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Abstract

This paper examines the pass-through from the market interest to the rate charged on bank loans using aggregate data for the U.K. Thereby, we explicitly disentangle credit supply and demand and allow the interest rate charged on loans to depend on the volume of loans. We find that, although banks adjust the lending rate to some extent, they largely accommodate shifts in demand. Overall, our results are consistent with the idea that banks provide insurance against liquidity shocks.

Keywords: Interest Rate Pass-Through, Relationship Banking

JEL codes: E43, G21

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1 Introduction

Retail interest rates on bank loans are important determinants of the borrowing conditions in most economies (Borio and Fritz, 1995). Consequently, these rates are highly relevant for the determination of aggregate demand and business cycle fluctuations.

The dynamics of retail interest rates have been analyzed empirically in numerous studies (see e.g. Cottarelli and Kourelis, 1994; Mojon, 2000; Sander and Kleimeier, 2004; De Bondt, 2005; Kleimeier and Sander, 2006; Égert et al., 2007). In these studies, results have been presented on both the speed and the extent of the interest rate pass-through from shocks in short-term money market interest rates onto, for example, the rates that banks charge on loans to their customers. The empirical specifications typically used have three characteristics that we will pick up here. First, the focus is on how banks set retail rates, that is, the supply side of the market for bank loans. Nevertheless, retail rates are likely to be influenced also by demand conditions. To ensure that it is the price-setting behavior of banks that is described, proper procedures for disentangling supply and demand are called for.

Second, prices and quantities are determined simultaneously in the credit market. Related to the supply side, for example, asymmetric information problems may give rise to both price and quantity adjustment after a change in money market rates (including the possibility of credit rationing as put forward by Stiglitz and Weiss, 1981). The single-equation models commonly applied neglect quantity adjustment and focus only on prices.

Third, and closely connected, banks are presumed to set lending rates by simply adding a fixed mark-up over marginal cost.[1] With respect to a system of supply and demand in the credit market, it follows that the loan supply curve is assumed to be horizontal (flat), which implicitly means that banks provide any amount of credit

[1] Marginal cost is mainly represented by policy or money market rates. Covariates that are not interest rates rarely appear in the estimated equations. Angeloni and Ehrmann (2003, 483) argue that such sparse empirical specifications are justified by the empirical literature suggesting "that the main determinant of bank pricing is a simple markup on those market interest rates that are closely controlled by monetary policy". In a second stage, however, several studies seek to explain the cross-country variation in pass-through estimates (Cottarelli and Kourelis, 1994; Borio and Fritz, 1995; Mojon, 2000; Sander and Kleimeier, 2004).

demanded at the prevalent lending rate.

In this paper, we add to the existing literature by explicitly distinguishing between supply and demand effects in the determination of retail rates. More specifically, we explicitly control for factors which may influence the demand for loans. Consequently, we are able to identify the loan supply curve which is, in turn, more general than the equations typically estimated in the literature on the interest rate pass-through process.

The focus of the analysis is on data for bank lending to private non-financial firms in the U.K. for the period from 1999 to 2007. One reason for the United Kingdom being suited for our analysis is that the U.K. is the largest European banking market with an independent monetary policy. Second, as the characteristics of the financial system matter for the transmission process of monetary policy (Kashyap and Stein, 1997; Cecchetti, 1999), we chose the U.K. as a country which is not exceedingly likely to fulfill the preconditions for a flat loan supply curve. British firms do not have close ties with banks (as it is the case, for instance, in Germany), so relationship lending is generally not important (see HM Treasury, 2003, 28). In principle, this could mean that the therefore increased potential of asymmetric information problems rather give rise to credit market frictions in which both the conditions on and the quantity of also bank finance vary with changes in the net worth of (potential) borrowers.[2]

Our results indicate that, although there is some evidence that banks extend the supply loans only at higher rates, overall, the supply function for corporate loans in the U.K. is relatively flat. Thus it seems that the British banking sector accommodates variations in the demand for loans to a large extent or, in other words, if firms face liquidity shortages, banks typically provide the necessary funds without significant adjustments in the lending rate charged.[3]

[2]Chrystal and Mizen (2002) analyze the monetary transmission mechanism in the U.K. and argue in favor of credit effects, which is in line with the view that credit market frictions matter. De Bondt (1999), however, does not find evidence for a credit channel. See HM Treasury (2003, 49) for a survey of related literature for the U.K.

