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Financial Structure, Bank Lending Rates, and the Transmission Mechanism of Monetary Policy

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The stickiness of bank lending rates with respect to money market rates is often regarded as an obstacle to the smooth transmission of monetary policy impulses. Yet, no systematic measure of the different degree of lending rate stickiness across countries has been attempted. This paper provides such a measure. It also relates the different degree of lending rate stickiness to structural features of the financial system, such as the existence of barriers to competition, the degree of development of financial markets, and the ownership structure of the banking system. Thus, the paper provides further evidence on the relationship between structural financial policies and monetary policy, as well as on the relevance of credit markets for the monetary policy transmission mechanism. The role of administered discount rates in speeding up the adjustment of lending rates is also discussed. [JEL: E43, E44, E52, E58]

THE EFFECTIVENESS of monetary policy hinges on a set of crucial structural parameters—not directly controlled by central banks—that reflect economic agents' reactions to policy impulses from money

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markets. These structural parameters (such as the elasticities of the demand and supply of financial and real assets to money market interest rates) are affected by the structure of the financial system, that is, the existence and degree of development of financial markets, the degree of competition in these markets, and the availability of foreign sources of finance. While economic theory has recognized this relation,[1] empirical evidence on the subject has mainly focused on the effect of structural changes in financial markets on the demand for money (for example, Tseng and Corker (1991)). An aspect that has been almost completely disregarded[2] is the relation between financial structure and the *speed* of the monetary policy transmission process. This paper takes up this issue by focusing on how the financial structure affects the degree of stickiness of bank lending rates, that is, the speed at which bank lending rates adjust to their long-run equilibrium value after a "shock" affecting money market rates.

Recent economic literature has stressed that banks are not neutral "conveyors" of monetary policy impulses (Bernanke and Blinder (1988), Bernanke and Gertler (1989), Bernanke (1993)). Consider, for example, a monetary policy tightening reflected in an increase in money market rates. Such a tightening may fail to contain aggregate demand or exchange rate pressures if financial intermediaries do not promptly adjust their lending rates.[3] The reaction of financial intermediaries is, of course, more important in developing countries, where the direct financial channels between primary lenders and borrowers are limited, but it is far from irrelevant in industrial countries. It is, for example, notable that between January and September 1992, when most European central banks were striving to defend the exchange rate mechanism (ERM) parities by raising money market rates, the differential between money market and bank lending rates increased substantially (by 100 basis points in Sweden and the United Kingdom, 200 basis points in Denmark and Italy, and over 300 basis points in Finland and Norway). This suggests that lending rates did not fully adjust to the changes in money market rates.

To analyze the relation between bank lending rate stickiness and finan-

[1] See, for example, Modigliani and Papademos (1980), Vanhoose (1985), Kareken (1984), and Faig-Aumalle (1987)).

[2] An exception is Pelzman (1969).

[3] It could be argued that the behavior of the lending rate becomes less important if the demand for bank deposits is sufficiently elastic. An increase in treasury bill rates will move deposits out of the banking system, thus affecting aggregate demand through the availability of credit, rather than through its cost. This argument, however, disregards the fact that in many countries banks have a large buffer of government paper that can be sold to counter the effect of deposit changes (Rodrigues (1993)).

cial structure, we follow a simple approach. First, we measure the speed of adjustment of bank lending rates in 31 industrial and developing countries, by regressing the lending rate on a distributed lag of money market rates. This way, we estimate the effect on lending rates of shocks in money market rates, the so-called "multipliers," when the shock occurs, after three months, after six months, and in the long run. Second, we explain the cross-country differences in these multipliers by regressing them on several variables related to the structure of the financial system, such as the degree of concentration in the banking industry, the existence of constraints on capital flows and barriers to entry, and the size and the efficiency of the money market.[4] We also examine the role of administratively set discount rates as instruments that "signal" changes in the stance of monetary policy, and their relation to bank lending rate stickiness.

The paper is organized as follows. Section I discusses several channels through which the financial structure can affect the stickiness of lending rates. Section II presents the model used in the empirical analysis and discusses some econometric problems related to its estimation. Section III summarizes the results of the time series regressions used to measure the degree of stickiness of bank lending rates, while Section IV presents estimates of the cross-section equation explaining the differences in the degree of stickiness. Finally, Section V summarizes the main findings of the paper and draws some policy conclusions.

I. The Stickiness of Bank Lending Rates and the Financial Structure

Definition of Lending Rate Stickiness

The term "interest rate stickiness" has taken on two related, but distinct, meanings in the banking industry. First, it has been used to indicate that bank rates are relatively inelastic with respect to shifts in the demand for bank loans and deposits. Second, it has been used to mean that, in the presence of a change of money market rates, bank rates change by a smaller amount in the short run (short-run stickiness), and possibly also

[4] Thus, this paper is clearly related to the "bank structure-performance" literature (see Heggestad (1979) and Gilbert (1984) for surveys, and Short (1979) for a cross-country analysis). However, this literature has focused on the relation between financial structure and the *level* of bank rates or bank rate differentials. While the level is important for the efficient allocation of resources, the dynamic properties of the lending rate are more relevant for the transmission mechanism of monetary policy.

in the long run (long-run stickiness). In this paper we will refer mainly to the second definition. More specifically, we will focus on the reasons for the existence of "short-term" stickiness, an aspect that we will show to be empirically more relevant than its "long-run" equivalent.[5]

Money market rates will be defined as rates on short-term financial instruments that are not administratively controlled by the central bank. We focus on these rates, rather than on administered short-term rates (such as discount rates), because market-determined rates are less likely to be subject to different forms of "attrition" (for example, political pressures) that can delay their adjustment (see also Section II).

The Relevance of the Financial Structure

The term "financial structure" will be used fairly broadly to include such features as the degree of development of money and financial markets; the degree of competition within the banking system, and between banks and other intermediaries (as affected by both the regulatory environment and the number and size of intermediaries); the existence of constraints on capital movements; and the ownership structure of the financial intermediaries.

The relation between these features and bank lending rate stickiness can be explained in four different, albeit related, ways.

Adjustment Costs and the Elasticity of the Demand for Loans

The banking industry, like any industry, faces adjustment costs when prices (that is, interest rates) change. The degree to which these costs delay the adjustment of lending rates to changes in money market rates depends on the elasticity of the demand for bank loans, which, in turn, depends on the structure of the financial system.

