INVESTIGATION OF THE DETERMINANTS OF THE ADJUSTMENT OF LENDING RATES IN MACEDONIA – A SUR APPROACH

Jane BOGOEV

Abstract: This paper empirically examines the determinants and differences of the short-run lending rate stickiness among banks in Macedonia by using the Seemingly Unrelated Regression model (SUR). For that purpose, eight bank balance sheet items, two macroeconomic variables and an indicator for the level of concentration in the banking system are considered. The results generally support the hypothesis of aggregation bias in the literature. Namely, the size of the short-run pass-through adjustment of lending rates to changes in the “cost of funds” rate is incomplete and heterogeneous among Macedonian banks where various bank balance sheet items play different role over banks’ lending rate setting decisions.

Keywords: Interest Rate Passthrough, Monetary Policy, Banks’ Financial Characteristics, Banks’ Heterogeneous Behaviour, Aggregation Bias

JEL Codes: C22, E43, E52, G21

1. INTRODUCTION

The aims of this paper are to empirically investigate banks’ heterogeneous lending rate adjustment to changes in the “cost of funds” rate and to identify what factors affect the lending rate setting decisions of banks in Macedonia. The rationale for exploring these issues in more depth is to provide a fuller picture about the effectiveness of the monetary transmission through the interest rate channel. From the monetary policymakers’ perspective, this is seen as important issue, having in mind the significance of the banking sector to the overall economy. Namely, financial assets in the Republic of Macedonia, as in other similar economies, are bank-dominated combining up to 90% of total financial assets in 2008, with banks’ loans as the major source of external finance to the private sector.

* Jane BOGOEV, National Bank of the Republic of Macedonian and Staffordshire University, UK, Address: F.Ruzvelt 4/23, 1000 Skopje, Republic of Macedonia, janebogoev@yahoo.com
In this research we primarily follow the mark-up pricing model of how banks’ set their retail rates designed for a non-perfect competitive environment, established by Rousseas (1985) and Ho and Saunders (1981), as well as various empirical methods found in the applied studies (see section 2). According to the existing theoretical and empirical literature, various macro and microeconomic factors are seen to affect banks’ pricing policy such as the structure of the financial system, macroeconomic characteristics of the economy and banks’ balance sheet items. Thus, the core aim of this paper is to explore how these factors affect the heterogeneous lending rate rigidity among Macedonian banks to changes in the “cost of funds” rate, since the existing empirical evidence indicates that the lending rate pass-through adjustment is incomplete, especially in the short-run.

For example, the existing empirical studies that investigate the interest rate pass-through in the Macedonian banking sector imply that it is incomplete in the short-run (Jovanovski et al., 2005) or both the short- and long-run (Velickovski, 2006). Moreover, for the reason that these studies are conducted on aggregate bank level data, we argue that their main possible drawback is that they may suffer from aggregation bias (see section 2).

Accordingly, the value added of this paper is as follows: First, it investigates banks’ heterogeneous retail rate adjustment rigidity and the factors that impede the “smooth” transmission, employing a different and arguably more appropriate estimation method of Seemingly Unrelated Regression (SUR), not currently found in the Macedonian literature as well as for the economies from Central and South Eastern Europe (CSEE). Second, the model adopted includes a comprehensive set of eight balance sheet items and it also controls for the impact of the macroeconomic factors. Third, this investigation is based on a disaggregated bank-level data set. For example, there is not any existing study that explores the size of the pass-through adjustment in the case of Macedonian banking sector that uses disaggregated bank-level data whereas, the literature conducted for the rest of the world, especially for the CSEE, based on bank-level data is quite limited. The reason for using disaggregated bank-level data set is because it is argued that studies that use an aggregated data may suffer from aggregation bias. Thus, using bank-level data should be the greatest value added of this paper to the overall thesis. Fourth, this study focuses only on lending rates denominated in denars unlike the rest of the studies for Macedonia as well as CSEE that use aggregated data set including domestic and foreign currency denominated series.

This paper is structured as follows: section 2 reviews the theory and empirical studies. Section 3 explains the model in detail. The estimation method is explained in section 4. Section 5 describes the data used. Estimation results are presented in section 6, while the final section concludes.
2. THEORETICAL AND EMPIRICAL BACKGROUND

The theoretical model that we primarily follow of how banks set their retail rates is the mark-up pricing model by Rousseas (1985). The author develops a mark-up pricing model for a non-perfect competitive banking sector, since it is argued that banks exhibit some degree of market power. Hence, a starting argument of the mark-up pricing theory is that banks in the loan market are price setters and are modelled to set their retail interest rates as a mark-up margin over their prime costs (variable costs), expressed with the equation:

\[ i = k(u) \]  \hspace{1cm} (1)

where:

- \( i \) is the interest rate on loans,
- \( u \) represents the unit prime or variable costs and
- \( k \) is the mark-up margin over the prime or variable costs.

The prime or variable costs according to Rousseas (1985), in the case of the banking sector, are determined from the variations in the costs of funding of their lending activities known as “cost of funds”. These costs basically represent the interest rates that banks pay on deposits and/or interest rates on their borrowing in the money market that both of them are taken as exogenous. The rationale for this is that banks in these market segments are price takers due to the relatively high level of competitiveness, which is not the case in the loan market. However, the main weakness of Rousseau’s (1985) theory is related with the argument that variations in banks’ retail interest rates are mainly determined by the variations in the “cost of funds” rate that fails to specify the extent to which those changes are transmitted.

Based upon the mark-up pricing model of Rousseas (1985), de Bondt (2002 and 2005) has re-defined the retail rate setting equation (1) as follows:

\[ i = \beta_1 + \beta_2 u \]  \hspace{1cm} (2)

where:

- \( i \) is banks’ retail rate (deposit or loan rate),
- \( \beta_1 \) is the mark-up margin, \( u \) is the “cost of funds” rate and
- \( \beta_2 \) represents the demand elasticity of deposits or loans, i.e. the size of the pass-through adjustment coefficient.

According to this equation, variations in retail rates are again determined by the variations in the “cost of funds” rate, but the extent to which those variations are transmitted to banks’ retail rates depends upon the size of \( \beta_2 \) coefficient. The \( \beta_2 \) coefficient can be less than one, implying an incomplete pass-through from “cost of funds” rate to banks’ retail rates; equal to one, referring to complete pass-through; or higher than one. Consequently, the main field of interest in many of the empirical studies, as well as in our research, is to explore what factors affect the \( \beta_2 \) coefficient. In the
theoretical literature, various theories provide different explanations. For example, Niggle (1987) argues that the loan demand elasticity may be an important factor for the banks in setting their loan interest rates, especially for those borrowers who have access to other external sources of finance. Stiglitz and Wiess (1981) argue that the size of the $\beta_2$ coefficient may depend upon the informational frictions on the loan market caused by the moral hazard and adverse selection problems. Klemperer (1987), Sharpe (1997), Lowe and Rohling (1992), Petersen and Rajan (1994) and Boot (2000) indicate that the size of the $\beta_2$ coefficient may be determined by the existence of switching costs and related to that, the so-called relationship lending activities between the bank and its customers; or as Weth (2002) refers to as the “hausbank” phenomenon. Hannan and Berger (1991) suggest that the size of the pass-through adjustment may depend upon the “menu costs”, i.e. the costs of changing the retail rates. Additionally, other theories and models, such as the ones by Ho and Saunders (1981) and Angbazo (1997), suggest that the size of the $\beta_2$ coefficient may depend on some general macroeconomic factors, market structure in the banking sector and some banks’ specific characteristics. The empirical studies that examine the factors that affect the size of the $\beta_2$ coefficient in equation 2, are discussed in what follows.