[3]Baumann et al. (2005), who examine the relations between alternative forms of corporate debt financing in the U.K., argue that in case of certain shocks in the market for corporate bonds (in case the corporate bond spread rises), banks extend credit to corporates at largely unchanged interest rates. They interpret this in a sense that firms face a relatively flat loan supply schedule in the short term.

We also find that banks do not fully pass on changes in market interest rates to lending rates. This result is in line with the extensive empirical literature documenting that bank lending rates adjust sluggishly to impulses in market rates.[4] Several explanations have been proposed for this empirically well-documented fact. Limited interest rate pass-through (at least in the short run) may arise due to adjustment costs (see e.g. Hannan and Berger, 1991; Hofmann and Mizen, 2004) or as a consequence of credit rationing (see e.g. Winker, 1999). Berger and Udell (1992) propose an alternative explanation which holds that limited interest rate transmission may be the outcome of implicit risk-sharing arrangements between banks and their customers. The idea is that, by keeping borrowing costs relatively stable, banks insure borrowers against interest rate risks and associated liquidity shocks. Thus, together with our result concerning the accommodation of demand shocks, it appears that U.K. banks (at least partly) shield their customers from liquidity shocks as well as from fluctuations in market interest rates.

The paper is structured as follows. In Section 2, we discuss the empirical model which is basis for our analysis. Section 3 describes the data and the estimation method which are applied. Results are presented and discussed in Section 4, Section 5 summarizes and concludes.

2 Empirical Setup

Our empirical analysis is based on a standard interest rate pass-through equation. De Bondt (2005), for instance, starts from the assumption that lending rates are set by banks using a markup over marginal cost. To the extent that a money market rate proxies the marginal cost of holding reserves, we obtain

$$R_t = \alpha + \gamma R_t^m, \tag{1}$$

where R_t is the lending rate in period t and R_t^m is the money market rate. De Bondt (2005) argues that the coefficient γ depends, among other things, on the degree of competition in the banking sector.

[4] Significant adjustment lags are reported for the U.K. e.g. by Heffernan (1997).

Since Equation (1) is not sufficient to capture the dynamics of the lending rate, empirical pass-through equations are typically augmented by lags of both interest rates. Additionally, as interest rates are likely to be found non-stationary, first differences of the time series are taken to yield

$$\Delta R_t = \alpha + \sum_{i=1}^{k} \beta_i \Delta R_{t-i} + \sum_{i=0}^{l} \gamma_i \Delta R^m_{t-i}. \tag{2}$$

If the long-run effect of a change in the market on the lending rate is less than unity, banks partly absorb market rate fluctuations without passing them on to their borrowers. According to Berger and Udell (1992), such a result is consistent with the interpretation that banks provide implicit insurance against shocks to market interest rates. Note that Equation (2) essentially is a loan supply function stating that banks supply any amount of credit demanded at rate R_t.[5] In other words, a standard assumption in the empirical literature estimating interest rate pass-through equations is that the supply of bank credit is infinitely elastic at the set interest rate since the quantity of loans neither appears in (1) nor in (2). Thus, the banking sector is presumed to absorb liquidity shocks related to the quantity of loans demanded. The accommodation of loan demand results in a flat loan supply curve which, in combination with a limited interest rate pass-through, implies that banks do not just absorb parts of the impulses in market interest rates, but also shocks to the demand for loans.

Intuitively, suppose that the economy is hit a liquidity shock in the sense that borrowers need additional funds. As long as the money market rate is not affected by this shock, then the interest rate on loans does not change and according to (1), banks fully accommodate this increase in the demand for loans at the prevailing lending rate.

