The Banking Spread

and the Resource Cost of Capital

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April 1998

Abstract

The paper provides a model of the banking firm in the macroeconomy intended to explain what determines the interest rate spread. The model focuses on the resource cost of capital in the determination of the spread. A statistical result confirms the prediction of the model, that is, the bank's spread is higher in low income economies.

JEL classification: G21 F30 F34 04 E43 E5.

Keywords: Interest rate spread, banking firm, banking output, interest rates.

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1. Introduction

Why is the bank's spread between the loan and deposit rates 1.2% in Canada and 9.1% in Colombia? We argue that a key factor that may help explain cross sectional differences in the interest rate spread is the resource cost of producing financial intermediation.

Among the papers that have been written on the determination of the bank's spread between the loan and deposit interest rates are Angbazo (1997), Zarruk (1989), Zarruk and Madura (1992), McShane and Sharpe (1985), and Ho and Saunders (1981). Probably the most recent paper is Wong (1997). Among several factors that influence the bank spread in Wong's paper, we single out the marginal administrative cost of loans. In this paper this factor is the key element that determines the differences in the interest rate spread across countries.

According to Swank (1996), the literature on the resource cost on banking has been largely empirical rather than theoretical. He points out that "the typical econometric study of the structure of bank production has only an implicit conception of the banking firm (p. 194)... (and that empirical studies of the resource cost on banking) are quite poor from a theoretical point of view (p. 195)".

We deal with the resource cost of capital in a variation of the intermediation

approach. The common intermediation approach regards deposits, capital and labor as inputs in the production of an output, loans. (Baltensperger 1980, p. 30).

In our variation of the intermediation approach we do not consider deposits nor loans as an input and/or output of the banking firm. In this paper deposits and loans are intermediated by the banking firm, not produced by it. The output of the banking firm is the intermediation of saving[1].

As Santomero (1984) points out, "we seem to have converged upon a global view of the maximization process that the firm attempts. Nevertheless there is little solid work on the nature of the financial firm's product." Hence, in our variation of the intermediation approach we have taken some liberties in the definition of the output of the banking firm. In this paper, the output of the banking firm is a service, the intermediation of saving between the household and the non bank firm. It is valued as a commission on the saving intermediated.

In our model there is complete certainty, hence, we abstract from all the kinds of risk that a bank may face. Swank (1996) and Wong (1997) analyze how different types of risks may determine the interest rate spread. As there is complete cer-

[1]In an infinite horizon extension of the model of this paper, saving is units of the good produced in the non bank firm. In the two period version we consider here, savings are units of the good that were planted, they were not produced, they were endowed.

tainty in our economy, we also abstract from a reserve decision. Our model does not have the purpose of being comprehensive, we only want to focus on a single aspect of the determination of the bank's spread, the resource cost of capital.

2. Environment

The economy is populated by a large number of identical households, firms and baking firms. The representative firm does not sell equity shares to the household, it finances its investment borrowing from the banking firm. The representative household cannot invest directly in the firm, it can only deposit his savings in the banking firm. The task of the banking firm is to take the units of the good saved by the household and to give them to the firm. To do this task the banking firm uses capital. The banking firm takes some units of the saving received from the household and uses them as a necessary resource to intermediate saving between the household and the firm. There is perfect competition in each of the two markets of the economy, the market of deposits and the market of loans.

In this model, the output of the banking sector is the intermediation of saving between the household and the firm. It is the task of receiving deposits, and lending them to the firms[2]. We use as a metric of the output of the banking firm the

[2]The model can be naturally extended to an infinite horizon. In the infinite horizon the

level of loans. Although we have chosen as the metric of financial intermediation the level of loans, we could have also chosen the level of deposits.

We introduce a technology for producing financial intermediation. The intermediation technology relates the physical capital used in the banking firm to the saving that is intermediated. For l and k^B the loans and the capital invested in the banking firm, the intermediation technology is $l_t = \lambda k_t^B$. Thus, the banking firm invests capital and produces the intermediation of saving.

We have said that in this model the output of the banking firm is the intermediation of saving between the household and the firm. The value of that output is a commission on the saving intermediated. The commission is the differential between the bank's loan and deposit rates, s. Algebraically, the output of the representative banking firm is a commission, s, on the saving intermediated λk_t^B. Thus, for y^B the output of the banking sector, the production function of the representative banking firm is $y^B = s_t \lambda k_t^B$. As a commission, the price of the bank's output is a percentage. We obtain the value of the output of the banking firm multiplying this percentage by the amount of saving intermediated.

task of the banks also includes collecting the loans from the non bank firm and paying back to depositors.

