On competition and banking

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Chapter 6

Monetary policy and market power in banking

6.1 Introduction

In this chapter we consider the effects of monetary policy on the competitiveness of the banking sector. We argue that the policy rate, and therefore monetary policy in general, affects competition among banks. Also, this implies that with a procyclical monetary policy (where the bank increases the policy rate in good states, and decreases it in bad states), bank competitiveness may vary over the business cycle. The hypothesis that the policy rate affects competitive conditions in the banking sector is related to the analysis in chapter 4. There we analyzed the effects of a policy rate adjustment in a Stackelberg banking duopoly. We showed that an increase in the policy rate may lead to an increase of the leading bank's output. The follower responds to the policy rate increase by reducing its output, which is the standard reaction of a firm to a cost increase. Thus, in that particular model a change in the policy rate may change the relative market shares of the two banks. In that way, it affects the competitive positions of the two firms.

In this chapter, we present a two-stage model in which the central bank sets the policy rate in the first stage, according to a specific type of interest-rate setting rule. In the second stage, there is competition among banks on the loan market. We focus on a policy rule that concentrates strictly on output stabilization. The feedback coefficient, which describes the size of the policy rate adjustment relative to the deviation of output from the natural or steady state level, is left unspecified. Thus, the central bank is assumed to stabilize output only to some, unspecified, degree. The resulting interest rate setting rule is a function of an economy-wide shock. For any given realization of the shock, which affects output, the policy rule specifies the rate the central bank wishes to set in order to (partially) stabilize output. The second stage of the model describes competition among banks in terms of a spatial competition model with horizontally differentiated products. Here, the policy rate set by the central bank performs the role of marginal cost to the banks (assuming zero marginal management costs). The number of banks is assumed to be exogenously given and fixed. The second-stage equilibrium therefore simply describes the optimal lending rate as charged by the banks, given the policy rate set by the central bank in the first stage.

Using a comparative statics approach, this model allows us to analyze the effects of different values of the policy rate, and therefore of different monetary policy rules (in terms of the size of the feedback coefficient), on the equilibrium lending rate. Evidently, lending rates will vary with the policy rate, since the latter is marginal cost. However, we are not interested in the level of the lending rate per se, but in the market power of the banks (focusing on the loan market). Note that market power is not the same thing as market structure (see chapter 2). For example, a monopolist does not necessarily have market power if there is a strong threat of entry. For that reason we interpret market power as the ability to charge a price above marginal cost. This can be measured by the relative markup of price over marginal cost, the Lerner (1934) index, defined as

$$\text{Lerner index} = \frac{\text{price} - \text{cost}}{\text{price}}$$

(see also chapter 2). In our banking model this should be read as

$$\text{Lerner index} = \frac{\text{lending rate} - \text{policy rate}}{\text{lending rate}}.$$

Corts (1999, p. 227) argues that the markup is the 'natural measure of a market's competitiveness'. He also mentions that because marginal cost in reality is usually not directly observable, many empirical studies use other measures to assess market power, for example conjectural variations (see also chapter 3). However, in our theoretical model marginal cost evidently is observable, and we can use the Lerner index to assess the competitiveness of the banking sector. Note that the value of the Lerner index can generally be affected by changes in the number of firms active in the market, or demand changes. In our theoretical model we therefore keep the number of banks as well as the demand for bank loans fixed, in order to concentrate on the effects of monetary policy.

Our results show that the lending rate as well as the markup or spread (lending rate minus policy rate) is increasing in the policy rate, and the Lerner index is decreasing in the policy rate. The latter result implies that in the context of our model a procyclical monetary policy leads to a countercyclical movement of the Lerner index.[1] That is, this measure of market power in banking may vary over the business cycle due to the monetary policy rule. In reality the number of banks as well as demand may of course change over the business cycle, blurring these effects. However, we conclude that the interest rate setting rule used by the central bank may affect the observed market power of banks. Evidently, this has important implications for competition policy with respect to the banking sector. Also, it suggests that empirical estimates of market power in banking (such as those discussed in section 2.5.2) should be interpreted carefully. Observed changes in such estimates may not be a consequence of changes in bank behavior but might be caused by changes in the policy rate implemented by the central bank.