Clearly, this need not be the case. It is certainly conceivable that the supply of bank credit depends on the interest rate. Arguments for a reverse relation - a higher lending rate due to higher credit volumes - are also apparent. On the one hand, the banks' marginal financing cost, and therefore the cost of making out additional loans, may be increasing in the amount of outstanding credit. Alternatively, higher loan volumes outstanding may imply that banks face a higher risk of default and that they therefore

[5]Equation (2) can be derived from a supply function specified in levels.

may only be willing to grant additional loans at a higher rate.

In this paper, we relax the assumption of an infinitely elastic supply of loans. To do so, we augment Equation (2) by a measure of loan quantity, denoted by Q_t. We also add the (balance sheet) capital ratio, C_t, as the literature typically argues that bank capitalization should be an important determinant of loan supply (see Gambacorta, 2008, for a detailed discussion).[6] Taking first differences of the interest rate series, we obtain

$$\Delta R_t = \alpha + \sum_{i=1}^{k} \beta_i \Delta R_{t-i} + \sum_{i=0}^{l} \gamma_i \Delta R^m_{t-i} + \sum_{i=0}^{m} \eta_i Q_{t-i} + \sum_{i=0}^{n} \delta_i C_{t-i}. \quad (3)$$

To address the potential endogeneity of the credit volume in Equation (3), we instrument Q_t with economic activity, A_t, and the inflation rate, π_t, so that

$$Q_t = \alpha + \sum_{i=1}^{o} \beta_i Q_{t-i} + \sum_{i=0}^{p} \gamma_i A_{t-i} + \sum_{i=0}^{q} \delta_i \pi_{t-i} + \sum_{i=0}^{s} \eta_i \Delta R_{t-i} \quad (4)$$

emerges as a loan demand relation which can also serve as the first stage in the instrumentation procedure. That is, we fully specify a system of equations to disentangle supply and demand in the credit market. A proper specification and estimation, in this regard, makes it possible not only to avoid endogeneity bias of the estimates, but also ensures that the pass-through equation (3) is indeed identified and, consequently, can be interpreted as an inverse loan supply function.

3 Data and Empirical Methodology

To estimate Equations (2) and (3), data for the period from January 1999 to December 2007 is used (data sources are given in Appendix A). The lending rate applied is the interest rate on outstanding sterling loans to non-financial enterprises, the rate of discount on three-month Treasury bills represents the market rate. Outstanding sterling loans to non-financial enterprises[7] and the ratio of balance sheet capital to the

[6] Gambacorta (2008) also discusses a direct effect on the lending rate based on the bank capital channel of monetary policy transmission. Moreover, bank capitalization has a prominent role in the research on the determinants of bank profitability as a measure of banks' risk aversion or bankruptcy risk (Demirgüç-Kunt and Huizinga, 1999; Demirgüç-Kunt et al., 2004; Maudos and Fernández de Guevara, 2004).

[7] As the loans outstanding with Monetary Financial Institutions (MFI) is available only, there is no perfect match between the volume of credit and the lending rate (which applies, as the capital

total assets of the banking sector represent the additional variables in the pass-through equation. The inflation rate is the percent increase of consumer prices (the 'all-items' Consumer Price Indicator) relative to the same month of the previous year.

Since the volume of loans is hardly correlated with aggregate measures of monthly industrial production, retail sales or unemployment rates, economic activity is represented by indicators from business tendency surveys. The future tendency of production in manufacturing and the composite confidence indicator for the construction sector[8] emerge as the most suitable indicators in this respect.

Results from standard unit root tests (ADF, DF-GLS and KPSS) indicate that all variables are integrated of order one in levels (interest rates, outstanding loans, capital and consumer prices) apart from the activity indicators which are level-stationary. In the following, the interest rates therefore appear in first differences, whereas the other variables are transformed into ratios (the ratio of capital in total assets) and growth rates (growth rates of prices and loan volumes).