This argument has been formalized by Hannan and Berger (1991), on the assumption that the bank loan market is characterized by monopolistic competition, that is, each bank faces a downward-sloping demand curve for its loans. In this case, a profit-maximizing bank that does not face adjustment costs will always set the lending rate at the point where the marginal revenue on loans is equal to an exogenously given money market interest rate (Klein (1971)). Thus, the lending rate would follow money market rates without delay.[6] In the presence of fixed adjustment

[5] As will be shown, in most countries lending rates tend to adjust almost fully to money market rate changes in the long run.

[6] However, in the monopolistic competition model, the change in the lending rate is not necessarily equal to the change in the money market rate (see Cottarelli and Kourelis (1994), p. 5).

costs, however, the lending rate will change only if those costs are lower than the costs of maintaining a nonequilibrium rate.

If the demand for loans is linear, the costs of preserving a nonequilibrium rate are equal to $0.25g(\Delta m)^2$, where Δm is the change in the money market rate and g is the derivative of the demand for loans with respect to the lending rate (Hannan and Berger (1989)). This means that the greater the elasticity of demand for loans, the higher the cost of keeping lending rates out of equilibrium. If we introduce a time dimension, the above argument implies that a bank will prefer not to change its lending rates if the discounted flow of lost profits arising from a nonequilibirum position exceeds the fixed costs of changing those rates.

In incomplete financial markets, demand elasticity is likely to be lower in the short run than in the long run because, in the long run, even in thin financial markets there are alternative sources of finance to bank loans. But the difference between the short- and long-run elasticities explains why lending rates are stickier in the short run. If, in fact, the elasticity of demand increases over time, the cost of being outside the equilibrium in each period and the discounted value of the stream of lost profits also rises over time. A bank will decide to raise lending rates only when that present value exceeds the fixed costs involved in changing them; if the elasticity of demand is lower in the short run, the adjustment will be delayed.

Thus, the relation between lending rate stickiness and financial structure is straightforward, as the financial structure clearly influences the elasticity of demand for loans. The demand for loans of each bank is less elastic in markets that have fewer competitors, higher barriers to entry, or no alternative finance sources (such as other financial intermediaries, foreign capital markets, commercial paper, or bankers' acceptances markets). In such markets, lending rates may show a limited response to changes in money market rates in the short run.

Adjustment Costs and Uncertainty about Future Money Market Changes

In the presence of adjustment costs, banks will not adjust their lending rates if they perceive that the changes in money market rates are only temporary. The uncertainty regarding the nature of money market fluctuations provides an additional link between lending rate stickiness and financial structure. Interest rate movements in insufficiently liquid money markets will be characterized by a strong random component and will not adequately transmit monetary policy impulses, as policy signals will be lost in the noise of random movements. As a result, the adjustment of lending rates will be slower.

Non-Profit-Maximizing Behavior

The conclusion that bank lending rates adjust promptly to changes in money market rates is based on the hypothesis that banks maximize profit. However, there may be financial structure conditions under which this hypothesis does not hold. This may be the case, for example, in banking systems dominated by state-owned banks, in which lending rate adjustments may be delayed due to political pressures or simple inefficiency. In general, banks will react more promptly to changes in money market conditions if non-profit-maximizing behavior is penalized by market forces. If market forces are weak (for example, because of barriers to entry, absence of competition from nonbank intermediaries, or constraints on international capital movements), inefficiency will not be penalized, which may result in lending rate stickiness.

Oligopolistic Competition Models

Price stickiness has often been considered a feature of oligopolistic markets, because of the unpredictable response of oligopolistic competitors to price changes, and/or the fact that oligopolistic collusion may break down when prices are changed. While there is not a monotonic relation between the degree of stickiness and the concentration of the banking industry, some stickiness when the market deviates from perfect competition, at least until a clear market leader emerges, can be explained by this feature. It can also be argued that, in oligopolistic markets, the stickiness can be reduced if the central bank acts as a market leader by *signaling* changes in the stance of monetary policy through changes in an administered discount rate, as the latter reduce the uncertainty about competitors' responses. This argument has been used to explain the strong empirical relation between the discount rate and bank lending rates observed in many countries.

II. The Empirical Model

Model Presentation

In order to analyze the relation between lending rate stickiness and financial structure, a measure of the degree of stickiness in various countries is necessary. To obtain such a measure, we begin with the following dynamic model for the lending rate:

$$i_{i,t} = \beta_{i,0} + \beta_{i,1} i_{i,t-1} + \beta_{i,2} m_{i,t} + \cdots + \beta_{i,n+2} m_{i,t-n} + \beta_{i,n+2+1} \Delta d_{i,t} + \cdots + \beta_{i,n+3+j} \Delta d_{i,t-j} + u_{i,t}, \tag{1}$$

where $i_{i,t}$, $m_{i,t}$ and $d_{i,t}$ are, respectively, the lending rate, the money market rate, and the discount rate for country i at time t. The index i ranges from 1 to M, where M is the number of countries included in the sample, while the time index t ranges from 1 to T_i.[7] The first difference operator is signified by Δ, $u_{i,t}$ is an error term, and the β_is are parameters whose values vary across countries. Equation (1) reflects a fairly common approach to the modeling of the lending rate. Its steady state form (omitting the error term) is:

$$i_i = \beta_0/(1 - \beta_1) + [(\beta_2 + \cdots + \beta_{n+2})/(1 - \beta_1)]m, \tag{2}$$

which is consistent with the monopolistic competition model relating the loan rate to the money market rate (that is, to the exogenously given marginal yield of alternative bank assets, or to the marginal cost of funds). The fact that no other variable is assumed to affect the lending rate in the long run is of course a simplification. In a monopolistic competition model of the banking market, the lending rate should also be influenced by shifts in the demand for loans, as well as by changes in the perceived riskiness of loans. These variables were omitted in order to keep the estimated model sufficiently concise. The possible omission of some variables explains why the error term in equation (1) cannot be assumed to be serially uncorrelated. We do assume, however, that $u_{i,t}$ is uncorrelated across countries.[8]

The dynamic specification reflects a partial adjustment model in which, along with the lagged dependent variable, the current and several of the lagged values of the money market rate are included. In addition, a polynomial distributed lag of the *change* in the discount rate is also included. This reflects the hypothesis, discussed in Section I, that changes in the discount rate speed up the adjustment of lending rates, with no effect on their long-run equilibrium value.