One of the pioneering studies that empirically applies the mark-up pricing model in examining the determinants of interest rate pass-through, is by Cottarelli and Kourelis (1994). Based on aggregate bank level data, the authors examine which factors most significantly affect the short-run pass-through multiplier by using a set of structural macro and microeconomic factors for a set of 31 economies around the world. The results indicated that significant determinants of the short-run pass-through multipliers are inflation, market concentration, barriers to entry, private ownership of the banking system and the volatility of the money market rate; while GDP per capita did not have any significant impact.

Another study based on aggregate bank level data conducted for a set of six euro-zone economies is by Mojon (2000). The author explores the possible structural factors that may affect the short-run pass-through adjustment of banks’ retail rates, including: inflation, money market rate volatility, the level of competition in the banking system, banks’ operating and funding costs. The estimates regarding the loan interest rates indicate that all of the aforementioned factors, except funding costs, significantly affect the short-run pass-through.

The analyses of Sander and Kleimeier (2004, a) based again on aggregate bank level data investigate the fundamental factors that affect the interest rate pass-through in 10 euro-zone economies. The results suggest that significant determinants are estimated to be inflation, GDP growth, the level of financial intermediation, money market volatility and a composite index for the effectiveness in the banking sector.
Based on the same econometric methods and by using a similar structural indicators, Sander and Kleimeier (2004, b) investigate the structural determinants of interest rate pass-through in the eight new EU member states from CSEE. According to the results, the variables that significantly affect the long-run pass-through multiplier of lending rates are inflation and money market volatility, while unlike the euro-zone economies, GDP growth and the level of financial intermediation did not have any significant impact on the pass-through multipliers. The most influential characteristics of the banking sector that significantly affect the short-run pass-through multipliers of loan interest rates are estimated to be the level of competitiveness and the credit risk exposure in the banking sector. In contrast, foreign ownership entered with a contrary sign from what was a-priori expected for which no detailed explanation is given.

The research of Sorensen and Werner (2006), conducted again on aggregate bank level data, explores the structural factors (up to 20 indicators24) that may affect the speed of adjustment of interest rate pass-through for a set of 10 EMU economies. According to the estimates, the basic fundamental factors that determine the speed of adjustment of banks’ retail rates are: GDP growth, portfolio diversification and credit risk exposure positively; and concentration, interest risk exposure, the level of liquidity, capitalisation and the extent of portfolio diversification in the banking sector negatively.

Based on individual bank level data, de Graeve et al. (2004) explore the fundamental determinants of interest rate pass-through in Belgium. The results indicate that one of the most influential factors that affects the short- and long-run pass-through multipliers of both lending and deposit rates is the capitalisation ratio. Interest rate risk exposure and the level of concentration in the banking system play a significant role only in determining only the loan but not the deposit rates.

Lago-Gonzalez and Salas-Fumas (2005) attempt to explore the structural factors that determine the speed of adjustment of retail rates to changes in the “cost of funds” rate among Spanish banks. Among the structural factors considered, the estimates suggest that the two commonly used macroeconomic factors, i.e. GDP and inflation, have (as expected) a positive impact on the adjustment speed of both lending and deposit rate. Regarding the bank specific characteristics, the results indicated that higher credit risk exposure results in a faster speed of adjustment of banks’ retail rates, while higher concentration in the banking sector and higher asset size leads to a lower speed of adjustment of banks’ retail rates; a finding consistent with the study by Sorensen and Werner (2006).

Gambacorta (2005, a) explores the structural determinants of the short- and long-run pass-through multipliers and the speed of adjustment of banks’ retail rates in Italy. The most significant factors that negatively affect the speed of adjustment and short-run

24 For details of these indicators see Sorensen and Werner (2006) p.41.
pass-through multipliers of both lending and deposit rates were estimated to be the liquidity and capitalisation of banks, the level of non-deposit funding and the existence of relationship banking. The size of Italian banks was positively associated the short-run pass-through multipliers. Nevertheless, the results in respect of the size of the banks are not robust because their significance varies with different model specifications.

Weth (2002) investigates which of the four financial characteristics (size, non-deposit funding, maturity miss-match between long-term loans and deposits and banks’ involvement in relationship banking) affect the size and speed of adjustment of lending rates among banks in Germany. According to their results, larger bank size, higher non-deposit funding and maturity miss-match between long-term loans and deposits lead to a faster and more complete speed of adjustment of lending rates to changes in the “cost of funds” rate. In contrast, higher bank involvement in relationship lending (the “hausbank” phenomenon) leads to a more rigid short-run adjustment of lending rates.

In a similar manner, Chmielewski (2004) investigates what determines retail rate setting decisions among banks in Poland, by considering the following three different financial characteristics: profitability, credit risk exposure and capitalisation ratio. The results indicate that more profitable banks and/or banks with higher credit risk exposure adjust their retail rates faster and more fully to changes in the “cost of funds” rate, while more capitalised banks exhibit higher adjustment rigidity.

One of the main possible weaknesses of some of the reviewed studies, i.e. Cottarelli and Kourelis (1994), Mojon (2000), Sander and Kleimeier (2004 a and b), Sørensen and Werner (2006); is related to the data sets used. Namely, the aforementioned studies are based on aggregate bank level data. This approach has some disadvantages and may lead to biased estimates. More precisely, according to de Graeve et al. (2004), estimating the pass-through multipliers with aggregate bank level data may lead to aggregation bias arising from the heterogeneous nature of the data. For instance, the aggregate bank level data are composed of data series obtained from each individual bank, which have heterogeneous behaviour and market strategies. By aggregating the data, this heterogeneity is suppressed and may result in inconsistent estimates. Consequently, de Graeve et al. (2004) suggest that more efficient pass-through estimates may be obtained by using individual bank level data. This argument is empirically supported in their paper that argues that, in the case of Belgium; the pass-through estimates based on aggregate bank level data were downward biased compared to the same estimates estimated on individual bank level data. Consequently, testing if this hypothesis holds in the case of the Macedonian banking system is actually one of the core aims of this research.

Another possible drawback regarding the studies that use bank-level data and partially the studies that use aggregated data for the same group of economies, i.e. EMU
and CSEE economies; may be related to the estimation method used. More precisely, the studies based on time series cointegration methods like: error correction method - ECM (Mojon, 2000; Sander and Kleimer, 2004 a and b) and Panel Cointegration (de Graeve et al., 2004; Weth, 2002 and Chmielewski, 2004) may provide inefficient estimates because they do not control for the cross-sectional correlation among the units. This may be especially pronounced for the studies based on panel cointegration methods because the estimators employed are based on the assumption of no cross-sectional correlation among the units. However, some studies have tackled this issue using the SUR model (Sorensen and Werner, 2006 and Lago-Gonzalez and Salas-Fumas, 2005) that has been specifically developed for that purpose (see section 4). Hence, controlling for the cross-sectional correlation among the units in the case of our example is seen as a major value added of this research.