3. The Problem of the Banking Firm

The banking firm invests capital, and produces the intermediation of saving. The output of the bank, the intermediation of saving, is valued as a percentage of the saving intermediated. For simplicity, capital in the banking firm does not depreciate.

The problem of the banking firm is to maximize the value of the bank:

$$\Pi = -k^B + \frac{1}{1+r} sl \tag{3.1}$$

subject to:

$$l + k^B = b \tag{3.2}$$

where

$$l = g(k^B) \tag{3.3}$$

Equation 3.1 is the profit function of the banking firm. The profit function states that in period zero the bank invests capital k^B and uses it to produce financial intermediation in period one. The term, $1/(1+r)$, brings period one output to time zero value. The term, sl is the output of the banking firm, a

commission s on the saving intermediated as measured by loans l. Equation 3.2 is the saving constraint of the banking firm. The banking firm receives b units of saving from the household and decides how many units to use as capital in the banking firm k^B, and how many to lend to the non bank firm l. Equation 3.3 is the technology for the production of financial intermediation. In the case of constant returns, $l = \lambda k^B$, the technology requires that every unit of saving intermediated by the banking firm be matched by λ units of saving used as capital in the banking firm.

The solution for the bank's spread is:

$$s = \frac{r}{g'(k^B)} \tag{3.4}$$

For the case of constant returns to scale the solution of the problem of the banking firm is:

$$s = \frac{r}{\lambda} \tag{3.5}$$

$$k^B = \frac{1}{1+\lambda} b \tag{3.6}$$

$$l = \frac{\lambda}{1+\lambda} b \tag{3.7}$$

In equation 3.4, s and $r/g'(k)$ are the price and the marginal cost of financial intermediation per unit of saving intermediated. The interest rate spread is determined by 3.4 at the industry level. Banks take the banking spread as given in the market and decide how much capital to invest. This in turn defines the level of saving intermediated by the banking firm. In equation 3.4, with constant returns to scale, the size of the banking firm is not determined, the size of the banking industry is determined, and the size of the bank's spread is determined.

Equations 3.6 and 3.7 give the optimal allocation of saving b between loans l and capital in banking k^B.

From equation 3.4, the bank's spread is lower the higher the marginal product of capital in banking λ. This is because, from equations 3.6 and 3.7 the higher the λ the higher the l and the lower the k^B. Hence, with a higher marginal product of capital in banking λ, the higher saving allocated as loans l has to remunerate a smaller saving allocated as capital in the banking firm k^B.

Also from equation 3.4, the bank's spread is higher the higher the return on capital r. Changes in the return on capital r do not change the optimal allocation

of saving between loans and capital in the banking firm, thus the bank's spread increases with increases in the return on capital because a given level of loans l has to produce income to remunerate a more expensive capital in the banking firm, k^B. The direct relationship between the spread, s, and the rental rate of capital, r, will be crucial for the empirical result we present below.

4. A Robinson Crusoe Economy

In the first period Robinson Crusoe is endowed with a number of coconuts y. He decides how many to consume c_0 and how many to plant b. In the second period he consumes the proceeds of the coconuts he planted. He lives two periods.

His island has a beach and a hill. Coconut production is subject to decreasing returns in the beach, $y^N = f(k)$, and to constant returns in the hill, $y^B = s\lambda k^B$. Robinson has a taboo that says that he has to plant in the hill a given proportion of the coconuts he plants in the beach: $k = \lambda k^B$.

Total coconut production $y = y^N + y^B$ is:

$$y = f(k) + s\lambda k^B \tag{4.1}$$

The first term of equation 4.1, $y^N = f(k)$, is what Robinson produces in

the beach under decreasing returns. The second part of total output, $y^N = s\lambda k^B$, is what Robinson produces in the hill under constant returns. The coconut production function in the hill can be interpreted in two ways. The first one, there are constant returns to k^B, the marginal product being $s\lambda$. The second one, coconut produced in the hill is a proportion (commission) of coconut planted in the beach λk^B.

The analogy with Robinson Crusoe in an Island helps explain the intermediation of saving in an economy with a household, a firm, and a banking firm. The household gives saving to the banking firm. The banking firm takes the units of saving from the household and gives them to the non bank firm. In producing the intermediation of saving between the household and the firm, the banking firm uses capital. The capital used in banking is not unproductive, it produces financial intermediation. Financial intermediation is a good that, under the first interpretation is a bunch of coconuts, the output of the banking sector, and under the second interpretation is a percentage of the coconuts planted in the beach, a commission on the saving intermediated.

