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Banking competition in Brazil

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Supervisor: Victor Gomes

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1 Introduction

The Brazilian credit market has undergone significant changes in recent years, driven by new technologies and regulatory reforms that could potentially alter the competitive landscape of the banking sector. This study aims to understand some of the impacts of these changes on the interest rates charged by banks, particularly focusing on the interest rate spread.

Brazilian banking industry is highly concentrated. On December 2024, the five largest banks hold 60.1% of the market share on credit operations(for total loans), 52.8% (for total deposits) and 45.3% (for total assets) ¹. Even though the concentration is high, it doesn't mean that it is non-competitive, Nakane (2001) tested the level of competitiveness and concluded that Brazilian market doesn't behave as a monopoly/cartel but institutions have some market power.

Santos (2021) used a Cournot model to estimate the effect of different factors on lending rates in Brazil between 2012 and 2016. He concludes that Brazilian rates are higher than other South American countries because of five main factors: IOF tax, high level of risk-free interest rate, higher probability of default, lower recovery rate and more concentrated financial system.

¹ Data from financial institutions accounting reports in <https://www.bcb.gov.br/estabilidadefinanceira/balancetesbalancospatrimoniais>

2 The model

The model proposed by [Ho and Saunders \(1981\)](#) assumes a market of homogeneous banks working as intermediary dealers. Each bank borrows money from clients to lend it to other clients. Borrowers and lenders arrive randomly on a Poisson distribution, the probability of a new deposit transaction and a new loan transaction are given by:

$$\lambda_D = \alpha - \beta a \quad (2.1)$$

$$\lambda_L = \alpha - \beta b \quad (2.2)$$

Banks can influence the probability of a new deposit or loan by changing it's prices (making it more or less attractive for new clients). The prices for deposits P_D and for loans P_L are:

$$P_D = p + a \quad (2.3)$$

$$P_L = p - b \quad (2.4)$$

where p is the "true" price of the loan or deposit, and a and b are fees that banks can use to increase the probability of a new deposit or loan.

The bank's wealth portfolio (W) is given by $W = Y + I + C$, where Y is the base wealth which is invested in a diversified portfolio, I is the credit inventory and C is the money market position (or short-term net-cash) which is the difference between money market loans borrowings. The expected utility of wealth is given by the following equation:

$$EU(W) = U(W_0) + U'(W_0)r_w W_0 + \frac{1}{2}U''(W_0)(\sigma_I^2 I_0^2 + 2\sigma_{IY} I_0 Y_0 + \sigma_Y^2 Y_0^2) \quad (2.5)$$

The r_w is the expected rate of return on wealth, σ_I^2 is the variance of the credit inventory, σ_Y^2 is the variance of the base wealth and σ_{IY} is the covariance between I and Y . For each new deposit transaction, the initial credit inventory changes by Q and the credit inventory is $I_0 - Q$. The utility of one deposit transaction is:

$$\begin{aligned} EU(W|one \text{ deposit transaction}) &= U(W_0) + U'(W_0)aQ + U'(W_0)r_w W_0 \\ &\quad + \frac{1}{2}U''(W_0)(\sigma_I^2 Q^2 + 2\sigma_I^2 QI) \\ &\quad + \frac{1}{2}U''(W_0)(\sigma_I^2 I_0^2 + 2\sigma_{IY} I_0 Y_0 + \sigma_Y^2 Y_0^2) \end{aligned} \quad (2.6)$$

Similarly, for each new loan transaction, the credit inventory is $I_0 + Q$ and the utility of one loan transaction is:

$$\begin{aligned} EU(W|one \text{ loan transaction}) &= U(W_0) + U'(W_0)bQ + U'(W_0)r_w W_0 \\ &\quad + \frac{1}{2}U''(W_0)(\sigma_I^2 Q^2 - 2\sigma_I^2 QI) \\ &\quad + \frac{1}{2}U''(W_0)(\sigma_I^2 I_0^2 + 2\sigma_{IY} I_0 Y_0 + \sigma_Y^2 Y_0^2) \end{aligned} \quad (2.7)$$

$$EU(W|a, b) = \lambda_D EU(W|one\ deposit\ transaction) + \lambda_L EU(W|one\ loan\ transaction) \quad (2.8)$$