3. **The Model**

This model aims to explore the determinants of the short-run pass-through adjustment of banks’ lending rates to changes in the “cost of funds” rate, mainly using bank level data. The model is designed to take into account the impact of various banks’ specific and macroeconomic control factors that, according to the theoretical predictions and the empirical studies assessed in the previous section, are seen to affect banks’ retail rate reaction function to changes in the “cost of funds” rate.

In order to capture the short-run dynamics of the interest rate series, the model is estimated in first differences. With this model specification we attempt to investigate the size and the factors that affect the pass-through multiplier within one-month (1-month impact multiplier). Another possibility is to estimate a model within an error correction model (ECM). However, the mark-up pricing theory which is designed for non-perfect competitive pricing environment implicitly precludes the possibility that there may be a long-run equilibrium relationship between the “cost of funds” rate and banks’ retail rates. Namely, majority of the studies assessed in section do not even test for the existence of a cointegrating relationship (Mojon, 2000; Sorensen and Werner, 2006; Weth, 2002 and Chmielewski, 2004) or fail to find a cointegrating relationship for some of the retail rate series and the "cost of funds" rate (Sander and Kleimer, 2004 a and b and de Graeve et al., 2004). Additional argument for estimating the model in first differences is to avoid the problem of spurious regression when some of the variables, i.e. interest rate series, contain a unit root.\textsuperscript{25}

There are several reasons why we are primarily interested in investigating the short-run variations in the interest rates to changes in the “cost of funds” rate. \textit{First},

\textsuperscript{25} Unit root test are available from the author upon request.
according to the mark-up pricing theory, in an imperfect competitive pricing environment, rigidity of prices should be more pronounced in the short- rather than in the long-run. More precisely, in the case of the banking sector, banks are faced with a downward sloping loan demand curve, which is usually more inelastic in the short-run. In the long-run, depending on the financial structure of the economy, the loan demand curve may become more elastic because the economic agents (households and especially firms) may find alternative sources of finance. Hence, this may ultimately force banks in the long-run to adjust their lending rates more fully to changes in the “cost of funds” rate (Cottarelli and Kourelis, 1994). Second, according to the “menu costs” theory (Hannan and Berger, 1991), banks may decide to adjust their retail rates only if the marginal gain from changes in retail rates is higher than the costs incurred in changing their interest rates. However, the longer the lending rate is kept unadjusted to the changes in the “cost of funds” rate, and then the one-off costs of not changing the lending rate become higher due to the forgone multi-period benefits. This implies that banks are more likely to exhibit higher adjustment rigidity in the short- than in the long-run.

In the model presented it is assumed that, in the short run, banks are agents with heterogeneous behavioural functions. Consequently, in order to investigate if this assumption holds, we have selected an estimation method that allows us to test if the slope coefficients statistically differ between the units. However, in the literature there are pro- and contra-arguments if various banks behave differently in the short-run. Whether this assumption holds or not, it is still not very clear in the theoretical as well as in the empirical literature. In the case of the Macedonian banking sector there are some possible a-priori theoretical arguments (explained in the following paragraph), as well as some a-priori empirical indicators based on simple eyeball analysis of the 1st differences of the loan interest rate series for each bank separately (see appendix 1). Whether this conclusion statistically holds or not and what are the possible factors causing it, is the subject of more comprehensive econometric analysis in section 6.

According to the theoretical literature, in the case of imperfect competition, there are some supporting arguments explaining why banks may have different price setting strategies and consequently, may have different sizes and speeds of short-run adjustment. One of the possible factors that may affect the optimal pass-through adjustment of banks, and thus affect the slope coefficients among them, are the different price elasticities of loan demand in the various loan market segments in which banks operate. For example, some banks prefer granting more consumer loans while others favour real estate loans. Some banks are more specialised in granting loans to the corporate sector while others concentrate on the household sector. Hence, this implies that various banks are faced with different loan demand elasticities. Bearing in mind that disaggregated interest rate series by sectoral structure and according to different types of loans by purpose are not
available (see section 5), then unequal loan demand elasticity among different loan market segments may be another non-modelled factor causing banks to have heterogeneous slope coefficients. Another possible factor that may determine banks’ heterogeneous retail rate setting behaviour in the short-run could be financial market imperfections and changes in certain regulatory requirements imposed by the monetary authorities by which banks are obligated to adjust their balance sheet items (Ho and Saunders, 1981; Angbazo, 1997 and Cottarelli and Kourelis, 1994). These may not affect all banks equally, i.e. making some banks better off and others not, depending upon their financial performances.

The assessed empirical literature in section 2 implies that there is no straightforward and commonly accepted empirical model. It can be noticed that there is a large variation among the empirical models used, both in respect of the variables included and the estimation methods employed. Having in mind the complexity of this whole area, in our model specification we attempt to deal with the following aspects. First, to investigate the determinants of the short-run lending rate adjustment to changes in the “cost of funds” rate by considering a comprehensive set of bank balance sheet items as well as some macroeconomic control variables. Second, we attempt to explore if the slope coefficients differ among the units and consequently, to directly test if the assumption that banks are agents with heterogeneous behaviour, conditional on the controls, holds in the case of Macedonia. Third, we take into account the contemporaneous cross-sectional correlation among the units.

The basic model specification that allows for different slope coefficients for each cross-sectional unit, based on a common equation structure is as follows:

\[ \Delta l_{it} = \beta_0 + \beta_1 \Delta m_{it} + (X_{it} \Delta m_{it}) \beta_2 + (\Phi_{it} \Delta m_{it}) \beta_3 + (\Pi_{it} \Delta m_{it}) \beta_4 + \epsilon_{it}; \quad i = 1, \ldots, N \]  

Where:
- \( \beta_0 \) is the intercept term;
- \( i \) is banks’ lending rate;
- \( m \) is the “cost of funds” rate (MBKS rate);
- \( X \) is a vector of bank specific characteristics (size, liquidity, capital, NPL ratio, maturity-mismatch, relationship lending, operational efficiency and portfolio diversification);
- \( \Phi \) is a vector of macroeconomic characteristics (inflation and economic growth);
- \( \Pi \) is a vector of variables measuring the level of concentration in the banking sector (Hirschman-Herfindhal index - HHI and HHI^2);
- \( \epsilon \) is the error term;
- \( t \) and \( j \) refer to time and bank specific subscripts;
- \( \Delta \) is a first difference operator;
- \( \beta_{iit} \) is a parameter to be estimated;
\( \beta_{2i} \) is a vector of parameters to be estimated of the interaction terms between the change in the “cost of funds” rate and each bank specific characteristic respectively;

\( \beta_{3i} \) is a vector of parameters to be estimated of the interaction term between the change in the “cost of funds” rate and macroeconomic variables (inflation and economic growth);

\( B_{4i} \) is a vector of parameters to be estimated of the interaction term between the change in the “cost of funds” rate and HHI indices.