In a sense, we consider here a microeconomic approach to monetary transmission, or more precisely to the pass through of changes in the policy rate to bank lending rates. As we discussed in chapter 2, this approach has its limitations since monetary policy goals have a macroeconomic nature. Thus, the analysis here should be interpreted as a partial analysis, where the focus is on how changes in the policy rate may affect bank lending rates. There is a large gap between the theoretical, microeconomic literature on market imperfections in banking (the IO approach to banking described in chapter 2) and the mainly macroeconomic analyses of monetary transmission. In most empirical studies of the pass through of policy rate adjustments only lip service is paid to the micro side (see e.g. Cottarelli and Kourelis, 1994; BIS, 1994; Borio and Fritz, 1995; Mojon, 2000; Sander and Kleimeier, 2001; Toolsema et al., 2001; and Hofmann, 2002). Microeconomic studies of monetary

[1]We use the term procyclical to refer to a movement in the same direction as that of the business cycle (e.g. the policy rule is procyclical since the policy rate increases in booms), and the term countercyclical to refer to a movement in opposite direction (e.g. the Lerner index moves countercyclically since it falls in good states).

transmission in the context of imperfect competition models of banking have remained limited in number (for an overview of such studies see Swank, 1994, section 2.4.3; see also Swank, 1994, chapter 3). Probably this is due to the partial nature of such research, as discussed above. In this chapter we aim to fill part of this gap by analyzing the effects of monetary policy on lending rates and the relative markup (Lerner index) of banks.

We focus on the effects of monetary policy on bank behavior. The existing literature on the relationship between monetary policy and bank competition has focused mainly on the other direction of causality. Several authors have studied the effects of bank competition or bank market structure on monetary policy, i.e. on the effectiveness of monetary policy and the optimal choice of policy targets and instruments. For example, Aftalion and White (1977) compare perfect competition versus pure monopoly in banking, and analyze the responsiveness of the banking system to various monetary policy tools, focusing on the European type of monetary system. VanHoose (1983) uses a similar approach based on US market conditions and monetary policy procedures. VanHoose (1985) uses the more general assumption of Cournot competition among financial institutions and considers a change in the number of banks. In general, these studies conclude that bank market structure may affect monetary control and influence the appropriate choice of monetary policy targets and instruments.

The issue that monetary policy may affect the competitiveness of banks was raised by Bagliano et al. (2000). They examine the possible effects of the monetary policy rule chosen by the European Central Bank (ECB) on bank competition in the context of pricing behavior of banks over the business cycle. They describe monetary policy by an interest rate setting rule that can have a procyclical[2] component. Using a model of implicit collusion based on Rotemberg and Saloner (1986), Bagliano et al. (2000) discuss the effects of the choice of a monetary policy rule by the central bank on collusion and the incentive of banks to set high lending rates over the business cycle. They conclude that a procyclical monetary policy may favor implicit collusion. This implies that the adoption of the ECB's common monetary policy itself will result in changes in the competitiveness of the national banking sectors. The changes may be different across countries. The precise effects depend

[2]Bagliano et al. (2000) refer to the monetary policy as *counter*cyclical themselves, using a definition that is different from ours.

on the degree of procyclicality of the national monetary policy before the Economic and Monetary Union (EMU) as compared to that of the ECB's policy (with respect to that particular country's business cycle).

In our model we use a similar interest rate setting rule to study the effects of monetary policy on bank competition. However, we use a different model of competition, based on horizontal product differentiation. In the particular model of Bagliano et al. (2000) there are only two states of the world (high demand and low demand, respectively), and there is always full collusion in bad states, independent of the central bank's policy rule. The choice of policy rule therefore only affects bank competitiveness in good states. In contrast, we present a model in which monetary policy affects bank behavior both in good states and in bad states (where our definition of the states is somewhat different from that of Bagliano et al., as explained in section 6.2 below).

The spatial competition model is based on the idea that with differentiated products, the results of price competition among firms are less extreme than in the standard Bertrand model. We use a popular spatial competition model that was introduced by Salop (1979). In the original model, products are differentiated because of geographical distance and transportation costs. Alternatively, it can be interpreted in terms of heterogeneous goods, in which case location refers to taste for a specific type of good. The model has been applied to the banking sector by various authors, for example to assess the optimal number of banks (Freixas and Rochet, 1997, pp. 67-73; see also our discussion in chapter 2). Chiappori et al. (1995) use it to study the consequences of deposit rate regulation. They also examine the effects of deposit rate regulation on the effectiveness of monetary policy. They show that monetary transmission is imperfect under deposit regulation with tied-sales contracts (i.e. loans are granted under the condition that the borrower deposits his current account in the same bank), in the sense that the response of the lending rate to the policy rate is less than one to one in that case. However, they do not consider the effects of monetary policy on market power of banks.