Our empirical procedure starts with the estimation of Equation (2) to yield a standard long-run pass-through estimate.[9] Then, the system of supply and demand made up by Equations (3) and (4) is estimated by Three-Stage Least Squares (3SLS). From both equations of the system, insignificant lags (the initial maximum number of lags was set to six, the number of lags is allowed to differ across variables) are sequentially removed. The resulting demand equation determines the lag structures used with instrumenting the growth rate of loans in the pass-through equation (the growth rate of the volume of credit in Equation (3) is instrumented by economic activity and inflation), which is estimated by Two-Stage Least Squares (2SLS) and Limited Information Maximum Likelihood (LIML), respectively, in the following.

A set of statistical tests can be performed on the (inverse) loan supply equation afterwards. Among these are, besides heteroscedasticity and serial correlation, a test of the exogeneity of the growth rate of loans and tests on the validity of the instruments

ratio does also, for all U.K. banks). On average, the total assets of MFI make up 84 % of the banking sector's assets over the sample period.

[8]Both are percent balances of positive and negative answers.

[9]The number of lags is selected via the Schwarz information criterion (a lag reduction procedure based on t tests would yield the same result).

used (to assure that the estimates can be expected being consistent). Finally, we test both estimated equations (the standard as well as the augmented pass-through relation) for the presence of threshold effects, including asymmetry of the interest rate pass-through.

4 Results

The first set of results is presented in Table 1. Model 0 is the standard pass-through equation with the change in the lending rate as the dependent variable and estimated by OLS. All lags as well as the contemporaneous term of the change in the T-bill rate are statistically significant at the 5 % level. The long-run pass-through estimate can be calculated as 0.85. Neither serial correlation nor heteroscedasticity are present in the error structure of the model.

The results for the pass-through equation augmented by the bank capital ratio and the growth rate of loans are shown under the header of Model 1. Again, no problems associated with both heteroscedasticity and serial correlation arise.[10] Model 1 uses fewer observations as relatively longer lag structures are being used in instrumenting the loans growth rate. The R-squared increases slightly, the estimate for the long-run pass-through of the monetary policy rate is reduced to 0.80.

Both the contemporaneous as well as the lagged capital ratio are significant at the 5 % level, the sum of the coefficients is slightly negative. The contemporaneous growth rate of loans is instrumented by the fourth lag of the indicator of future production tendency in manufacturing, lags 2, 3 and 6 of the composite confidence indicator for construction, as well as the contemporaneous inflation rate and the first lag of it.[11]

One necessary condition for instrument validity is that they are exogenous (not correlated with the error term). The standard Sargan test of the null hypothesis of exogenous instruments (overidentification) does not reject the null for Model 1. However, instruments should also be relevant. Table 1 provides the R-squared of the

[10] The hypotheses of homoscedasticity and no serial correlation are tested by use of the IV-specific statistics of Pagan and Hall (1983) and Cumby and Huizinga (1992), respectively.

[11] Other lags or contemporaneous values of the instruments being insignificant in the first stage of the instrumentation procedure were excluded to mitigate the weak instruments problem.

above-mentioned instruments in the first stage of being 0.34 and a corresponding F test suggests that they are higly significant. This is supported by the conclusion from the underidentification test of Cragg and Donald (1993). For a further examination of instrument strength, also the weak identification test based on the statistic of Cragg and Donald (1993) is applied, using the critical values derived in Stock and Yogo (2005).[12] When using 2SLS, the value for this F statistic is not satisfactorily high with respect to the critical values related to bias and size distortions. We therefore estimate by LIML which is to be preferred over 2SLS in terms of bias and also tests are more robust to weak instruments (Stock and Yogo, 2005). According to the associated critical values (being at most 4.45), the null hypothesis of weak instruments is rejected with our value of 7.55 for the test statistic.

With instruments ensured to be both exogenous and relevant, it can be observed from the results in Table 1 that both the contemporaneous and lagged growth rate of loans is statistically insignificant at the 5 % level. Consequently, there seems to be no relation between the change in the lending rate and loan supply growth and, in terms of the interpretation proposed above, it appears that the loan supply relation is indeed flat. Thus, our results indicate that banks accommodate fluctuations in the demand for loans and, in this sense, insure borrowers against liquidity shocks.