The independent variables in the model 1.3 are included with one period (month) lag. The rationale for this, instead of including their contemporaneous values, is that there may be some adjustment inertia of lending rates to changes in the “cost of funds” rate. This inertia may be caused by the existence of some “menu costs” and the time-lag caused by the decision-making process. Using a one period time lag is also preferable for the balance sheet items and the macroeconomic control variables. Moreover, bearing in mind that bank’s interest rate series reported are those for the end of each calendar month, and that the “cost of funds” rate or changes in balance sheet items and/or macroeconomic variables may take place near the end of the calendar month, then using the current month reduces the possible reaction time considerably.

According to the mark-up pricing theory, all independent variables included in model 3 such as, the “cost of funds” rate, bank balance sheet items, macroeconomic indicators and market concentration variables are taken to be strictly exogenous. If for some of the bank balance sheet items this might be arguable; however their inclusion with one period time lag may partially reduce the possibility of violation of the non-strict exogeneity assumption by imposing the contemporaneous exogeneity assumption (see section 4). As Gambacorta (2005, a) argues, “.....bank-specific characteristics should refer to the period before banks set their interest rates.” p.13.

In the model the vector parameters \( \beta_{1i}, \beta_{2i}, \beta_{3i} \) and \( \beta_{4i} \) cannot be directly interpreted on a ceteris paribus basis by isolating the impact of the rest of the variables. This is because the equation contains interaction terms, which makes the interpretation of the results more complicated. Our main interest is to analyse their statistical significance and sign from which we may be able to draw a conclusion on whether there is any impact of the independent variables over the size of the pass-through adjustment and if there is, in what direction they affect the pass-through adjustment.

To obtain the partial effect of the changes in the “cost of funds” rate to the pass-through adjustment of lending rates, we do a first order differentiation of equation 3 in respect of “cost of funds” rate by giving a certain value of the rest of the variables that contain the interaction terms such as their mean value\(^{26}\). The same procedure holds if we aim to investigate the impact of a bank’s specific variables, macroeconomic variables and

\(^{26}\) For details see Wooldridge (2002), p.190.
the impact of the concentration in the banking sector over the pass-through adjustment. All coefficients, as indicated by equation 3, are estimated for each cross-sectional unit separately.

The economic argument for each regressor and the expected \textit{a-priori} sign of the parameters (Table 12), is discussed in what follows.

The “cost of funds” rate is included to measure the size of the pass-through adjustment of banks’ lending rates. The expected sign of $\beta_1$ coefficient is positive. In selecting the “cost of funds rate” we have selected the weighted average monthly money market (MBKS) rate. The rationale for selecting the MBKS rate is for the reason that banks’ short-term borrowing takes place at the money market rate and accordingly, it represents the financing costs of their lending activities.

Bank size, measured by total assets, is included in order to estimate how the asset size affects the pass-through adjustment and whether the differences in the adjustment between banks depend on their asset size. According to the “menu costs” (Hannan and Berger, 1991) theory, larger banks should exhibit lower interest rate rigidity because their “menu costs” of adjusting the retail rates represent a smaller proportion of total bank’s costs, leading the larger banks to adjust their retail rates more fully to changes on the “cost of funds” rate. In contrast, the bank lending channel theory predicts a contrary impact of banks’ size. More explicitly, in periods of monetary policy tightening, bigger banks have greater access to, and can more easily raise, non-deposit funds in order to offset the monetary policy measures, which makes them less dependent on changes in the “cost of funds” rate. Hence, according to the arguments presented, the expected sign of size variable is ambiguous.

The variables measuring the levels of bank liquidity and capitalisation serve as proxy variables for liquidity and the insolvency risk of banks (Angbazo, 1997). The rationale for their inclusion in the model, according to the bank lending channel theory, is that banks with more liquid assets and/or better capitalised banks are seen as less risky in the financial market and therefore they may more easily raise external funds in order to meet new loan demands or deposit withdrawals. Consequently, the expected sign of these two variables is negative. However, in the case of liquidity variable, this theoretical rationale may not apply due to the structural surplus liquidity of the Macedonian banking system that may bias the results.

The non-performing loans (NPL) ratio is a proxy variable for the credit risk exposure of the banks and their risk averse behaviour (Angbazo, 1997). According to the mark-up pricing theory, those banks with higher credit risk exposure, in order to compensate for the lost income of borrowers’ default, are expected to charge higher lending rates and to set-up higher interest margins compared to banks with lower credit risk exposure (Rousseas, 1985 and Ho and Saunders, 1981). Thus, those banks, till
certain threshold level of NPLs, are expected to increase their lending rates proportionately more than the “cost of funds” rate in order to compensate for the lost income of borrowers’ default. This implies a positive sign of the coefficient. However, after a certain threshold level of NPLs, the banks may instead decide to ration credit and adjust their lending rates less fully to changes in the “cost of funds” rate due to their higher intolerance of incurring additional risks caused by the adverse selection and moral hazard problems (Stiglitz and Weiss, 1981). In the opposite case, when the “cost of funds” rate decreases, those banks with higher NPL ratio are expected to reduce their lending rates proportionally less in order to maintain their higher interest rate margins. Consequently, the theory of Stiglitz and Weiss (1981) predicts a negative sign of the coefficient.

The maturity-mismatch variable indicates the maturity gap between long-term loans and long-term deposits and is taken as a proxy variable for the interest rate risk that banks face and the stability of financing the long-term loans (Allen, 1988; Angbazo, 1997; Weth, 2002 and Sorensen and Werner, 2006). In other words, this variable seeks to measure what proportion of long-term loans is financed by long-term deposits and thus, the extent of interest rate risk exposure of banks on the money market. More precisely, when the maturity-mismatch ratio is low, it implies that a higher proportion of long-term loans is financed by long-term deposits, making banks less dependent on money market borrowing and hence, less sensitive to changes in the “cost of funds” rate and vice versa (Ho and Saunders, 1981). In the case of Macedonia, the stability of long-term loans is additionally secured by subordinated deposits that foreign owned banks obtain from their parent banks from abroad and/or long-term deposits that the rest of the banks borrow from other foreign banks or companies. Thus, in this study this variable is modified by including the subordinated deposits. The expected sign of this variable is positive.

The ratio of long-term loans over total loans, as suggested by Berger and Udell (1992) and Weth (2002), is an indicator of the relationship lending activities between the bank and its borrowers. The rationale for including this variable, according to the relationship lending theory (Boot, 2000 and Weth, 2002), is that when the bank is more engaged in relationship lending activities with its borrowers, then the higher will be the interest rate smoothing. Accordingly, when the proportion of long-term loans is higher relative to total loans, then it is considered that the bank has more long-term commitments with its borrowers and the reverse. In this way the bank can more closely monitor the borrowers and obtain more proprietary information and thus, smooth the interest rates. Therefore, the sign of this variable is expected to be negative.

The ratio of operating costs to total costs is a used as a proxy measure for banks’ operational efficiency. Namely, operating costs such as staff costs and other administrative costs, according to mark-up pricing theory, are considered as a relatively
rigid part of banks’ total costs that do not vary much with the level of lending activities (Rousseas, 1985). Hence, when the operating costs are lower, it implies that the bank has higher operational efficiency and can more easily pass-through the “cost of funds” changes to its lending rates. Therefore, the sign of this variable is expected to be negative. Regarding the case of Macedonia, some banks were formerly state-owned and privatised during the transition period, while others were established as greenfield banks, both groups of banks have different starting points in their management efficiency. For example, the former had to employ more educated workers and to fire under-educated workers due to the inherited over-employment that was typical of the former regime. In contrast, the greenfield banks did not have to go through the transformation process and have directly employed appropriately skilled workers exactly as much as they needed. Accordingly, this indicator for the operational efficiency for both types of banks may differ and may indicate different processes which may bias the results.