A more recent contribution to the banking literature based on the Salop model is that of Schargrodsky and Sturzenegger (2000), in which the effect of prudential regulation (aiming at increased solvency) on bank competition is examined. They interpret product differentiation as banks specializing in different geographic or economic areas, and assume the degree of specialization (the transportation cost parameter of the original Salop model) to be endogenous. In that case, they show that tighter capital requirements imply a lower degree of specialization, which may induce more intense competition, i.e. lower spreads. This result contradicts the traditional prediction of a trade-off between solvency and competition.

The remainder of this chapter is structured as follows. Section 6.2 gives the basic setup of the model. It describes the monetary policy of the central bank and presents a simple model of competition for the banking sector based on the Salop model. Section 6.3 derives the solution of the model. In section 6.4 we turn to the effects of monetary policy in this model. In particular, we examine the effects of the monetary policy rule used by the central bank on market power in banking as measured by the Lerner index. We show that with a procyclical monetary policy the Lerner index varies over the business cycle. Section 6.5 concludes.

6.2 The model

In order to investigate how policy rate adjustments affect the lending rate and the Lerner index, we present a two-stage model. In the first stage the central bank decides on the policy rate according to an interest rate setting rule that describes monetary policy. In the second stage, the commercial banks compete by setting interest rates for loans and lending to entrepreneurs. This timing can be justified as follows. In the formal model, banks compete for one period only (i.e. in stage 2). Informally, however, we can think of banks competing for several, say T, periods. At the end of period T, the central bank decides to adjust the short-term interest rate for some reason (for example, after several periods of boom there will now be a recession). After the new rate has been set, the banks compete again for some time, until the central bank adjusts the interest rate again, etc. This section starts with a short description of monetary policy (stage 1) and proceeds with the model of bank competition (stage 2) which is based on the Salop model of spatial competition.

In order to model policy rate adjustments we assume that the central bank aims at (some degree of) output stabilization. As we will show below, this implies that the central bank uses an interest rate rule of a specific form. Let $\overline{y}$ denote the trend or steady-state output level, and y the current output level. Output stabilization implies that the central bank sets the short-term policy rate according to an interest rate setting rule of the form

$$i = \bar{i} + \phi_y (y - \overline{y}),$$

where $\bar{i}$ refers to the steady-state interest rate and $\phi_y > 0$ is a feedback parameter. As we will show below, by increasing (decreasing) i the central bank can decrease (increase) output y. Thus, by using this policy rule the central bank stabilizes output y around its natural level $\overline{y}$ to some (exogenous) extent, indicated by the parameter ϕ_y. Note that central banks in general are concerned with inflation as well. For example, the ECB primarily aims at limited inflation. Only if that goal is achieved, the ECB might consider taking measures to stabilize output. In contrast, the Federal Reserve (Fed) primarily aims at output stabilization (see e.g. Taylor, 1993). In the present chapter, we focus on output only, for expositional convenience. Thus, our model presents a simplified view of monetary policy and is more closely related to the case of the Fed than to the ECB's policy. However, if we assume that in the short run there is a positive correlation between the output gap and the deviation of inflation from its expected level (like in the Lucas, 1973, misperception model which is based on imperfect general price information), the rule can also be interpreted to command a policy rate increase if inflation is high.

With respect to the bank competition subgame of stage 2, consider a Salop circular city of length 1 on which there is a unitary density of entrepreneurs located uniformly along the circle. Entrepreneurs can undertake an investment project of fixed size normalized to 1. In order to invest, they need to borrow from a bank. There are n banks, located equidistantly along the circle. We let n be exogenous.[3] We consider horizontal product differentiation among banks, and assume each bank to offer a single product only, i.e. loans of a specific type. The type of loan offered by the bank is indicated by the bank's location on the circle. Thus, loans are heterogeneous among banks.

We interpret an entrepreneur's location on the circle as the entrepreneur's taste for a specific type of bank. An entrepreneur l, located

[3]In an earlier version, circulated under a different title (Toolsema, 2001a), we analyze the case of endogenous n. There we have a three-stage model. In an intermediate stage, after the central bank determines the policy rate but before the banks compete by setting lending rates, the commercial banks decide whether or not to be active in the market. That is, the number of banks n is endogenously determined in this stage, and we examine the effects of different monetary policy rules on the equilibrium value of n.

at distance x_{lj} from bank j, is x_{lj} away from his preferred type when borrowing from bank j. Let t be a taste parameter, which is the analog of a transportation cost. Then, tx_{lj} expresses (the monetary equivalent of) the entrepreneur's decrease in utility from obtaining a loan from bank j instead of borrowing from his preferred type of bank.