Note that the endogeneity test[13], however, suggests that the loans growth rate can be treated as being exogenous in the pass-through equation. As a consequence, OLS results (as 2SLS results do, neither of them are reported here) hardly differ from the ones obtained by LIML in Table 1 in terms of the magnitude of coefficients, but also with respect to statistical significance.[14]

The robustness of the results presented so far is evaluated with respect to possible thresholds in Equations (2) and (3). By use of the test of Hansen (2000) for a threshold

[12]Even if the correlations between the endogenous variables and the proposed instruments are non-zero, they may be 'too small' (Baum et al., 2007), with adverse consequences for consistency and inference (see Stock and Yogo, 2005). This is called the 'weak instruments problem'. Removing insignificant lags from the instrument set improves the weak identification test statistic while, of course, the partial R-squared of the instruments in question deteriorates.

[13]In case of estimation by LIML, a suitable test is based on a Difference-in-Sargan statistic (C statistic or GMM distance), which, under conditional homoscedasticity, is equivalent to a Hausman test (Baum et al., 2007).

[14]This also applies to the results presented in Table 2.

break in Equation (2) with respect to the change in the T-bill rate, we obtain an (F) test statistic of 1.97, with an associated p-value based on 1000 bootstrap replications of 0.57. A similar result emerges for Equation (3), although the respective p-value is much lower.[15] The pass-through from the T-bill rate to the bank interest rate on lending to non-financial enterprises therefore can be presumed symmetric in the U.K.

Apart from searching a threshold break related to pass-through asymmetry the possibility of a break with respect to different interest rate *levels* also was evaluated for the augmented pass-through equation. This is deduced from the notion that the credit market clearing (and therefore the pass-through process) may work differently in times of low or high rates, which is closely connected to the possible appearance of credit rationing, at least in the short run. When using the level of the lending rate as threshold variable, the test leads to a rejection of the null of no threshold (the F statistic is 3.16, with a p-value of 0.03). The level of the lending rate associated with the break is 5.77. In our sample, lending rate values above this threshold, however, are the rule rather than the exception (only between 2003:2 and 2004:3 the interest rate on loans to non-financial enterprises is below 5.77).

The implications of a break in Equation (3) associated with different states of the lending rate are evaluated as follows. An indicator variable I taking on the value one if the lending rate is above the threshold of 5.77 and zero otherwise was interacted with the change of the T-bill rate in the way shown in the first part of Table 2 (Model 2). Furthermore, also the loans growth terms were interacted with the indicator I to yield

$$\Delta R_t = \alpha + \sum_{i=1}^{k} \beta_i \Delta R_{t-i} + \sum_{i=0}^{l} \gamma_i \Delta R^m_{t-i} + \sum_{i=0}^{l} \theta_i \Delta R^m_{t-i} I_{t-i} + \sum_{i=0}^{m} \delta_i C_{t-i} + \sum_{i=0}^{n} \eta_i Q_{t-i} + \sum_{i=0}^{n} \phi_i Q_{t-i} I_{t-i}, \quad (5)$$

which also was estimated within the empirical framework used above as Model 3 (see the second part of Table 2). With both these altered pass-through equations, test

[15] Although there also is a threshold test with IV regression (Caner and Hansen, 2004), the above-mentioned test is applied to an OLS regression as results do hardly differ between 2SLS and OLS (see the remarks on endogeneity of the growth rate of loans in the pass-through equation). The associated test statistic is 2.79 with a p-value of 0.07. The grid search conducted by the test procedure deliveres a most likely threshold with a change in the T-bill rate of 0.05. In a corresponding interactive regression model, however, no statistically significant deviation from pass-through symmetry can be detected.

results on model specification and instrument quality are hardly different from those for Model 1. The long-run pass-through estimate is 0.61 for State 1 (the lending rate is below 5.77) and 0.84 in State 2, with the difference being due to the interaction term of lag 2 whose coefficient is significantly different from zero. The interest rate pass-through seems to be somewhat more complete in times of relatively high lending rates. By an F test, the two estimates for the long-run pass-through, however, are not found different at conventional significance levels (the corresponding test delivers a p-value of 0.22 for both models).