Given the cross-country differences in the βs in (1), lending rates will show a different degree of stickiness in response to shocks in money market rates. The following procedure was followed to derive summary measures of the degree of stickiness. From equation (1) we derived sets of "multipliers" reflecting the adjustment of the lending rate during the period when the money market rate changes (impact multipliers), and at

[7] Notice that the sample period varies across countries (see Section III).

[8] This, of course, does not mean that the interest rates are uncorrelated across countries, but, rather, that the cross-country correlation of interest rates is transmitted through money market rates.

different time lags (interim multipliers). These multipliers are, in general, deterministic *nonlinear* functions of the βs:

$$h_{i,\ell} = \phi(\beta_i), \tag{3}$$

where $h_{i,\ell}$ is the value of the multiplier for country i after ℓ periods; $\phi(.)$ is a nonlinear function (see Appendix); and β_i is a vector of estimated coefficients for country i. We assume that the value taken by the multipliers depends on the structural features of the financial system:

$$h_{i,\ell} = Z_i\gamma_\ell + v_{i,\ell}, \tag{4}$$

where Z_i is a K-element vector describing the financial structure of economy i and $v_{i,\ell}$ is an error term uncorrelated across countries. In matrix form equation (4) can be written, for different lags, as:

$$h_0 = Z\gamma_0 + v_0; \tag{5}$$

. . . .

$$h_\ell = Z\gamma_\ell + v_\ell; \text{ and} \tag{6}$$

. . . .

$$h_L = Z\gamma_L + v_L, \tag{7}$$

where h_0 is a vector of impact multipliers ($\ell = 0$); h_ℓ is a vector of "interim" multipliers reflecting the adjustment of the lending rate after ℓ periods; and h_L is a vector of long-term multipliers reflecting the total adjustment of lending rates (all these vectors have M elements). Z is an $(M \times K)$ matrix of structural variables, and the v vectors are $(M \times 1)$ vectors of homoscedastic residuals, which are assumed to be independently distributed not only across countries, but also across time lags.

The main focus of this paper is the estimation of the γ vectors describing the relation between the structural variables and the h multipliers, that is, our measure of lending rate stickiness. A two-step estimation process was followed. In the first step (Section III), equation (1) was estimated for 31 countries. Then, by filtering the estimated β vectors through equation (3), an estimate for the h vectors was derived. In the second step (Section IV), the estimated vectors were regressed against the structural variables included in Z.

Discussion of the Model

Before moving to the next section, some of the features of the above empirical model must be discussed.

Definition of the Multipliers

The multipliers defined above refer to the effect of a change in the money market rate *for a given discount rate*. We focus on these multipliers because the stickiness of bank lending rates emerges more clearly in the absence of discount rate changes. Indeed, as argued above, oligopolies are expected to respond fairly quickly to changes in the discount rate.

It could be argued that, from a policy perspective, the reaction of lending rates to both money market and discount rates should be examined, since they are both controlled by the monetary authorities. However, the discount rate is often not a market rate, but is set administratively. Unfortunately, administered rates may themselves show a high degree of stickiness, as they may be subject to more direct political pressures, and often require complex administrative procedures. Thus, a transmission mechanism centered on discount rate changes may be less effective than a transmission mechanism relying only on money market changes—hence the need to assess the stickiness of lending rates in the absence of changes in the discount rate.

The Relation Between the β Coefficients and the h Multipliers

In the above model, the multipliers h, rather than the β coefficients, are modeled as a linear function of the structural variables Z, because as discussed in Section I, there is a relation between the structural variables and the size of the adjustment at different lags, which is measured by h. One could be tempted to assume a direct relation between the β*s* and the Z matrix but this would be inappropriate. Consider, for example, the following distributed lag model (the i subscript is omitted, for simplicity):

$$i_t = \beta_0 + \beta_2 m_t + \beta_3 m_{t-1} + \beta_4 m_{t-2} + u_t. \quad (8)$$

Suppose that the β coefficients had been modeled directly as a linear function of the variable included in Z; for example:

$$\beta_3 = Z\phi + \chi. \quad (9)$$

Based on the discussion in Section I, we expect that an increase in, say, variable z_k will lead to a faster adjustment, that is, to a larger multiplier after two periods. This requires a larger sum $\beta_2 + \beta_3$ with respect to other countries but it does not constrain the value, or even the sign of the coefficient of z_k in equation (9). An increase in z_k may lead to a decrease or an increase in β_3, depending on whether β_2 increases by more or less than $\beta_2 + \beta_3$. Since z_k affects the sum of two coefficients, we cannot infer the effect of z_k on one of the two.

The Dynamic Specification of the Model and the Two-Step Estimation Procedure

The relation between the β coefficients and the *h* multipliers is, as noted above, nonlinear, because of the inclusion of the lagged dependent variable in equation (1). If equation (1) did not include the lagged dependent variable, equation (3) would be linear. In this case, by substituting (3) into (1), the lending rate could be expressed as a function that, while nonlinear in the variables, would be linear in the parameters, and could be estimated directly. A two-step estimation process would not be necessary.

The adopted specification is preferable for two reasons. First, a dynamic specification including the lagged dependent variable is typically more parsimonious than the one based on distributed lags. Second, and more important, even if the relation between lending rates and structural variables were linear in the parameters, its direct estimation would be extremely cumbersome. In fact, each structural variable would appear, on the right-hand side, multiplied by several lags of the money market rate and the discount rate. Thus, for example, with 10 structural variables and 12 lags for the money market and the discount rates, there would be as many as 240 regressors, characterized by a high degree of collinearity. This would make any serious specification search virtually impossible.

Relation between Multipliers at Different Lags

The parameters γ in equations (5)–(7) are not independent across equations. This is intuitive because all the γs at different lags (for an arbitrarily long lag length) are a function of a limited number of the β parameters in (1). However, the relation between the γs cannot be easily exploited to improve the efficiency of the estimation, because it involves not simple linear constraints on the γs but nonlinear constraints on linear combinations of the γs (see Appendix). Therefore, the existence of these constraints will be ignored in the second step of the estimation process.

h Multipliers are Not Observed but Estimated

If the *h* multipliers were directly measured, the ordinary-least-squares (OLS) estimates of equations (5)–(7) would be unbiased and efficient. However, the *h* multipliers are estimated from equation (1). Therefore, in order to estimate the γ vectors efficiently, equations (5)–(7) must be estimated after adjusting for heteroscedasticity, that is, through weighted least squares (Saxonhouse (1976), (1977), Cottarelli and Kourelis (1994)).