The ratio of non-interest income to gross income indicates the degree of portfolio diversification of the bank. Accordingly, it indicates that banks that have a higher share of non-interest income to total income “...do not only rely on traditional banking activities such as granting loans and taking deposits...” (Sorensen and Werner, 2006). Thus, those banks have more diversified portfolio structure and are engaged in other activities in the financial market, perhaps including: insurance, investment banking and/or activities on the foreign and stock exchange markets. This implies that those banks are less dependent on the money market borrowing, leading them to smooth the interest rates over the business cycles (Sorensen and Werner, 2006 and de Graeve et al., 2004). Moreover, high inflation indicates higher perceived risk for the overall macroeconomic environment, which is likely to induce banks to adjust their retail rates faster and more fully to changes in “cost of funds” rate. Hence, this variable is expected to enter with a negative sign.

The rate of growth of industrial production index (IPI) and the level of inflation are included as macroeconomic control variables. Inflation is included in the model to control for the price changes in the economy. Because the interest rate series are in nominal terms, then including inflation in the model should indicate the extent of nominal indexing of interest rates to changes in the price level and how this indexing affects the pass-through adjustment. For example, in high inflationary environments it is expected that banks will adjust their retail rates more frequently and thus, more “easily” to pass-through the changes in the “cost of funds” rate to their borrowers, compared to periods with stable and relatively low inflation (Cottarelli and Kourelis, 1994; Mojjon, 2000 and Egert et al., 2006). This variable is expected to enter with a positive sign.

The rate of growth of IPI is included as a control variable for the economic cycles and the level of loan demand in the economy. The rationale for including this variable is
that in periods of economic growth when the loan demand rises, it will be easier for the banks to pass-through the changes in the “cost of funds” rate to their lending rates (Egert et al., 2006). Moreover, this variable may also indicate the level of overall risk faced by the banks. When the economic growth is relatively high households’ income is likely to be increasing and firms are likely to have higher profitability and hence banks may perceive a better financial environment with a lower risk of borrowers’ default. Therefore, they may more easily pass-through the “cost of funds” rate changes. The expected sign of this variable is positive. However, in the case of Macedonia, economic growth and IPI as the proxy measure were severely affected by the transition process and this loan demand control variable may also be capturing other factors related to the process of transition. For example, loan demand may be affected by the political instability and financial instability in the country, especially in the initial period of transition which was characterised by banking failure, with another failure of saving houses in a later period. Therefore, the sign and size of this variable should be interpreted with caution.

The inclusion of the variables measuring the overall level of concentration in the banking sector is to give an estimate of the effect of banks’ market power on the size of the pass-through adjustment. According to the mark-up pricing theory, banks operate in non-perfect competitive environment with entry and exit barriers and thus, exhibit some degree of market power (Rousseas, 1985 and Ho and Saunders, 1981). Consequently, in more concentrated markets, where banks have some market power, they are able to charge non-competitive prices (interest rates) in order to maximise their profit. Consequently, the banks are expected to adjust their retail rates more sluggishly to changes in the “cost of funds” rate, indicating to a negative sign of the coefficient. These theoretical predictions of the mark-up pricing theory, where market power of the banks is taken to be exogenous, are according to the structure-conduct-performance hypothesis (CSP). In contrast, the predictions of market-efficiency (ME) hypothesis by Demsetz (1973) refer to an inverse relationship between market concentration and the pass-through adjustment. More specifically, this theory assumes that firm’s efficiency is exogenous. Consequently, more efficient banks in the loan market set their lending rates according to money market conditions and adjust their lending rates more fully to the changes in the “cost of funds” rate in order to acquire a higher share of the market. This implies to a positive sign of the coefficient. In measuring the level of concentration in the banking sector, as it is usual in the literature, we have decided to use the Hirschman-Herfindhal index (HHI).

In the literature it is also argued that a non-linear relationship between market concentration and pricing may exist, i.e. a “V” shaped behaviour. Namely, firms in concentrated markets may charge higher monopoly prices, but after a certain threshold
level of concentration, due to the threat of new entrants in the market, firms may start charging more competitive prices in order to maintain their market share (Cottarelli and Kourelis, 1994). In order to control for this possible effect, we have included squared value of the concentration index, whose coefficient is expected to be positive.

Table 12 Expected sign of each of the parameters of the model 3

<table>
<thead>
<tr>
<th>Variable:</th>
<th>Expected Sign</th>
<th>Variable:</th>
<th>Expected Sign</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Cost of funds&quot; rate</td>
<td>+</td>
<td>Operational efficiency</td>
<td>-</td>
</tr>
<tr>
<td>Bank size</td>
<td>+ / -</td>
<td>Portfolio diversification</td>
<td>-</td>
</tr>
<tr>
<td>Liquidity</td>
<td>-</td>
<td>Inflation</td>
<td>+</td>
</tr>
<tr>
<td>Capital</td>
<td>-</td>
<td>Economic growth</td>
<td>+</td>
</tr>
<tr>
<td>NPL ratio</td>
<td>+ / -</td>
<td>HHI</td>
<td>- /+</td>
</tr>
<tr>
<td>Maturity-mismatch</td>
<td>+</td>
<td>(HHI)^2</td>
<td>+</td>
</tr>
<tr>
<td>Relationship lending</td>
<td>-</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. Estimation Method

The selection of the estimation method is primarily done in order to fulfil the aims and objectives outlined in section 1 and to enable us to empirically test if the theoretical expectations derived in the previous section hold in the case of the Macedonian banking sector. We have also taken into account the specific nature of the data and the cross-sectional units.

Given the aims and objectives of this paper, we needed to select a method that is able to estimate the determinants of banks’ short-run retail rate adjustment to changes in the “cost of funds” rate. We also had to select a method that enables different slope coefficient estimates for each cross-sectional unit and that will allow us to test if those coefficients statistically differ between the units. We aim to test for this, although the existing literature does not currently provide a clear answer about this issue, nevertheless as mentioned in section 3, we have some arguments on a-priori basis why the slope coefficients might be statistically different among the units.

According to the assessment of the applicability of the various estimation methods in the empirical studies, the specific nature of the data series and the phenomenon of contemporaneous correlation among the banks, we have selected Zellner’s (1962 and 1963) Seemingly Unrelated Regression (SUR) model. The rationale for selecting this model is based upon several reasons. Firstly, in the case when there is contemporaneous correlation among the disturbances that are by nature heteroskedastic, then the SUR model based on a Feasible Generalised Least Squares (FGLS) estimator provides more efficient estimates compared to OLS, by using the information of the variance-covariance matrix of the error terms. Secondly, it is designed for samples with large time dimension
(T) and small or finite cross sectional dimension (N) where one of the major requirements is T to be substantially greater than N, which is the case with our data (T=96; N=15). *Thirdly*, it may estimate different slope coefficients for each cross-sectional unit that allows testing for their cross-sectional equality.