Concerning the results from Model 3, there is a significantly positive lagged effect of loans growth in State 1.[16] However, this hardly results in a positively sloped loan supply relation because, as argued above, State 1 is not very representative for the sample. With State 2 (taking the negative interaction term into account), the effect is not significantly different from zero. The test on whether the sum of the coefficients on the lagged growth rate of loans and the threshold interaction term has a p-value of 0.21. All in all, these additional results confirm our previous conclusion that the supply curve for loans is essentially flat.

It seems noticeable that, qualitatively, the same results emerge in a standard vector autoregression (VAR, with one lag, chosen by use of the Schwarz information criterion) setting with considering cointegration (by use of the standard Johansen procedure) between the interest rates and (the logs of) loans, bank capital, as well as the price level. The corresponding pass-through equation in error-correction form, however, is not affected by any of the threshold breaks examined.

5 Summary and Concluding Remarks

In this paper, we explore empirically how lending rates are set in the U.K. banking sector and what can be concluded concerning loan supply and banks' reactions to changes in the demand for loans. In line with the existing literature, we find that

[16]Note that in Model 3 there is no contemporaneous interaction term with I and the growth rate of loans as, if it would be included (whether instrumented or not), identification would emerge to be weak. The respective test in this case would fail because the same set of instruments is used for nearly equal endogenous variables, or it would detect that one of the instruments - the contemporaneous interaction term - is almost identical to the presumed endogenous variable.

changes in money market rates are only partially passed through to lending rates. This result is consistent with the interpretation that banks provide implicit insurance against interest rate fluctuations.

In addition, the estimation of a pass-through relation that can be interpreted as an inverse credit supply function reveals that the latter is indeed flat in the U.K. example. Consequently, our results suggest that banks also accommodate fluctuations in the demand for loans to a large extent and that they insure their customers also against liquidity shortages. Hence, there is additional evidence provided for banking relationships giving rise to contracts with implicit insurance elements.

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A Data Description

The lending rate is the monthly average of U.K. resident banks' sterling weighted average interest rate on loans to private non-financial corporations (in percent, nsa). Source: Bank of England (code: CFMHSDC).

The monetary policy stance is measured by the monthly average rate of discount on three-month Treasury bills (in percent, nsa). Source: Bank of England (code: IUMAAJNB).

The volume of credit is represented by the monthly amounts outstanding of MFI's sterling loans to private non-financial corporations (sterling millions, nsa). Source: Bank of England (code: LPMVWMQ).

Balance sheet capital of the banking sector ('capital and other internal funds', sterling millions, nsa) comes from the National Statistic's 'Bank Balance Sheets' (codes: TBGA and TBGT). From the same source (codes: TBGB and TBGU), the total liabilities of the banking sector (sterling millions, nsa) were extracted to be used to calculate the capital ratio.

Real activity is measured by the indicator of future production tendency from the business tendency surveys related to manufacturing (% balance, sa) and the construction-related composite confidence indicator (% balance, sa). Source: OECD Main Economic Indicators.

The consumer price index 'CPI all items' (2005=100, nsa) is used to calculate the inflation rate. Source: National Statistics (code: D7BT).

B Tables

Table 1: Pass-Through or (Inverse) Supply Equation I

This table reports the results from the benchmark pass-through equation (Model 0, estimated by OLS) as well as for the augmented pass-through relation (Model 1, estimated by LIML). The latter is interpreted as an inverse loan supply equation. The contemporaneous growth rate of loans is instrumented by economic activity and inflation. Data for the U.K. for the period from 1999:01 to 2007:12 are applied with both models. The p-values for the t test on non-significance are given in parentheses. Two asterisks indicate statistical significance at the 5 % level. Heteroscedasticity is tested by the White test with Model 0 and the Pagan-Hall test with Model 1. Durbin's alternative statistic is used to test for AR(1) serial correlation of the errors of Model 0, the Cumby-Huizinga test is applied with Model 1.