The use of weighted least squares requires estimating the variance of the elements of the *h* vectors. Such an estimate can be derived easily for

the impact multiplier $h_0 = \beta_0$ (whose variance is estimated directly from equation (1)), but is more problematic for the interim multipliers, since they are nonlinear functions of the β coefficients. Consequently, the discussion in Section IV will focus mainly on the impact multipliers, that is, on the estimation of equation (5).

Nonlinear Relation between h and Z

Equations (5)–(7) postulate a linear relation between the multipliers h and the structural variables Z. One problem with this assumption is that for certain values of the Z variables, the multipliers could become negative (implying that the lending rate declines when money market rates are raised). The standard solution to this problem would be to impose a nonlinear relation between h and Z, so that for any value of Z, h would always remain positive. A simple way of doing so is to assume that the relation between h and Z is described by a logistic function:

$$h = c/[1 + \exp(-Z\gamma)]. \tag{10}$$

This way h would be constrained between 0 and c (a fixed parameter). By taking lags, equation (10) could be linearized:

$$\log(c/h - 1) = -Z\gamma \tag{11}$$

This approach would not be problematic if h were observed, but, as it is not, the error term would enter equations (5)–(7) in a nonlinear fashion. The original linear formulation was therefore maintained. As will be shown, this does not seem to create problems in the estimation of equation (5), as all fitted values remained positive.

III. Step One: Analysis of Stickiness

The Data

Having laid out the scheme of the empirical model, we can proceed to its estimation. The estimation of equation (1) for different countries requires monthly series of lending rates, money market rates, and discount rates.[9] These data must be available for a sufficiently long period during which lending rates were not administratively controlled by the

[9] High frequency data are needed because time aggregation may bias the estimates. Moreover, for the purpose of policy analysis, monthly lags are certainly more relevant than quarterly lags.

central bank[10] and no direct controls on the amount of credit were in place.[11] This limited the sample size to 31 countries, almost equally split between developing and industrial countries. It also limited the sample period, sometimes to no more than two years.

Three types of lending rates were used: posted prime rates, posted nonprime rates, and average rates actually charged on bank loans. The fact that these rates may show different dynamic properties with respect to money market rates was ignored in the first step of the estimation process, but was taken into account in the second step (see Section IV). The data on money market rates usually refer to either treasury bill or interbank rates. Discount rates refer to interest rates on various forms of last resort credit from the central bank.

The stationarity of the above 93 series (three series for each of the 31 sample countries) was assessed using augmented Dickey-Fuller tests. Since almost all the series were found to be nonstationary, the model was estimated not only in levels but also in first differences, which in most cases was sufficient to remove the nonstationarity.[12] We will refer therefore to two sets of results: "Model 1" results (estimates in levels), and "Model 2" results (estimates in first differences).

Estimation Results

Table 1 shows the estimated multipliers of changes in money market rates at different time lags for both Model 1 and Model 2. (Detailed results are presented in Cottarelli and Kourelis (1994)). With reference to Model 1, columns 1–4 report, respectively, the impact multiplier, the multiplier after three months and that after six months, and the long-run multiplier. The same information for Model 2 is reported in columns 5–8. The last two rows of the table report the mean and the variation coeffi-

[10] In order to allow some initial adjustment of the lending rate to its equilibrium level after the removal of interest rate ceilings, the sample periods used for estimate (1) in countries that experienced ceilings started at least six months after their removal.

[11] If direct controls are in place, the relation between lending rates and money market rates is severed. This is because, in the absence of credit rationing, the lending rate will be determined by the intersection of the demand for bank loans and the administratively fixed supply of bank credit. In this case, a change in money market rates may not bring about any change in the lending rate. Thus, if the stickiness of lending rates were assessed during periods of binding direct controls, the degree of stickiness would probably be overestimated.

[12] The only exception is Poland, for which, due to the limited sample size, it was not possible to estimate the model in first differences (first differences models are likely to require longer distributed lags).

Table 1. *Multipliers*
(Effect on the Lending Rate of Changes in Money Market Rate)

Country	Model 1				Model 2			
	Impact	3-month	6-month	Long-run	Impact	3-month	6-month	Long-run
Australia	0.11	0.40	0.60	1.17	—	0.35	0.67	0.81
Belgium	0.21	0.61	0.81	1.03	0.21	0.67	0.87	0.87
Canada	0.76	0.93	1.00	1.06	0.78	0.89	0.93	0.93
Colombia	0.42	0.87	0.97	1.03	0.44	0.76	1.06	1.06
Denmark	0.07	0.25	0.38	0.71	0.15	0.44	0.63	0.70
Finland	0.13	0.20	0.27	0.60	0.13	0.23	0.28	0.28
Germany	0.38	0.67	0.83	1.04	0.37	0.87	0.95	1.00
Greece	—	0.40	0.74	1.05	—	0.61	0.82	0.82
Hungary	0.09	0.31	0.47	0.88	0.19	0.38	0.65	0.65
Iceland	0.61	1.04	1.07	1.08	0.61	1.06	1.06	1.06
Indonesia	0.19	0.59	0.84	1.21	0.20	0.74	0.74	1.00
Ireland	0.32	0.80	0.96	1.03	0.34	1.07	1.07	1.07
Israel	0.77	1.22	1.24	1.25	0.77	1.05	1.05	1.05
Italy	0.11	0.40	0.61	1.22	0.12	0.60	0.76	0.83
Jamaica	0.15	0.38	0.66	0.92	0.24	0.37	0.77	0.77

Table 1. *Multipliers* (concluded)

(Effect on the Lending Rate of Changes in Money Market Rate)