Nonetheless, the SUR model has some limitations and requires certain assumptions to be fulfilled. The main assumptions are the exogeneity of the regressors and a normal distribution of the residuals, mainly for the Maximum Likelihood Estimator (MLE). In respect of the exogeneity assumption, the strongest form is the strict exogeneity assumption where all regressors from each equation are uncorrelated with the respective equation’s error terms for all time periods:

$$E = (u_t | x_1, x_2, x_3... x_j) = 0$$

(4)

However, Wooldridge (2002) argues that this assumption may be relaxed by assuming a contemporaneous exogeneity, i.e. no correlation between the regressors and the error terms in the same time period, presented below:

$$E = (u_t | x_j) = 0$$

(5)

5. DATA ISSUES

The data period ranges from 2001:M1 to 2008:M12 and we have 96 monthly observations per bank. The reason for restricting the time period is because before 2001 the interest rate series for each bank were not available. The restriction to the end of 2008 is because at the beginning of 2009 a new accounting methodology was applied which distorts comparisons with the rest of the data series used in this analysis.

Throughout the sample period we work with a balanced panel comprising 15 banks that have been operating continuously over the sample period. The SUR model is conducted on balanced panel data; although there are some recent developments in SUR methods for unbalanced data, these are still in the process of development.

The sample has been adjusted for mergers and acquisitions. The adjustment of banks’ balance sheet items has been done by backward aggregation of the data series before the merger or acquisition occurred. Although this is the most commonly used approach in the literature (Ehrrmann et al., 2001; Gambacorta, 2005, b and Benkovskis, 2008) and no other approach appears preferable, we have to be aware that this may bias the data because changes in the management of the merged bank and any gained know-how are not controlled for.

Regarding the adjustment of interest rate series, in the case of merger we aggregate the data backwards as a weighted average of the value of the stock of loans and the respective interest rate of both entities. In doing this we have assumed, in the case of merger, that the management of both entities has also been merged and no single entity’s retail rate setting strategy is taken as a dominant one. This may be problematic in that
after the merger the new entity may apply a completely different price setting strategy. Nevertheless, due to the relatively small cross-sectional sample and the need to work with balanced panel data, we think that this is the “second” best solution. In the case of acquisition, we have kept the lending rates of the acquiring bank before the acquisition has occurred, instead of backward aggregating the series as in the case of mergers. We argue that after the acquisition has occurred, the acquiring bank is likely to have maintained its previous retail rate setting strategy and has not changed or adopted the strategy of the acquired bank.

All variables in the model are expressed in nominal terms, except for the industrial production index which is in real terms. Some of the balance sheet items such as total assets, total loans, long-term loans, gross deposits and liquidity have been seasonally adjusted by using the census X-12 additive method.

In examining the determinants of banks’ lending rate rigidity, we use the interest rates series on banks’ outstanding loans for each bank separately. Regarding the currency structure, we use an interest rate series denominated in denars. Regarding the sectoral structure, the interest rate series include both sectors: corporate and household. Another limitation of the interest rate series is that they include all types of loans, no matter their purpose because disaggregated data according to the type of the loan by purpose are not available.

Detailed description of each data series is presented in Table 13

6. RESULTS

The estimation strategy goes from a general (unrestricted) model as presented with equation 3, to a more specific version in order to select the most parsimonious model. The aim of this specification search was to capture better the determinants of cross-sectional variation in the pass-through adjustment of lending rates among Macedonian. In order to select the most parsimonious model we have performed a number of preliminary regressions.

Starting from the most general model, given the theoretical arguments previously discussed, we have obtained the following results:

Regarding the variable that controls for the possible non-linear relationship between the level of concentration and the pricing behaviour of the banks, i.e. the squared value of the Hirschman-Herfindahl Index (dmbkshhi2) it was is jointly insignificant at 5% level of significance27.

27 The results are available from the author upon request.
<table>
<thead>
<tr>
<th>Variable:</th>
<th>Description:</th>
<th>Value:</th>
<th>Source:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lending rate</td>
<td>Weighted average monthly loan rates for each bank separately</td>
<td>In %, annualised</td>
<td>NBRM</td>
</tr>
<tr>
<td>&quot;Cost of funds&quot; rate</td>
<td>Weighted average MBKS rate</td>
<td>In %, annualised</td>
<td>NBRM</td>
</tr>
<tr>
<td>Bank size</td>
<td>Log of total assets</td>
<td>Nominal</td>
<td>NBRM</td>
</tr>
<tr>
<td>Liquidity</td>
<td>Ratio of liquid over total assets. Liquid assets include: cash in vault at the NBRM, short term deposits in accounts in banks abroad, CB bills and treasury bills with maturity up to 1 year, cash in vaults in domestic banks, short term restricted deposits in accounts in domestic banks, short term loans granted to domestic financial institutions (banks and saving houses).</td>
<td>Nominal</td>
<td>NBRM</td>
</tr>
<tr>
<td>Capital</td>
<td>Ratio of equity plus reserves to total assets.</td>
<td>Nominal</td>
<td>NBRM</td>
</tr>
<tr>
<td>Credit risk exposure</td>
<td>Ratio of NPL to total loans.</td>
<td>Nominal</td>
<td>NBRM</td>
</tr>
<tr>
<td>Maturity-mismatch</td>
<td>Ratio of long-term loans to long-term deposits and subordinated deposits.</td>
<td>Nominal</td>
<td>NBRM</td>
</tr>
<tr>
<td>Relationship lending</td>
<td>Ratio of long-term loans to total loans.</td>
<td>Nominal</td>
<td>NBRM</td>
</tr>
<tr>
<td>Operational efficiency</td>
<td>Ratio of administrative costs to total costs.</td>
<td>Nominal</td>
<td>NBRM</td>
</tr>
<tr>
<td>Portfolio diversification</td>
<td>Ratio of non-interest income to gross income.</td>
<td>Nominal</td>
<td>NBRM</td>
</tr>
<tr>
<td>Price changes</td>
<td>Annual rate of inflation, measured by CPI.</td>
<td>In %</td>
<td>SSO</td>
</tr>
<tr>
<td>Economic growth</td>
<td>Annual rate of growth of IPI.</td>
<td>In %</td>
<td>SSO</td>
</tr>
<tr>
<td>Market concentration</td>
<td>Log of HFI and (HFI)^2</td>
<td>Index</td>
<td>Author's own calc: upon the data from NBRM</td>
</tr>
</tbody>
</table>

Source: NBRM and SSO.

Given the theoretical rationale for inclusion of this variable (explained in section 3), and the fact that the average loan market share of the three largest banks during the sample period was around 65%, we decided to include it only for the three largest banks in the sample. The reason for doing this is because we think that the three largest banks may be price leaders. However, this variable was again jointly insignificant for all the three of them at the 5% level of significance. A possible explanation for the insignificant impact of the squared concentration index variable is on the basis that the threat of probable entry of outside competitors in the Macedonian banking sector is not considered as a serious factor in setting the lending rates. Namely, there are still relatively high entry barriers in this market, i.e. relatively high entry and exit costs, despite the change in the banking law in June 2007. For example, new entrants into the banking sector have to fulfill strict regulatory requirements as well as deposit relatively high funds at the central bank.