Dependent variable: Change in the lending rate	Model 0	Model 1
Δ Lending rate$_{t-1}$	-0.127	-0.126
	(0.19)	(0.19)
Δ Treasury bill rate$_t$	0.246 **	0.216 **
	(0.00)	(0.00)
Δ Treasury bill rate$_{t-1}$	0.320 **	0.352 **
	(0.00)	(0.00)
Δ Treasury bill rate$_{t-2}$	0.175 **	0.162 **
	(0.02)	(0.02)
Δ Treasury bill rate$_{t-3}$	0.215 **	0.173 **
	(0.00)	(0.09)
Capital ratio$_t$		0.079 **
		(0.00)
Capital ratio$_{t-1}$		-0.097 **
		(0.00)
Growth rate of loans$_t$		0.009
		(0.39)
Growth rate of loans$_{t-1}$		-0.003
		(0.53)
Long-run pass-through estimate	0.85	0.80
Number of observations	105	102
Centered R-squared	0.63	0.67
Heteroscedasticity test (p-value)	0.98	0.61
AR(1) test (p-value)	0.37	0.29
Endogeneity test (Difference-in-Sargan, p-value)		0.25
Overidentification test (Sargan, p-value)		0.45
Underidentification test (Cragg-Donald, p-value)		0.00
Weak identification test (Cragg-Donald, F statistic)		7.55
Test of excluded instruments (1st stage, p-value)		0.00
Partial R^2 of excluded instruments (1st stage)		0.34

Table 2: Pass-Through or (Inverse) Supply Equation II

This table reports the results from two models estimated (by LIML) for robustness purposes. The p-values for the t test on non-significance are given in parentheses. Two asterisks indicate statistical significance at the 5 % level.

Dependent variable: Change in the lending rate	Model 2	Model 3
Δ Lending rate$_{t-1}$	-0.140	-0.086
	(0.16)	(0.38)
Δ Treasury bill rate$_t$	0.363 **	0.329 **
	(0.01)	(0.00)
Δ Treasury bill rate$_{t-1}$	0.341 **	0.297 **
	(0.02)	(0.03)
Δ Treasury bill rate$_{t-2}$	-0.110	-0.084
	(0.43)	(0.53)
Δ Treasury bill rate$_{t-3}$	0.100	0.119
	(0.45)	(0.36)
Capital ratio$_t$	0.077 **	0.069 **
	(0.00)	(0.01)
Capital ratio$_{t-1}$	-0.093 **	-0.088 **
	(0.00)	(0.00)
Growth rate of loans$_t$	0.006	0.005
	(0.56)	(0.57)
Growth rate of loans$_{t-1}$	-0.004	0.045 **
	(0.00)	(0.02)
Δ Treasury bill rate$_t \cdot I_t$	-0.170	-0.126
	(0.24)	(0.38)
Δ Treasury bill rate$_{t-1} \cdot I_{t-1}$	0.007	0.025
	(0.96)	(0.87)
Δ Treasury bill rate$_{t-2} \cdot I_{t-2}$	0.338 **	0.301 **
	(0.03)	(0.04)
Δ Treasury bill rate$_{t-3} \cdot I_{t-3}$	0.089	0.049
	(0.56)	(0.74)
Growth rate of loans$_{t-1} \cdot I_{t-1}$		-0.051 **
		(0.01)
Long-run pass-through estimate (State 1)	0.61	0.61
Long-run pass-through estimate (State 2)	0.84	0.84
Number of observations	102	102
Centered R-squared	0.70	0.72
Heteroscedasticity test (Pagan-Hall, p-value)	0.50	0.94
AR(1) test (Cumby-Huizinga, p-value)	0.28	0.18
Endogeneity test (Difference-in-Sargan, p-value)	0.36	0.49
Overidentification test (Sargan, p-value)	0.56	0.58
Underidentification test (Cragg-Donald, p-value)	0.00	0.00
Weak identification test (Cragg-Donald, F statistic)	7.60	7.72
Test of excluded instruments (1st stage, p-value)	0.00	0.00
Partial R^2 of excluded instruments (1st stage)	0.35	0.36