Generally, the deposit rate closely follows the money market or policy rate. Therefore, we use the common assumption that each bank faces an infinitely elastic deposit supply at the nominal short-term interest rate i. In stage 2, the n banks decide on the interest rates on loans r_j, $j = 1, ..., n$. Then, each entrepreneur borrows from the bank he prefers. After obtaining loans, entrepreneurs are subject to an economy-wide shock. Finally, total repayments obtained by the bank depend on the shock and are used to repay depositors.

Again consider entrepreneur l, located at distance x_{lj} from bank j. Without the shock, by borrowing from bank j and investing the loan, this entrepreneur obtains a net return equal to

$$S_{lj} = V - r_j - tx_{lj},$$

where V denotes the gross return on the investment project. Note that S_{lj} denotes the net return generated by the investment, corrected for the costs of obtaining the loan. We assume that for each entrepreneur l there is a bank j such that $S_{lj} \geq 0$, and thus the market for loans is covered.

Economic conditions affect the actual return. Sometimes, this is modeled by letting the gross return V depend on economic conditions. However, for expositional convenience, we take a different approach. We assume that if aggregate demand turns out to be low, some entrepreneurs will go bankrupt. The economy-wide shock is therefore assumed to affect the entrepreneurs' return in the following way. Let s be uniformly distributed on the interval $(0, 1)$. Suppose that for a given realization s of the shock a fraction $1 - s$ of the entrepreneurs (selected randomly) goes bankrupt. We assume that the entrepreneurs have limited liability and no collateral. Thus, if an entrepreneur goes bankrupt, he does not repay the principal nor the interest, and ends up with a payoff of zero. Therefore, for a given shock $0 < s < 1$, entrepreneur l's *expected* net return generated by the investment is given by

$$sS_{lj} = s\left(V - r_j - tx_{lj}\right).$$

This can be interpreted as the expected value of net return for given economic conditions. We assume that the realization of the shock becomes known before stage 1, so that the central bank can respond to it by adjusting the policy rate i in order to stabilize output. For simplicity, we set the size of the shock $\overline{s}$ associated with the natural output level $\overline{y}$ at $\overline{s} = \frac{1}{2}$.

As an alternative specification, we could interpret the term tx_{lj} as transportation costs that are sunk once the entrepreneur has obtained a loan. Whether the entrepreneur goes bankrupt or not, he incurs these costs. In that case the expected net return should be written as

$$s\left(V - r_j\right) - tx_{lj}.$$

That is, if the entrepreneur goes bankrupt, he ends up with a payoff equal to $-tx_{lj}$. Assuming that for each entrepreneur l there is a bank j such that this expected net return is nonnegative, this leads to qualitatively the same results, as will be illustrated below.

6.3 Solution of the model

In order to solve for the equilibrium of the model, we apply backward induction. Starting with stage 2, we take the short-term interest rate i as given. The distance between two adjacent banks is given by $\frac{1}{n}$. The indifferent entrepreneur between two adjacent banks j and k is therefore located at $\widehat{x}_{jk}$ such that

$$V - r_j - t\widehat{x}_{jk} = V - r_k - t\left(\frac{1}{n} - \widehat{x}_{jk}\right),$$

implying

$$\widehat{x}_{jk} = \frac{-r_j + r_k + \frac{t}{n}}{2t}.$$

The assumption that the market is covered can thus be written as $V - r_j - t\widehat{x}_{jk} \geq 0$ for all adjacent banks j, k. Assuming symmetry among banks, all banks other than j will set the same lending rate r_{-j}, and total demand faced by bank j when it sets rate r_j is given by

$$D_j\left(r_j, r_{-j}\right) = 2\widehat{x} = \frac{-r_j + r_{-j} + \frac{t}{n}}{t}.$$

Evidently, with the specification of the shock to entrepreneurs' net return as described in the previous section, the shock s will also affect the banks' earnings. A fraction $1-s$ of entrepreneurs goes bankrupt and does not repay anything, whereas the remaining fraction s is able to repay the entire loan plus interest. Bank j's profits are given by

$$\pi_j = s\left(1+r_j\right)D_j\left(\cdot\right) - \left(1+i\right)D_j\left(\cdot\right).$$