Another variable with a questionable theoretical rationale for inclusion in the model given the specific nature of the Macedonian banking system, is the operational

28 *idem*
29 For more details see Official Gazette of the Republic of Macedonia No. 67/2007.
efficiency variable (see section 3). By performing an F-test for the joint significance of this variable, the results pointed that it is jointly insignificant at 5% level of significance\textsuperscript{30}. Thus, we decided to exclude this variable from the model and proceed with a more parsimonious specification. This solution was based on two arguments. Firstly, the economic rationale presented in section 3, which implies that this variable may not be expected to significantly affect the size of the pass-through adjustment in the case of the Macedonian banking sectors. Secondly, this omission was due to statistical reasons given the joint insignificance of this variable.

The results from the final model specification are presented in Table 14 and Table 15, which indicate that the model can significantly explain the pass-through variations in lending rates for almost all 15 banks in the sample. The results for the overall significance of the bank-specific equations, apart from the equations for banks 7 and 10, indicate that they are statistically significant at 10% level of significance (see Table 14). To double check if the model is correctly specified, we have performed an F-test for the joint significance of each independent variable in each cross-sectional equation. The results indicated that all regressors in the model are jointly significant at 5% level of significance (see Table 15).

In order to examine if there is some efficiency gain from employing the SUR method, we performed the Breusch-Pagan test that tests if the contemporaneous covariance between the error terms from each equation is equal to zero. The results indicated that at 1% level of significance we can reject the null hypothesis of zero contemporaneous covariance between the residuals from each equation, implying that there is indeed some efficiency gain from employing the SUR method\textsuperscript{31}.

6.1. Interpretation of the Results

To assessment of the size of the pass-through adjustment of lending rates to changes in the money market rate, as explained in section 3, has been done by first order differentiation in respect of the change in the money market rate (dmbks), and evaluated at the mean value of the rest of the variables over the sample period. As presented in Table 14, there are large differences in the size of the estimated pass-through adjustment of lending rates to changes in the money market rate between banks.

As expected, for almost all banks, except for banks 7 and 14, the pass-through coefficient is positive and below 1. The pass-through coefficient is negative and statistically insignificant for bank 7, implying that the current model specification cannot explain the price setting behaviour of this bank. For bank 14, the pass-through coefficient

\textsuperscript{30} The results are available from the author upon request.

\textsuperscript{31} The results of the Breusch-Pagan test of independence are as follows: chi2(105) = 305.253, P-value: = 0.0000. The correlation matrix of the residuals is available from the author upon request.
is negative again but statistically significant. This may be partially explained by the specific history of this bank. For the rest of the banks, the size of the pass-through coefficient ranges from 0.02 (bank 1) to 0.39 (bank 9). The pass-through coefficient can be interpreted as a one percentage point increase in the money market rate in the previous month, leads on average from a 2 up to 40 basis points increase in the lending rates in the current month on a ceteris paribus basis, given the mean value of the rest of the variables.

Table 14 Size of the pass-through adjustment of lending rates for each bank separately

<table>
<thead>
<tr>
<th>Bank</th>
<th>DMBKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.02***</td>
</tr>
<tr>
<td>2</td>
<td>0.10***</td>
</tr>
<tr>
<td>3</td>
<td>0.11*</td>
</tr>
<tr>
<td>5</td>
<td>0.33***</td>
</tr>
<tr>
<td>6</td>
<td>0.13***</td>
</tr>
<tr>
<td>7</td>
<td>-0.15</td>
</tr>
<tr>
<td>8</td>
<td>0.19***</td>
</tr>
<tr>
<td>9</td>
<td>0.39***</td>
</tr>
<tr>
<td>10</td>
<td>0.03</td>
</tr>
<tr>
<td>11</td>
<td>0.07*</td>
</tr>
<tr>
<td>12</td>
<td>0.17***</td>
</tr>
<tr>
<td>13</td>
<td>0.09*</td>
</tr>
<tr>
<td>14</td>
<td>-0.35***</td>
</tr>
<tr>
<td>16</td>
<td>0.20***</td>
</tr>
<tr>
<td>27</td>
<td>0.09***</td>
</tr>
</tbody>
</table>

Source: Author’s own calculations.

Regarding the rest of the variables included, i.e. the balance sheet items, macroeconomic control variables and the banking concentration index variable, as already discussed in section 3, we can only interpret their sign and statistical significance directly, given that these are interaction terms. From Table 14 and Table 15, it can be noticed that there is a huge variation of the significance and sign of the same variables among the banks. This implies that the same variables do not have equal importance or even the same direction of impact on the pass-through adjustment process of the lending rates. In other words, these results support our hypothesis of aggregation bias in the literature, which has mainly used aggregated data (see section 2).

---

32 The details for this bank are not provided in order not to reveal the anonymity of the data due to their confidentiality.

33 Further details about each individual bank are not provided in order not to reveal the anonymity of the data due to their confidentiality.
Table 15 Estimated signs of the rest of the independent variables in the model presented for each bank separately and the F-test for their joint significance

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>Assets</th>
<th>Liquidity</th>
<th>Capital</th>
<th>NPLratio</th>
<th>Mat-mismatch</th>
<th>Rel. lending</th>
<th>Portfolio</th>
<th>Inflation</th>
<th>IPI</th>
<th>HII</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bank 1</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Bank 2</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Bank 3</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Bank 4</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Bank 5</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Bank 6</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Bank 7</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Bank 8</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Bank 9</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Bank 10</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Bank 11</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Bank 12</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Bank 13</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Bank 14</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Bank 15</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Bank 16</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Bank 17</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

F-stat for joint significance of the variable: 6.91***  4.80***  5.36***  5.42***  4.47***  2.99***  1.87***  3.76***  2.61***  3.55***

*** p<0.01, ** p<0.05, * p<0.1

Source: Author's own calculations.

The results in Table 14 imply to a lack of synchronisation of the pass-through adjustment process among various banks in the Macedonian economy. Moreover, the results in Table 15 indicate that the relationship between the size of the pass-through adjustment and the rest of the coefficients in the model differs considerably to the extent that their sign is not consistent among the cross-sectional units. This confronts the results of most of the literature that explores the determinants of the pass-through adjustment in various economies around the world by using aggregated data set (see section 2). Namely, in using aggregated data banks’ heterogeneous behaviour, their different decision-making processes and price-setting strategies are suppressed. This may also be the case with the studies that explore the size and speed of pass-through adjustment in Macedonia (Jovanovski et al., 2005 and Velickovski, 2006) that are again based on aggregate data and do not taking into account for heterogeneous behaviour.

One of the possible reasons for banks’ heterogeneous behaviour in the case Macedonia may be due to the transition process not affecting all banks equally. Namely, the bank balance sheet structure of various banks may have undergone a long-run adjustment process in order to reach some optimum level and/or structure in order to maximise their utility. For instance, those banks that were formerly state owned and were privatised, had different starting grounds compared to greenfield banks. More precisely, the state owned banks may have been overcapitalised, had relatively high NPL ratio and/or had insufficient liquid assets due to the policy of soft budget constraints. Hence, by the process of privatisation those banks may have had to adjust their balance sheet...
items in order to maximise their rate of return. Another possible explanation for their heterogeneous behaviour, as mentioned in section 3, is that divergent movements in their balance sheet structures may have been affected differently by changes in the regulatory requirements. These above results, indicating aggregation bias, are in line with the results of de Graeve et al. (2004) for the case of Belgium (see section 2).