	Model 1				Model 2			
Country	Impact	3-month	6-month	Long-run	Impact	3-month	6-month	Long-run
Japan	0.06	0.19	0.25	0.75	0.03	0.22	0.35	0.53
Malaysia	0.16	0.29	0.39	0.91	0.13	0.28	0.37	0.44
Mexico	0.83	1.40	1.34	1.29	0.72	1.30	1.10	1.30
Netherlands	0.52	0.97	1.03	1.04	0.52	0.82	0.82	0.82
New Zealand	0.09	0.48	0.60	0.67	0.11	0.55	0.75	0.75
Philippines	0.27	0.75	0.81	0.87	0.24	0.64	0.64	0.64
Poland[a]	0.04	0.15	0.24	0.59	—	—	—	—
Portugal	0.28	0.77	0.97	1.12	0.47	0.95	0.95	0.95
Singapore	0.27	0.71	0.83	1.00	0.27	0.71	0.82	0.95
South Africa	0.61	0.79	0.88	0.99	0.73	0.96	0.96	0.96
Spain	0.35	0.80	0.98	1.12	0.36	0.78	0.85	0.94
Sri Lanka	—	0.22	0.28	0.30	—	0.13	0.19	0.19
Swaziland	0.48	0.52	0.54	0.57	0.54	0.66	0.66	0.66
United Kingdom	0.82	1.02	1.04	1.04	0.87	0.94	0.94	0.94
United States	0.32	0.69	0.85	0.97	0.41	0.97	0.97	0.97
Venezuela	0.38	1.03	1.30	1.48	0.24	0.75	0.75	0.75
Mean	0.32	0.64	0.77	0.97	0.33	0.67	0.76	0.82
Variation coefficient	0.79	0.51	0.40	0.25	0.78	0.45	0.33	0.29

[a] Model 2 was not estimated for Poland.

Table 2. *Correlation Between Multipliers*
(At different lags)

	Model 1				Model 2			
	h_0	h_3	h_6	h_L	h_0	h_3	h_6	h_L
h_0	1.00	0.89	0.77	0.46	1.00	0.80	0.70	0.63
h_3		1.00	0.96	0.67		1.00	0.92	0.88
h_6			1.00	0.80			1.00	0.93
h_L				1.00				1.00

cient (that is, the ratio between standard deviation and mean) of each column. The following features are notable.

Results Robust with Respect to Model Specification

Models 1 and 2 yield very similar measures of the multipliers. The correlation coefficient between the impact multipliers of Model 1 and of Model 2 (that is, between the first and fifth columns of Table 1) is 0.97. The correlation coefficient declines slowly at longer lags: it is 0.91 and 0.86, respectively, for three- and six-month multipliers but remains fairly high (0.74) even for the long-run multipliers. Thus, the results are robust with respect to different model specifications.

Degree of Stickiness High on Average

The degree of stickiness is, on average, relatively high. While, in the long run, the lending rate seems to adjust fully to the money market rate (the long-run multiplier is, on average, 0.97, and it falls within the range of 0.75–1.25 in three fourths of all cases), the impact multiplier is only one-third of the long-run multiplier.[13] Broadly speaking, this implies that in order to increase lending rates by 100 basis points during the month of the money market rate shock, the money market rate must be raised by 300 basis points. On average, after three months and six months, respectively, about one-third and one-fourth of the adjustment remains to be completed. Moreover, the ordering of the countries by degree of stickiness is not affected much by the lag at which multipliers are measured (see Table 2).

Strong Cross-Country Differences, Particularly at Short Lags

There is much cross-country variation around these average values, particularly for shorter lags. The standard error is about 80 percent of the mean for the impact multiplier but drops to 50 percent after three months and to 25 percent in the long run. Thus, countries seem to differ more

[13] Given the similarity of the results of the two models, we will comment only on the Model 1 estimates.

in the short than in the long run. This has two implications. First, it suggests that the effect of different financial structures can be better assessed by looking at short lags, rather than at long lags, a feature that will also be evident from the results of Section IV. Second, this result is consistent with the fact that the strong short-run differences are due to adjustment costs or "inefficiencies," rather than long-run differences in loan demand elasticities. The effect of these adjustment costs and inefficiencies tends to fade away in the long run.

The differences among impact multipliers across countries cannot easily be related to the degree of development of the economy. Focusing on the impact multipliers, the subsample of countries represented by higher-than-average performers (that is, those with an impact coefficient higher than 0.32) is almost equally split between industrial and developing countries. The same is true for below-average performers. Clearly, an explanation of the cross-country differences must go beyond a simple consideration of the degree of overall development of the economy.

Relevance of Discount Rate Changes

The effect of discount rate changes on lending rates for the countries in which such a variable was significant is reported in Table 3. The discount rate appears to be a powerful instrument for speeding up the adjustment of the lending rate to money market shocks. The discount rate is significant in about one-half of the sample countries. Among these

Table 3. *Effect of Changes in the Discount Rate*

	Model 1			Model 2		
Country	Impact	3 months	6 months	Impact	3 months	6 months
Australia	0.20	0.14	0.11	0.27	—	—
Belgium	0.68	0.35	0.17	0.58	0.17	—
Denmark	1.25	0.91	0.66	1.00	0.34	—
Finland	0.45	0.38	0.32	0.41	0.19	—
Germany	0.23	0.12	0.07	0.17	—	—
Iceland	0.25	0.02	0.01	—	—	—
Ireland	0.36	0.23	0.07	0.25	—	—
Italy	0.63	0.62	0.46	0.51	0.19	0.06
Japan	0.07	0.29	0.26	0.09	0.33	0.18
Netherlands	0.69	0.09	0.01	0.51	—	—
Poland	1.03	0.83	0.66	1.03	0.83	0.66
South Africa	0.19	0.10	0.06	0.09	—	—
Sri Lanka	0.15	0.20	0.05	0.19	—	—
Swaziland	0.32	0.19	0.11	0.23	—	—
United States	0.49	0.21	0.09	0.29	—	—
Mean	0.47	0.31	0.21	0.40	0.34	0.30

countries, the average impact multiplier of a change in the discount rate is 0.47, and in some cases it is as high as 100 basis points. When the discount rate is changed, the percentage multiplier rises to 89 percent from 26 percent, a threefold increase in the speed of adjustment of lending rates.

One important feature of the countries in which the discount rate is significant must be noted. In the absence of a discount rate change, lending rates in those countries show a *below average* response to money market changes. Their average impact multiplier is 0.26, against an average of 0.36 for the other countries,[14] which suggests that the stickiness of lending rates and the effectiveness of the discount rate may be related. If a relation exists, it could be interpreted in two ways. On the one hand, it could be argued that, in the presence of a weak financial structure and sticky lending rates, monetary authorities have to rely on publicized discount rate changes to spur the banking system. On the other hand, it could be claimed that in countries where the central bank has customarily relied on discount rate signals, banks have become "addicted" to the use of this instrument, to the extent that lending rates are not changed unless the discount rate also changes.