Each bank j maximizes profits π_j with respect to r_j, taking i as given. Solving this maximization problem and imposing symmetry we find the equilibrium lending rate is given by

$$r^* = \frac{t}{n} - 1 + \frac{1+i}{s}. \tag{6.1}$$

It can easily be verified that the second-order condition for a maximum is satisfied. Bank j's profits in equilibrium are given by

$$\begin{aligned} \pi^* &= s\left(1+r^*\right)\frac{1}{n} - \left(1+i\right)\frac{1}{n} \\ &= s\left(1+\frac{t}{n}-1+\frac{1+i}{s}\right)\frac{1}{n} - \left(1+i\right)\frac{1}{n} \\ &= \frac{st}{n^2}. \end{aligned}$$

Note that banks' profits are independent of the policy rate i. Only the entrepreneurs' expected payoff is influenced by the policy rate.

Now we turn to stage 1. In this stage, the central bank sets a policy rate, stabilizing output towards its natural level. The central bank realizes that expected[4] total output (or total income) of the entrepreneurs at the end of stage 2 is given by the integral of the expected net return of all entrepreneurs, which can be written as

$$\int_{l=0}^{1} sS_{lj}\mathrm{d}l = s\int_{l=0}^{1}\left(V - r^* - tx_{lj}\right)\mathrm{d}l \equiv sI.$$

We use I to denote the integral $\int_{l=0}^{1} S_{lj}\mathrm{d}l$. Note that the subscript lj of x should be interpreted here as referring to entrepreneur l who visits

[4]We refer to *expected* output here, because although s is assumed to be known, it is uncertain which entrepreneurs will go bankrupt. Only the fraction of entrepreneurs that will go bankrupt is known.

his *preferred* bank j. Total output y includes the banks' profits and is given by

$$y = s \int_{l=0}^{1} (V - r^* - tx_{lj})\,\mathrm{d}l + \frac{st}{n} = s\left(I + \frac{t}{n}\right).$$

The integral $I = I(r^*(i))$ is a decreasing function of r^*, so it is a decreasing function of i. Now we can derive the explicit policy rule followed by the central bank in the setting of this output specification.

The central bank is assumed to aim at stabilizing output (to some exogenous extent) around its natural level $\overline{y} = \overline{s}I(\overline{i})$. Intuitively, in case of a shock $s > \frac{1}{2}$ that causes output to be relatively high ceteris paribus, the central bank sets $i > \overline{i}$, reducing I and thereby reducing output towards $\overline{y}$. In case of a shock $s < \frac{1}{2}$ that causes output to be low, the central bank sets $i < \overline{i}$, stimulating output. More precisely, the optimal monetary policy from the point of view of a central bank aiming at output stabilization (to some extent) can be described in terms of the shock s by the interest rate setting rule

$$i = \overline{i}\,[1 + \phi(2s - 1)]\,, \tag{6.2}$$

where $\phi > 0$, s refers to the economy-wide shock and $\overline{i}$ denotes the 'average' or steady-state short-term interest rate. The parameter ϕ is a feedback coefficient (related to the coefficient ϕ_y in the discussion above), indicating to what extent the central bank stabilizes output. This policy rule describes the central bank's equilibrium strategy. Observe that the central bank moves the short-term interest rate i procyclically since $\phi > 0$: in good states of the world, i.e. for $\frac{1}{2} < s < 1$, $\phi(2s - 1)$ is positive, whereas in bad states, where $0 < s < \frac{1}{2}$, this term is negative. Writing the monetary policy rule in this way, the central bank's policy rule is related directly to the level of s instead of y. The reason is that fluctuations in y (apart from those caused by the central bank's policy) are determined solely by the economy-wide shock s in our setup. In the first stage of the model the central bank observes the value of s, realizes how this will affect y in the second stage, and adjusts the policy rate i accordingly.

Note that in this framework the central bank does not choose a specific strategy in order to maximize some explicit payoff function. Instead, the description of central bank behavior is more general and does not specify the degree of procyclicality (say, the amplitude of the procyclical movement) of monetary policy explicitly. This more general specification allows us to examine the effects of different monetary policy rules on the degree of market power in the banking sector. Alternatively, the framework can be interpreted as follows. The primary aim of the central bank in our model is to stabilize output to a certain, given degree. This uniquely determines the policy rule (i.e. the feedback coefficient ϕ). In following this particular policy, the central bank does not take into account the effects of the monetary policy on banks' market power. However, as will argue below, such effects do exist. This has important implications for competition policy for banks.

