will be

$$Max(V) = (1 - \delta)r_L L - (r_D - sr_G)\left(\frac{(1 - k)L - B}{1 - s - \theta}\right) - $$
$$- r_B B - \mu\delta L - r_K KL$$ (22)

for which the two first order conditions with respect to L and B will solve for

$$r_B = \frac{r_D - sr_G}{1 - s - \theta}.$$ (23)

$$r_L = \left(\frac{1}{1 - e}\right)\left(1 - \frac{1}{\delta}\right)[(1 - k)r_B + \mu\delta + r_K K],$$ (24)

Some interesting insights emerge if we set $r_B = r_P$ and allow the bank to adopt the capital asset price model, i.e. the return on capital (r_K) as a function of risk free rate (r_G) and the market risk premium (r_m):

$$r_K = r_G + \beta(r_m - r_G), \qquad (25)$$

$$\frac{\partial r_L}{\partial r_P} = \left(\frac{1}{(1-\delta)\left(1 - \dfrac{1}{e}\right)} \right)(1-k)+$$

$$+ \left(\frac{1}{(1-\delta)\left(1 - \dfrac{1}{e}\right)} \right)(1-\beta)\mu_G K . \qquad (26)$$

In equation (26), the first term will be positive for $e > 1$. However, the second term will be positive for $\beta < 1$ and negative for $\beta > 1$. For the scenario $\beta > 1$, the first term should outweigh the second term for $\dfrac{\partial r_L}{\partial r_P}$ to be positive. A notable thing here is that the capital market can play a role in the transmission mechanism. Thus, we have proved how the alignment between the lending rate and the policy rate could entail complications in the presence of various regulatory requirements.

Conclusion

This paper attempted a theoretical analysis of how various regulatory parameters impinging on the banks' balance sheet could influence optimal lending rate response to the policy rate. The policy rate alone can not bring about the desired changes in the banks' lending rates. Several other factors such as the interest elasticity of loans, the deposit interest rate, government securities' yield, loan defaults and regulatory and prudential norms such as capital requirement and provisioning could play an important role. Theoretically, it could be possible for the banks to subsidize loans and adjust loan interest rate in the opposite direction to the policy rate under certain conditions. From policy perspective, the paper also demonstrated that in line with optimal problem faced by the banks, the alignment of the policy rate with the lending rate could be determined by parameters such as the interest elasticity of loan, the loan default risk, the prudential capital requirement, and the response of yield on government securities to the policy rate. Additionally, for a stock exchange listed bank, the parameter 'beta' measuring the response of bank stock return to the market risk could also affect lending rate response to the policy rate. According to the literature, the interest elasticity of loans could depend upon the competitiveness of credit market and macroeconomic developments. Default risk could depend upon macroeconomic conditions and the institutional mechanism for debt resolution. Thus, we conclude that a calibrated approach for monetary transmission mechanism may be required, i.e., changes in the policy rate could be accompanied by appropriate and adequate regulatory and prudential parameters to achieve desired changes in the banks' lending rates. At a time when a great deal of discussion is going on whether to regulate banks more than ever before, theoretical insights of the paper will contribute to this discourse. This paper confined to standard comparative static analysis. Such a simplistic framework could be justified when commercial banks, especially in developing economies, might not be well versed with or prefer complicated balance sheet management. Nevertheless, for future research, the analysis of banks' behavior in terms of dynamic optimization, alternative risk pricing, financial innovations and endogenous default risk approaches incorporating regulatory requirements may provide further insights for policy purposes.

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