Both these interpretations imply a negative statistical relation between the impact multipliers of money market changes and those of discount rate changes. The first interpretation, however, also implies that the stickiness of lending rates can be explained purely by looking at structural variables. If the financial structure is responsible for both the stickiness of lending rates and the use of the discount rate as a monetary policy signal, it should be possible to estimate a reduced form equation in which the money market multipliers are uniquely related to the structural variables. However, this would not be possible if, in addition to the effect of the financial structure, the use of the discount rate as a policy signal further reduces the multipliers. In this case, a negative dummy equal to 1 when the discount rate is used as a "policy signaling" device should be significant, and with negative sign, in the regression of Section IV.

IV. Step Two: Determinants of the Stickiness of Lending Rates

We now focus on the factors explaining the cross-country differences in the stickiness of lending rates.

[14] For the countries in which the discount rate is significant, there is a negative correlation between the size of the impact multiplier of money market rates and those of the discount rate.

Structural Variables

Step two—the estimation of the relation between multipliers and structural variables—requires the identification and measurement of the latter. Based on the discussion in Section I, four groups of structural variables (reflecting the degree of bank competition, the extent of money market development and the openness of the economy, the public/private nature of the banking system, and the overall degree of development of the financial system) have been singled out. In addition, it was necessary to control for some additional factors affecting the dynamics of the lending rates, such as the different inflationary environment, the type of the lending rate series used in step one, and the use of the discount rate as policy signal.

Before proceeding, two caveats are necessary. First, while the range of structural variables included is large (given the limited number of observations available), it may not be exhaustive. Probably the most important omission, due to insufficient data availability, is the absence of variables reflecting the barriers to competition between bank and nonbank financial intermediaries. This will have to be borne in mind when interpreting the results.[15]

Second, it must be stressed that, while the following variables can be defined as "structural," they are not fixed over time. This does not create a problem in the majority of cases in which no major structural change (such as the removal of barriers to entry) occurred in the period over which the multipliers were measured. Then the structural variables could be measured at any period of time, and, indeed, were sometimes based on a single annual observation. However, when structural changes occurred or whenever information on the structural variables was available over time, the structural variables were computed by using average values over the sample period.[16]

Competition within the Banking System

As in most studies of the relation between banking structure and performance, the degree of competition within the banking system was proxied by variables measuring the degree of concentration of the banking system, such as the market share of the largest five banks (MARSH)

[15] Omitted variables can bias the regression results if they are correlated with the included variables. This may be the case, for example, because regulators may constrain both the competition within the banking system and that between banks and nonbanks.

[16] See Cottarelli and Kourelis (1994) for further discussion, as well as for the value of the structural regressors.

and the number of bank branches per 100,000 inhabitants (NOBRA). The expected sign is negative for the former variable and positive for the latter (the larger the concentration, the lower the degree of competition and therefore the lower the multipliers).[17]

While this is the standard approach, the theory of contestable markets implies that market concentration measures are not good proxies for the actual degree of competition. The reason is that concentrated markets can behave like competitive markets if firms are subject to the threat of entry of new competitors. We have therefore included in the regression a qualitative index of the existence of barriers to entry (ENTRY). This index, ranging from zero (strongest barriers to entry) to four (no barriers to entry), reflects the legislation on the opening of new bank branches (both domestic and foreign) existing in each country, and has an expected positive sign. Moreover, in some regression specifications, the variable MARSH and NOBRA have been included in the following form:

$$MARSH^* = (4 - ENTRY) * MARSH \tag{12}$$

$$NOBRA^* = (4 - ENTRY)/NOBRA \tag{13}$$

Equations (12) and (13) imply that the degree of market concentration becomes relevant only in the presence of barriers to entry.[18] The stronger those barriers, the greater the impact of market concentration on the multipliers.

Extent of Money Market Development and Openness of the Economy

The extent to which the money market is developed has been taken into account in two ways. First, a variable measuring the size of the "random component" in the money market rate series used in the step one regressors was included (RANDO). The expected sign of this variable is negative: if the money market rate series are very "noisy," the speed of adjustment should be lower. This is because, in the presence of adjust-

[17] This is because of the lower demand elasticity in less competitive markets and the presumed higher stickiness of oligopolistic prices. It has been noted in Section I that, while there are reasons to argue that oligopolistic prices may be stickier than competitive prices, the same argument may not hold for monopolistic prices (apart from the effect imputed to the lower demand elasticity characterizing monopolies). Thus the relation between degree of stickiness and concentration may not be linear. To take this into account, absolute deviations from the MARSH sample mean have been calculated (so that very concentrated and very fragmented markets would behave similarly). However, this has not yielded substantially different results from those reported in Section IV.

[18] Note that, in this specification, the expected sign of NOBRA* is now negative (as NOBRA appears in the denominator), while the expected sign of MARSH* continues to be negative.

ment costs, banks will only follow interest rate changes that are not too erratic. RANDO has been set equal to the standard error (expressed as a percentage of the average value of the money market rate) of an ARIMA model fitted on each money market interest rate series.[19]

The second aspect to be considered is the size of the market for short-term negotiable financial instruments issued by enterprises (ENTMA) and other agents (OTHMA), both measured in relation to each country's GDP.[20] The existence of a market for short-term instruments issued by enterprises (commercial paper and bankers' acceptances) may be relevant because it increases the elasticity of the demand for bank loans. In this case, if banks do not adjust rapidly to changes in money market conditions, they may be disintermediated. The existence of a market for other short-term marketable instruments (mainly certificates of deposit (CDs) and treasury bills) may also be important. The existence of these instruments increases the liquidity of enterprise and household portfolios, thus increasing the elasticity of demand for loans. Moreover, if banks raise a large share of their resources from the issuance of CDs, whose interest rates rapidly adjust to money market conditions, they will face large costs if they delay the adjustment of their lending rates.

An additional variable—CAPCO—has been introduced to capture the barriers to foreign competition. Its expected sign is negative; it takes the value 1 in the presence of constraints on capital flows and the value 0 otherwise.[21]

Banking System Ownership

As more comprehensive measures of the degree of public sector ownership were not readily available, the public/private nature of the banking system was measured by a variable (PUBLI), equal to the

[19] For simplicity, the same (2,1,2) ARIMA model was fitted to all series.