6.4 Effects of monetary policy

We will now apply a comparative statics approach in order to analyze the effects of changes in the policy rate and of different monetary policy rules (in terms of the size of the feedback coefficient ϕ) on the equilibrium lending rate and the Lerner index. We first concentrate on the effects of changes in the policy rate i. Then, we turn to an analysis of the effects of different monetary policy rules and study the effects of different feedback coefficients ϕ.

Lemma 6.1 *The equilibrium lending rate is positively related to the policy rate. In fact, we have* $\frac{dr^*}{di} > 1$*.*

PROOF The proof follows directly from (6.1): $\frac{\mathrm{d}r^*}{\mathrm{d}i} = \frac{1}{s} > 1$. ■

The interpretation of this lemma is straightforward. The equilibrium lending rate set by the bank is increasing in the policy rate determined by the central bank. The policy rate i in our model represents the marginal cost of a bank. The lemma thus states that the price set by the bank is increasing in the marginal cost. Also, the spread or markup $r^* - i$ is increasing in the policy rate since $\frac{\mathrm{d}(r^*-i)}{\mathrm{d}i} = \frac{\mathrm{d}r^*}{\mathrm{d}i} - 1 > 0$.

In this chapter our aim is to analyze the effects of different monetary policy rules (that is, different feedback coefficients) on the degree of competition among banks. Therefore, we now examine the effect of the central bank's policy rate i on the Lerner index of the commercial banks. In our model, the Lerner index L is given by

$$L \equiv \frac{r^* - i}{r^*}.$$

Lemma 6.2 *The Lerner index is negatively related to the policy rate:* $\frac{dL}{di} < 0$.

PROOF We have

$$\frac{\mathrm{d}L}{\mathrm{d}i} = \frac{\mathrm{d}}{\mathrm{d}i}\frac{r^* - i}{r^*} = \frac{1}{(r^*)^2}\left(\frac{\mathrm{d}r^*}{\mathrm{d}i}i - r^*\right).$$

Substituting from (6.1), we obtain

$$\frac{\mathrm{d}L}{\mathrm{d}i} = ns\frac{ns - n - ts}{(-ts + ns - n - ni)^2}.$$

Since $ns - n$ must be negative, the numerator is negative, and we conclude that $\frac{\mathrm{d}L}{\mathrm{d}i} < 0$. ■

From this lemma we see that the policy rate i set by the central bank affects the market power of the commercial banks as measured by the Lerner index. If the central bank lowers the policy rate, the banks get more market power in the sense that they can set a higher relative markup. So, a change in the policy rate in our model does not only affect aggregate output but the competitiveness of the banking sector as well.

It is true that lemma 6.2 only shows that the Lerner index is downward sloping in marginal cost in this particular model, but the result is far more general. For example, it holds for the standard linear symmetric Cournot model with n firms (or banks) as well. This can be seen as follows. Let demand be given by $p = a - bQ$ where p refers to price and Q to total output of the n firms; a and b are parameters. Marginal cost equals c. Then in equilibrium an individual firm's output is given by

$$q^* = \frac{a - c}{(n+1)\,b},$$

implying that the equilibrium price is

$$p^* = \frac{a + nc}{n + 1}.$$

The Lerner index satisfies

$$L = \frac{p^* - c}{p^*} = \frac{a - c}{a + nc},$$

with derivative

$$\frac{\mathrm{d}L}{\mathrm{d}c} = -\frac{(n+1)\,a}{a+nc} < 0.$$

Thus, in the Cournot model the Lerner index is downward sloping in marginal cost. Note that a similar result holds for the case of a monopolist ($n = 1$). This result corresponds to our lemma 6.2, and suggests that our conclusions with respect to the effect of monetary policy on banks' market power are not limited to the precise model specification applied here, but are more general.

Bank j's profits in equilibrium are given by $\pi^* = \frac{st}{n^2}$.This shows that bank's profits are independent of the policy rate i. So, summarizing, an increase in the policy rate increases the lending rate as well as the spread, decreases in the Lerner index, and leaves the banks' profits unaffected.

Using the alternative specification of an entrepreneur's expected net return given by

$$s\,(V - r_j) - tx_{lj},$$

it can be shown that

$$r^* = \frac{t}{sn} - 1 + \frac{1+i}{s}.$$

This implies

$$\frac{\mathrm{d}r^*}{\mathrm{d}i} = \frac{1}{s} > 1,$$

as before. For the Lerner index, we now obtain

$$\frac{\mathrm{d}L}{\mathrm{d}i} = ns\frac{ns-n-t}{(ns-n-t-ni)^2},$$

which is again negative. Thus lemma's 6.1 and 6.2 are valid in this specification as well. Finally, banks' equilibrium profits are $\pi^* = \frac{t}{n^2}$ and are again independent of i.