This heterogeneity among banks’ behaviour can be examined in more detail if we analyse the impact (the sign) of each variable (see Table 15). For example, asset size has a positive impact on the size of the pass-through adjustment at 8 banks, consistent with the “menu costs theory”. In contrast, for the rest of the banks, asset size has a negative impact which is in line the bank lending channel theory.

A similar different impact can be noticed for the rest of the balance sheet items. For example, the NPL ratio has a positive impact on the size of the pass-through adjustment in 10 banks in the sample, which is consistent with the mark-up pricing theory. These banks may have attempted to compensate for the lost income due to the borrowers’ default by adjusting their lending rates more closely to the “cost of funds” rate. However, for the rest of the sample banks, this variable has a negative impact on the size of the pass-through adjustment, which is line with the theory of asymmetric information and lending rate stickiness. In other words, these banks have probably reached some threshold level of NPLs in their portfolio structure so they do not adjust their lending rates closely to the “cost of funds” rate in order not to attract additionally risky borrowers.

The maturity-mismatch variable, indicating the interest rate risk that banks face, affects positively the size of the pass-through adjustment at 12 banks which supports the theoretical expectations. More precisely, those banks that have lower coverage of their long-term loans with long-term deposits, are forced to borrow more frequently on the money market and thus, to adjust their lending rates more fully to changes in the “cost of funds” rate.

The similar conclusions for the banks’ heterogeneous behaviour can be drawn if we assess the impact of the two macroeconomic control variables and the concentration index variable. For instance, inflation is estimated to have a positive impact at 4 banks, whereas its impact is negative for the rest. The different impact of price changes on the size of the pass-through adjustment may be explained by the various forward looking approaches that banks have in their lending rate adjustment. For instance, some banks may have perceived a stable inflation in the future and decided not to fully pass-through the “cost of funds” rate changes to their lending rates, while others have perceived the reverse.

The concentration index variable (HHI), has a negative impact on the size of the pass-through adjustment at 8 banks which is consistent with the predictions of the mark-
up pricing model for the non-perfect competitive pricing environment. Namely, these banks use their market power and hence, by not adjusting fully their lending rates to changes in the money market rate they extract higher monopoly profits. For the rest of the banks, this variable has a contrary impact, which may imply that those banks are adjusting their lending rates more fully to changes in the money market rate in order to get higher market share.

6.2. Robustness Check

A robustness check of the existing model has been undertaken in the following two ways. First, as mentioned in section 4, when after a sufficient number of iterations in estimating the coefficients and their variances for each cross-sectional unit converge; then the FGLS estimator equals the MLE. Hence, in this way we compare if the estimates already reported in section 6 estimated by FGLS estimator are in line with the ones calculated by MLE. However, as discussed in Green (2008), whether MLE provides some efficiency gains in small samples is uncertain. Second, if any of the system equations is miss-specified, then all coefficients in each equation will be inconsistently estimated. Therefore, for a consistency check, it is argued that the results should be compared with the ones estimated with the OLS conducted on equation-by-equation (Moon and Perron 2006).

For the first type of robustness check, i.e. estimating the model with MLE, we can summarise that the estimates are very similar to the ones obtained by FGLS estimator. The overall significance of the equations for each bank separately as well as the individual and joint significance of each regressor in the model in the MLE estimation are very similar to the ones estimated by FGLS estimator. Regarding the estimated size of the pass-through coefficients they are again quite alike with the ones reported in Table 14. The main difference appears with bank10, where the size of the pass-through adjustment is now estimated to be negative. However, the pass-through adjustment for this bank is statistically insignificant, as it was the case with the FGLS estimator. Regarding the signs of the rest of the coefficients in the model, they are broadly in line with the estimates obtained by FGLS estimator.

According to the second type of robustness check, i.e. OLS equation-by-equation, the estimates in respect of their size and sign are generally in line with those of the FGLS estimator. More precisely, the estimated size of the pass-through coefficient for each bank individually is similar to the ones obtained by FGLS estimator. An exception is bank3 where now the size of the pass-through coefficient is estimated to be higher at 0.24. Regarding the estimated sign of the rest of the coefficients, they are similar to the

34 The results discussed in this section have not been reported due to the length limitation. They are available from the author upon request.
ones previously discussed in section 6.1. The efficiency gain by employing the SUR model can be noticed if we compare the standard errors of both types of estimators, i.e. SUR with FGLS estimator and OLS equation-by-equation. According to the results, the standard errors estimated by the SUR model are lower than the ones estimated by OLS equation-by-equation, implying to some efficiency gain by employing the SUR model.

7. CONCLUSIONS

The aims of this paper were to explore the short-run variations in the size of the pass-through adjustment of lending rates to "changes in the cost of funds" rate among banks in Macedonia as well as to investigate what factors affect their different lending rate setting behaviour. In other words, this paper attempted to investigate what determines banks' short-run heterogeneous lending rate setting behaviour. For this purpose we have used a set of up to eight bank balance sheet items, two macroeconomic control factors and a banking concentration index variable.

In order to fulfill the aims, we tried to tackle some of the weaknesses found in the existing empirical literature for Macedonia as well as part of the literature for the developed economies and CSEE. More precisely, all of the studies conducted for the Macedonian banking system as well as part of the studies for CSEE and developed economies are based on aggregate data that may suffer from aggregation bias (see section 2). Another drawback in the empirical literature is that majority of the studies conducted for both for the CSEE and developed economies that use bank-level data (see section 2), do not control for contemporaneous cross-sectional correlation among the disturbances.

Accordingly, in this paper we attempted to deal with the problem of aggregation bias by using disaggregated bank-level data set. In order to consider the contemporaneous cross-sectional correlation among the disturbances we have applied the SUR model. Moreover, we have used disaggregated bank-level lending rates denominated in domestic currency only.

The main findings of this paper are that in the short run, various banks adjust their lending rates differently to changes in the "cost of funds" rate. This can be concluded from the estimated size of the pass-through adjustment coefficients that are considerably different between the banks. Another finding of this paper is that various factors including bank-specific characteristics, macroeconomic control variables and the banking concentration index variable affect the lending rate setting behaviour of banks differently. Both of these findings support the hypothesis of aggregation bias in the literature. The robustness of these results has been checked by using different estimation methods; SUR estimated with MLE and simple OLS equation-by-equation.

Overall, the presented empirical findings in this paper indicate that the size of the short-run pass-through adjustment of lending rates to changes in the "cost of funds" rate
is incomplete and heterogeneous among the Macedonian banks. Moreover, it is estimated that various factors may affect differently banks’ lending rate setting decisions. These findings indicate that the short-run pass-through adjustment process among banks in Macedonia lacks synchronisation. This may imply that the interest rate channel may still not have an important role in the monetary transmission.

Appendix 1

**Figure 22** Figures of 1st differences of the loan interest rates of the Macedonian banks for the period 2001-2008

Source: author’s own calculation based upon the data from NBRM.
REFERENCES
35. Velickovski, I., 2006. Monetary transmission through the interest rate channel and the financial markets in Macedonia: what have we done, what have we achieved and what have we learned?. National Bank of the Republic of Macedonia Working Paper 17.