Robinson's problem is to maximize discounted utility:

$$u(c_0) + \beta u(c_1)$$

subject to:

$$c_0 \leq y - b$$

$$c_1 \leq f(k) + s\lambda k^B$$

where

$$k = \lambda k^B$$

and

$$k + k^B = b$$

Among the first order conditions for this problem we have equations 3.6, 3.7, and:

$$s = \frac{f'(k)}{\lambda} \tag{4.2}$$

Equation 4.2 has the same meaning of equation 3.4: the bank's spread increases with the rental rate of capital and decreases with the marginal productivity of capital in the banking sector. Additionally, the first order condition 4.2 states that the bank's spread is the ratio of the marginal product of capital in the non bank sector to the marginal product of capital in the banking sector, this last marginal product being in terms of deposits, that is, the marginal product of capital in the intermediation technology. Thus 4.2 is a kind of marginal rate of

transformation.

By equating equations 4.2 and 3.4 we find the rate at which the banking firm discounts future output, is the rental rate of capital in the nonbank sector.

We have assumed decreasing returns in the firm and constant returns in the intermediation technology. We did so because, in order for the model to predict that the bank's spread is lower in the rich countries, we need more concavity in the production function of the non bank firm.

5. The World Economy

The world is populated by a number of economies that are closed to trade and capital flows. Economies are identical in every respect except in their initial endowment. Economies with a lower endowment y will tend to have a lower capital stock k, and by equation 4.2, will tend to have a higher banking spread s. The model has an empirically verifiable implication. The banking spread will tend to be inversely related to endowments.

In order to focus on one single element of the determination of the banking spread we have simplified our model in a number of ways. In dealing with the world economy, the simplifications was the assumption that economies are closed to trade and capital flows. This "as if" assumption is consistent with no convergence

of income levels across countries. In the real world economies are not closed and capital would tend to flow were its return is highest until marginal products and income levels are equalized. As there are income differences across countries, cross sectional differences in bank spreads are the right incentive for convergence of income levels.

6. The Data

The implication of the model being tested in this paper is that the banking spread is higher the lower the endowment of the economy. Countries with higher per capita GDP will tend to have a higher capital stock, a smaller rental rate of capital, and a smaller interest rate spread.

We runned the following regression of the interest rate spread, s, on (the log of) per capita GNP, y:

$$s = 0.152 - 0.011y + \varepsilon$$

$$(0.015)(0.002)$$

where standard errors are in parenthesis. The coefficient of per capita GDP has the expected negative sign and it is significant. We did not find evidence of heteroscedasticity.

Figure 7.1 plots the inverse relationship between the two variables for a sample of 79 countries[3].

7. Conclusion

A significant component of the bank's spread between the loan and deposits interest rates is the resource cost of capital. This component may help explain the important differences in the interest rate spread across countries.

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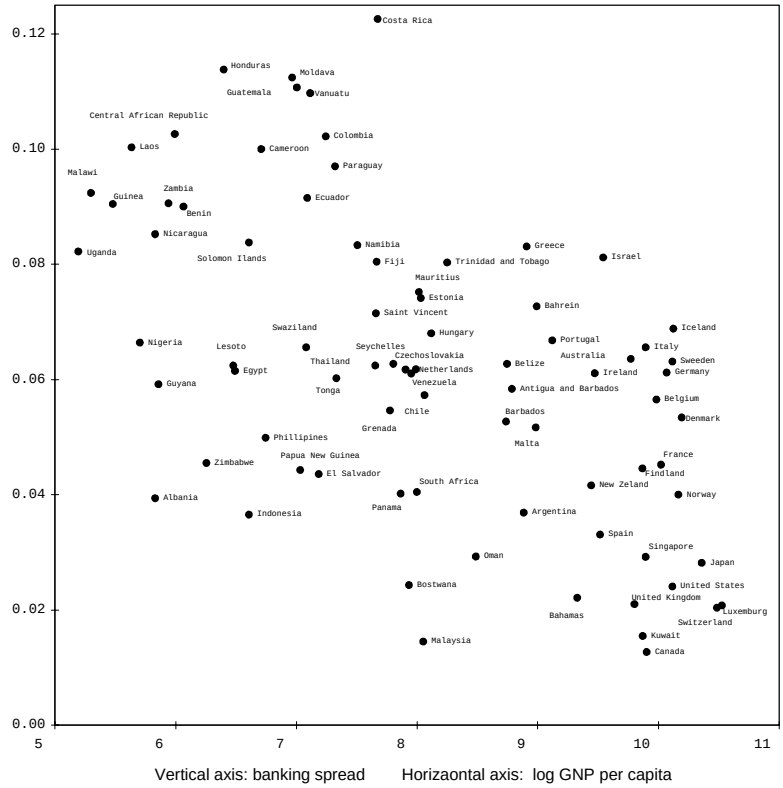

Figure 7.1: Banking spread and log GDP per capita in 79 countries