We now turn to the comparative static effects of the feedback coefficient ϕ. This analysis should be interpreted as the comparison of different monetary policy rules. That is, we analyze the effects of different degrees of procyclicality in the policy rate on lending rates and on the competitiveness of the banking sector.

Proposition 6.1 *For $\frac{1}{2} < s < 1$, $\frac{dr^*}{d\phi} > 0$ and $\frac{dL}{d\phi} < 0$. For $0 < s \leq \frac{1}{2}$, $\frac{dr^*}{d\phi} \leq 0$ and $\frac{dL}{d\phi} \geq 0$. An increase in ϕ increases the degree of procyclicality of r^* and the degree of countercyclicality of L.*

PROOF Note that in (6.2) $\frac{\mathrm{d}i}{\mathrm{d}\phi} > 0$ if $s > \frac{1}{2}$, but $\frac{\mathrm{d}i}{\mathrm{d}\phi} \leq 0$ if $s \leq \frac{1}{2}$. Together with lemma's 6.1 and 6.2, this proves the first two sentences of the proposition. From this, it follows that an increase in ϕ increases the degree of procyclicality of r^* and of the countercyclicality of L. To see this, define $\overline{r} = r^*\left(\bar{i}\right)$ and $\overline{L} = L\left(r^*\left(\bar{i}\right)\right)$ as the levels of r and L, respectively, associated with $s = \overline{s} = \frac{1}{2}$. For $\frac{1}{2} < s < 1$, $i > \bar{i}$ so $r^* > \overline{r}$ and $L < \overline{L}$ whereas for $0 < s < \frac{1}{2}$, $i < \bar{i}$ so $r^* < \overline{r}$ and $L > \overline{L}$. Combining this with the first part of the proposition, for $\frac{1}{2} < s < 1$, $r^* > \overline{r}$ and r^* increases as ϕ increases; and $L < \overline{L}$ and L decreases as ϕ increases. For $0 < s < \frac{1}{2}$ we have the opposite results: $r^* < \overline{r}$ and r^* decreases as ϕ increases; and $L > \overline{L}$ and L increases as ϕ increases. ■

Intuitively, the last part of the proof should be interpreted as follows. For any $\phi > 0$, if s is high ($\frac{1}{2} < s < 1$) then i is high, so r^* is high (above $\overline{r}$) and L is low (below $\overline{L}$). If ϕ increases, i increases, so r^* becomes even higher (even further away from $\overline{r}$) and L will be lower (further away from $\overline{L}$). If s is low ($0 < s \leq \frac{1}{2}$), however, then i is low, r^* is low and L is high. In that case, an increase in ϕ increases i and r^* and decreases L. Thus, an increase in ϕ increases the amplitudes of the procyclical movement and countercyclical movement, respectively, of r^* and L.

Proposition 6.1 shows that with a procyclical monetary policy rule the lending rate moves procyclically. The reason is simply that the central bank moves the policy rate procyclically, and this policy rate is treated here as the marginal cost of the commercial banks. The price or lending rate set by the banks simply follows movements of this marginal cost. Furthermore, the proposition indicates that the procyclical policy rule implies a countercyclical movement in the degree of market power of commercial banks. Our hypothesis is that an upward movement of the business cycle leads to a decrease in market power[5], via the higher policy rate set by the central bank. Finally, the proposition claims that as the degree of procyclicality of the policy rule ϕ increases, the degree of procyclicality of the lending rate and the degree of countercyclicality of the Lerner index increases as well.

Note that this proposition depends crucially on the results that $\frac{\mathrm{d}r^*}{\mathrm{d}i} > 0$ and $\frac{\mathrm{d}L}{\mathrm{d}i} < 0$ but *not* on the specific model of second-stage competition (for example, we would obtain qualitatively the same results with a simple linear symmetric Cournot model; see also the discussion of that

[5]Note that the result of less market power in good states corresponds to the Rotemberg-Saloner result of price wars during booms (Rotemberg and Saloner, 1986).

model above). It can be verified that the proposition also carries over to our alternative specification where the entrepreneur's expected net return is given by $s(V - r_j) - tx_{lj}$ instead of $s(V - r_j - tx_{lj})$. Although the precise expression for output y is slightly different in that case, the monetary policy rule is qualitatively the same. Since lemma's 6.1 and 6.2 continue to hold in this case, so does proposition 6.1.