Deriving the equation 2.8 with respect to the fee a to maximize the wealth, we get to:

$$\frac{\partial EU(W|a, b)}{\partial a} = -\beta \left(U'(W_0)aQ + \frac{1}{2}U''(W_0)\sigma_I^2(Q^2 + QI) \right) + (\alpha - \beta a)U'(W_0)Q = 0 \quad (2.9)$$

From 2.9:

$$a = \frac{1}{2} \frac{\alpha}{\beta} + \frac{1}{4} \left(-\frac{U''(W_0)}{U'(W_0)} \right) \sigma_I^2(Q + I) \quad (2.10)$$

Doing the same for the fee b :

$$\frac{\partial EU(W|a, b)}{\partial b} = -\beta \left(U'(W_0)bQ + \frac{1}{2}U''(W_0)\sigma_I^2(Q^2 - QI) \right) + (\alpha - \beta b)U'(W_0)Q = 0 \quad (2.11)$$

$$b = \frac{1}{2} \frac{\alpha}{\beta} + \frac{1}{4} \left(-\frac{U''(W_0)}{U'(W_0)} \right) \sigma_I^2(Q - I) \quad (2.12)$$

The credit spread is defined by $S = a + b$. Substituting a and b above for S we get:

$$S = \frac{\alpha}{\beta} + \left(-\frac{U''(W_0)}{U'(W_0)} \right) \sigma_I^2 Q \quad (2.13)$$

Defining the Arrow-Pratt coefficient of absolute risk aversion as $R = -\frac{U''(W_0)}{U'(W_0)}$, we can rewrite the credit spread as:

$$S = \frac{\alpha}{\beta} + \frac{1}{2} R \sigma_I^2 Q \quad (2.14)$$

This is the pure spread that will be estimated in the model, in which the first term α/β is the bank's neutral risk spread, which is the part of the risk that is affected by the competition. The second term is a first-order risk adjustment, which depends on the risk aversion (R), the size of the marginal transactions (Q) and the short-term variance of the interest rate (σ_I^2). The model's assumption of homogeneous banks implies that the terms in the credit spread are the same for all banks, even if the inventories (I) and the base wealth (Y) are different.

The empirical model is built based on the theoretical model above but considering three market imperfections: (i) banks also pay implicit expenses through service fees and other costs indirectly involved in the transactions. (ii) the bank's opportunity cost of holding required reserves and (iii) the default risk on loans, for riskier borrowers, the bank may ask for a higher risk premium on the interest rate. The empirical model estimates the bank margins M given by:

$$M = \delta_0 + \delta_1 IR + \delta_2 OR + \delta_3 DP + u \quad (2.15)$$

The intercept δ_0 is the pure spread defined in equation 2.14, IR is the implicit interest expense, OR is the opportunity cost of the required reserves, DP is the default risk premiums on loans and u is the error term.

The equation 2.15 is the first stage of the model used to find the pure spread δ_0 defined on equation 2.14. In the second stage, the regression will be δ_0 estimated for each time t :

$$\delta_t = \gamma_0 + \gamma_1 \sigma_t^2 + \varepsilon_t \quad (2.16)$$

From equation 2.14:

$$\gamma_0 = \frac{\alpha}{\beta} \text{ and } \gamma_1 = \frac{1}{2} RQ$$

Competition is affected by the term γ_0 and γ_1 is the risk aversion (which the model assumes as the same for all banks).

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Appendix

APPENDIX A – Expected utility of wealth

The expected utility of wealth is given by the equation:

$$E[U(W)] = U(W_0) + U'(W_0)r_w W_0 + \frac{1}{2}U''(W_0)(\sigma_I^2 I_0^2 + 2\sigma_{IY} I_0 Y_0 + \sigma_Y^2 Y_0^2) \quad (\text{A.1})$$

This function based on the assumption that the agents are risk averse, which is mathematically represented as a concave function, which is defined by the condition: $E[U(W)] < U(E[W])$. [Ingersoll \(1987\)](#) shows that