[20] To account for the possibility that the size of the money market is not relevant beyond a certain level, the above variables were also introduced in the following nonlinear form:

$$OTHMA^* = 1/(1 + \phi\exp(-\pi OTHMA)),$$

that is, through a logistic function. This specification implies that, for very high as well as very low levels of OTHMA, changes in the market size have limited effect. The two parameters ϕ and π were estimated by scanning (i.e., by minimizing the residual sum of squares). The estimated ϕ and π implied a close linear relation between OTHMA* and OTHMA (for the actual values taken by the latter in the cross-country sample), which suggests that the effect of OTHMA was approximately linear.

[21] No attempt has been made to differentiate by type of controls on capital movements. Annual information on this variable has been derived from Alesina, Grilli, and Milesi-Ferretti (1993).

number of the five largest banks that are public. This variable is expected to be negatively related to the impact multipliers.

Degree of Development of the Financial System

In order to test the hypothesis that lending rates adjust faster in more sophisticated financial environments, we included variables measuring the overall degree of development of the financial system. A standard approach would require taking the ratio between total financial assets and GDP. This measure, unfortunately, is not readily available for all countries included in the sample. We therefore used three proxies: per capita GDP (GDPPC), which usually exhibits a strong correlation with the ratio between financial assets and GDP;[22] the ratio between broad money and GDP (M2GDP), which is often used as a proxy for the degree of financial deepening (e.g., De Gregorio and Guidotti (1992)); and the ratio between broad and narrow money (M2OM1), which captures the development of more sophisticated deposit instruments.

Additional Variables

To identify the effect of the above factors, it is necessary to control for the existence of other variables influencing the measured multipliers.

First, two dummy variables were introduced to distinguish between the type of lending rate used in the step one regressions. The variable PRIME takes the value 1 for posted prime rates and zero otherwise. It is expected to have a positive sign, since rates applied to the best (i.e., higher demand elasticity) customers are likely to react faster and because the adjustment costs for changing posted rates are lower than for changing actual rates. The variable POSTE takes the value 1 for nonprime posted rates and zero otherwise. Its sign is uncertain because the two factors mentioned with reference to the PRIME variable now move in different directions.

Second, adjustment lags of nominal variables (nominal prices or interest rates) are likely to be shorter in environments in which inflation has been high for a number of years and, consequently, indexation is widely used (Cecchetti (1986)). Structural inflation was measured as the average inflation rate during the 1980s (INFLA).

Third, the variable EDISC was included to test the possibility that the multiplier is lower when the discount rate is used as a signaling device (the possible "discount-rate addiction" hypothesis noted in Section II). EDISC, which is defined as a dummy variable taking the value 1 for the

[22] For the 32 countries considered by Wellons, Germidis, and Glavanis (1986), the correlation coefficient between per capita GDP and financial assets to GDP ratio is 0.66.

countries in which the discount rate was significant in the step one regressions, is expected to have a negative sign if the addiction hypothesis is true.

Fourth, we also included an additional dummy variable (DUSHO) equal to 1 for countries in which the sample period of the step one regression was shorter than two years. This variable was included because, in the presence of a lagged dependent variable, OLS estimates, while consistent, are biased (the so-called Hurwicz bias). As discussed in Nickell (1981), this bias is likely to result in an overestimation of the speed of adjustment. Therefore, we expect the sign of DUSHO to be positive.

Specification Search and Preferred Equations

Impact Multiplier Equation

Table 4 reports the estimates of equation (5), that is, the relation between impact multipliers and the structural variables, for Model 1.[23] Following the "from general to specific" approach, the specification search started with the inclusion of all exogenous variables listed above.[24]

The estimates of the most general specifications are reported as estimates (1)–(2) in Table 4, referring, respectively, to the OLS and weighted least squares (WLS) results. While the two estimates are similar, it is confirmed that the use of OLS would have produced artificially low coefficient standard errors (and correspondingly higher t-statistics). However, even estimate (2) presents a remarkably good fit (the adjusted R^2 is 0.80, which is very high for cross-section estimates) and low standard errors.[25] Of the 13 variables included in the regression, only MARSH and GDPPC have a sign opposite to what was expected. Of these, MARSH, which measures the market share of the five largest banks, is very close to zero and is not significant,[26] leaving per capita GDP as the only significant variable with the "wrong" sign. As recalled, this

[23] See Cottarelli and Kourelis (1994) for the results obtained using Model 2 estimates, which were very similar.

[24] However, given the limited number of degrees of freedom, the alternative proxies for the degree of financial development (i.e., GDPPC, M2GDP and M2OM1) were introduced individually. Table 4 only reports the results for GDPPC, as M2GDP and M2OM1 were never significant. The DUSHO variable was also never significant and was dropped to save degrees of freedom.

[25] Both the adjusted R^2 and the equation standard error have been expressed in terms of the original residuals, i.e., those of the estimate not adjusted for heteroscedasticity (the corresponding statistics on the equation adjusted for heteroscedasticity look, of course, even better).

[26] For the given sample size, a 10 percent and a 5 percent significance level require t-statistics of 1.70 and 2.04, respectively.

Table 4. *Estimates of Equation (5)*

(Dependent Variable: Impact Multipliers from Model 1)