Proposition 6.1 shows that a procyclical monetary policy ($\phi > 0$) moves the lending rate as well as the degree of market power over the business cycle. Moving the lending rate can be seen as one of the aims of a procyclical policy. However, we have shown that the Lerner index L is affected as well, and thus the competitiveness of the banking sector is varying over the business cycle with a procyclical policy rule. These hypotheses can be related to those of Bagliano et al. (2000, proposition 5). In their model, an increase in the degree of procyclicality ϕ leads to softer competition among banks in good states. This contradicts our finding that $\frac{\mathrm{d}L}{\mathrm{d}\phi} < 0$ for good states ($s > \frac{1}{2}$). However, for $s < \frac{1}{2}$, we find the opposite effect of market power increasing in ϕ whereas in the model of Bagliano et al. (2000) there is always full collusion in bad states.

6.5 Conclusion

Applying the Salop spatial competition model to banking, we have analyzed the effects on bank competition of the choice of a monetary policy rule by the central bank. We have shown that monetary policy may affect the degree of market power - as measured by the Lerner index - in the banking sector. This confirms the findings of Bagliano et al. (2000), who apply a model of implicit collusion to the banking sector. Although the precise effects in their model are different from ours, we come to the same general conclusion that monetary policy affects the competitiveness of banks. In our theoretical framework the level of the policy rate, which performs the role of marginal cost, affects the ability of banks to charge a lending rate above the policy rate. When the policy rate increases, the Lerner index decreases. Thus, according to our model the choice of a procyclical policy rule implies a countercyclical movement of the degree of market power in banking.

In our model the central bank's only aim is to stabilize output (to some degree). However, our results show that implementing policy rate changes does not only affect output but the competitiveness of banks as well. This has important implications for competition policy for the banking sector. In general, governments prefer well-functioning financial markets. This involves a trade-off between the benefits of competition in banking, and financial stability. We discussed this trade-off in chapter 2. However, taking into account the restrictions on bank competition imposed by the desired level of stability, the government will generally prefer competition in the banking sector to be as strong as possible. In our model, we show that this preferred level may not be attained in practice, since market power varies with the monetary policy rule followed by the central bank. More precisely, in our model the central bank's policy does affect the competitiveness of banks, but it does not affect financial stability. Thus, the above analysis indicates that when the central bank follows a procyclical monetary policy rule, the preferred level of competition cannot always be achieved. This also implies that a high value of the Lerner index measured at some point in time may not always be fully due to the abuse of market power, e.g. collusion, by banks; it may partly be caused by the specific interest rate setting rule applied by the central bank.

We conclude this chapter with some possible directions for future research. First, the specification of monetary policy in our model assumes that the central bank aims at output stabilization only. This is of course a simplification, because as we argued in the introduction to this chapter, central banks are concerned with a stable price level as well. The results of our model only apply to policy rate adjustments implemented in order to stabilize output. It would be interesting to analyze whether similar results can be obtained if the main goal of the central bank is price stability. Ideally, a model should be developed in which the monetary policy rule contains all possible aims of a real-world central bank.

In particular, developing such a model in which the central bank is primarily concerned with price stability, and perhaps to some degree with output stability as a secondary aim, may yield interesting insights for the case of the ECB. If that specification would also show that the monetary policy rule affects the competitiveness of banks, that would have important implications for the national competition policies of the EMU countries, who share a common monetary policy. For example, the parameter ϕ_y, which can be interpreted as a feedback coefficient with respect to the state of the own economy, probably was high for Germany before EMU but relatively low for the other EMU-members. The reason is that these other members mainly had to adjust their monetary policy to the actions taken by the Bundesbank following German shocks. The shift to EMU may imply an increase in the feedback coefficient ϕ_y for these other members, and a decrease in ϕ_y for Germany. So, if our result that monetary policy affects market power in banking would carry over to the ECB case, this would predict that the shift to EMU may have affected the competitiveness of the various European national banking sectors in different ways. Also, it would suggest that the ECB's common monetary policy itself affects bank competitiveness differently across countries.

Second, we have proposed several hypothesis that could be tested empirically in future research. For example, we predict a negative relationship between the Lerner index and the policy rate. Also, with a procyclical policy rule we predict a negative relationship between the Lerner index and the business cycle. For example, during a boom, the central bank will set a high policy rate. Our model predicts the Lerner index to be low in that case. Empirical testing of these hypotheses and possibly those of the extended model proposed above could yield important insights into the relationship between monetary policy, the pass through of policy rates to bank lending rates, and bank behavior.