Estimation Technique	N	Constant	INFLA	PRIME	POSTE	CAPCO	RANDO	ENTMA	OTHMA	PUBLI	GDPPC	MARSH[a]	NOBRA[a]	ENTRY	EDISC	AR^2	SE
OLS	1	0.50	0.012	0.25	−0.34	−0.18	−0.031	−0.001	0.010	−0.056	−1.29	0.033	0.002	0.027	−0.16	0.93	0.87
		(4.09)	(9.81)	(4.63)	(−5.69)	(−3.49)	(−5.73)	(−0.09)	(3.87)	(−4.61)	(−2.42)	(0.26)	(1.76)	(1.96)	(−3.74)		
WLS	2	0.51	0.013	0.22	−0.37	−0.21	−0.035	−0.003	0.013	−0.039	−1.50	0.007	0.003	0.023	−0.14	0.80	0.109
		(4.35)	(7.09)	(3.22)	(−3.93)	(−3.07)	(−5.45)	(−0.43)	(4.48)	(−2.50)	(−2.34)	(0.04)	(1.88)	(1.07)	(−2.41)		
WLS	3	0.30	0.012	0.22	−0.28	−0.15	−0.031	−0.002	0.011	−0.032	—	0.082	0.003	0.010	−0.21	0.74	0.125
		(3.66)	(6.18)	(2.87)	(−2.97)	(−2.18)	(−4.51)	(−0.30)	(3.57)	(−1.90)	—	(0.46)	(1.57)	(0.46)	(−3.80)		
WLS	4	0.30	0.012	0.25	−0.27	−0.12	−0.032	—	0.009	−0.022	—	—	0.003	0.015	−0.20	0.75	0.122
		(4.29)	(6.85)	(3.92)	(−4.04)	(−2.27)	(−4.69)	—	(3.76)	(−1.94)	—	—	(1.67)	(1.81)	(−3.93)		
WLS	5	0.33	0.012	0.25	−0.27	−0.12	−0.032	—	0.009	−0.022	—	—	0.004	—	−0.23	0.72	0.129
		(5.17)	(7.12)	(5.01)	(−4.04)	(−2.13)	(−5.93)	—	(4.05)	(−1.77)	—	—	(3.21)	—	(−6.60)		
WLS	6	0.30	0.011	0.17	−0.29	−0.12	−0.025	—	0.013	−0.045	—	—	—	0.036	−0.14	0.78	0.114
		(4.07)	(6.53)	(3.50)	(−3.86)	(−2.01)	(−4.28)	—	(5.48)	(−5.04)	—	—	—	(2.74)	(−3.16)		
OLS	7	0.31	0.011	0.20	−0.33	−0.18	−0.027	−0.002	0.011	−0.064	−0.54	0.001	−0.040	0.076	−0.12	0.93	0.089
		(1.98)	(9.84)	(4.58)	(−5.24)	(−3.36)	(−4.97)	(−0.27)	(4.86)	(−5.78)	(−0.99)	(1.18)	(−0.27)	(2.99)	(−3.16)		
WLS	8	0.45	0.012	0.15	−0.37	−0.21	−0.030	−0.002	0.015	−0.060	−1.33	0.038	0.012	0.060	−0.083	0.80	0.110
		(2.60)	(6.52)	(2.38)	(−3.44)	(−2.78)	(−4.72)	(−0.27)	(5.24)	(−4.68)	(−1.42)	(0.53)	(0.06)	(2.09)	(−1.56)		
WLS	9	0.26	0.011	0.15	−0.31	−0.15	−0.026	—	0.013	−0.046	—	—	0.22	0.54	−0.13	0.82	0.105
		(3.41)	(6.81)	(2.97)	(−4.21)	(−2.45)	(−4.60)	—	(5.76)	(−5.26)	—	—	(1.66)	(3.23)	(−3.30)		

[a] In estimates 7–9 this variable is adjusted for the existence of barriers to entry (see Section IV).

variable acts as a proxy for the level of financial development, and thus is not important on its own. Therefore, it was dropped in estimate 3, without any major change in the other coefficients and t-statistics.

In estimate (3), four variables (ENTMA, MARSH, NOBRA, and ENTRY) are not significant. Therefore, ENTMA and MARSH (the least significant of the group) are dropped in estimate (4), which raises the t-statistics for the remaining two variables. These, however, continue to be insignificant. It must be noted that NOBRA (the number of bank branches) and ENTRY (reflecting the ease of opening bank branches) show a relatively high correlation,[27] so that their lower significance, when introduced in tandem, may reflect problems of multicollinearity. Indeed, when the two variables are introduced separately in estimates (5) and (6), respectively, they each become significant at the 1 percent significance level. On account of the lower standard error and higher adjusted R^2, estimate (6) will be considered the "preferred" equation.[28]

In estimates (7)–(9), MARSH and NOBRA are replaced by their corresponding values adjusted for the existence of barriers to entry (see equations (12) and (13) above), but the results do not change appreciably. ENTMA, MARSH* and NOBRA* remain insignificant. GDPPC is also not significant, while ENTRY is significant even in the most general specification. This confirms estimate (6) as the preferred equation.

Interim and Long-Term Multiplier Equations

While the focus of this paper is on the impact multipliers for the reasons discussed in Section II, it is worthwhile to examine how the estimated equations behave when applied to interim and long-term multipliers.[29]

These estimates, reported in Table 5 (again, for Models 1 and 2) together with the preferred impact equations, show a much worse fit. The adjusted R^2 drops to 0.50 and 0.23), respectively, for the three- and six-month multipliers, and becomes negative for the long-run multi-

[27] Their correlation coefficient is 0.52, meaning that the number of branches is higher in countries with lower barriers to opening new branches.

[28] It can be noted that the adjusted R^2 of estimate (6) is almost as high as that of the overparameterized estimate (2). This indicates that the significance of the "wrongly signed" GDPPC may have been spurious.

[29] As noted in Section II, the standard errors of the estimated interim and long-term multipliers are not easily computable. Therefore, in the estimation of the corresponding step two equations, we adjusted for heteroscedasticity using the standard errors of the impact multipliers. This is not a problem as long as the standard errors of the interim multipliers are equal to those of the impact multipliers up to a multiplicative constant.

[30] The use of the adjusted R^2, however, underestimates the portion of the dependent variable variance explained by the equation. Even for the long-term multiplier equation, the unadjusted R^2 remains close to 0.30.

Table 5. *Estimates of the Interim and Long-Term Multiplier Equations*
(Dependent Variable: Multipliers from Model 1)

Estimation Technique	Multiplier	Constant	INFLA	PRIME	POSTE	CAPCO	RANDO	OTHMA	PUBLI	ENTRY	EDISC	AR^2	SE
WLS	Impact	0.30	0.011	0.17	−0.29	−0.12	−0.25	0.13	−0.045	0.036	−0.14	0.78	0.114
		(4.07)	(6.53)	(3.50)	(−3.86)	(−2.01)	(−4.28)	(5.48)	(−5.04)	(2.74)	(−3.71)		
WLS	3-month	0.71	0.014	0.20	−0.24	−0.14	−0.036	0.021	−0.067	0.026	−0.34	0.50	0.23
		(5.66)	(4.77)	(2.29)	(−1.90)	(−1.33)	(−3.60)	(5.33)	(−4.32)	(1.13)	(−5.19)		
WLS	6-month	0.80	0.012	0.18	−0.19	−0.13	−0.035	0.024	−0.054	0.030	−0.36	0.23	0.26
		(5.06)	(3.34)	(1.70)	(−1.20)	(−1.01)	(−2.85)	(4.80)	(−2.79)	(1.05)	(−4.38)		
WLS	Long-run	1.01	0.005	−0.02	−0.21	−0.23	−0.017	0.020	0.011	0.011	−0.16	−0.10	0.25
		(6.26)	(1.43)	(−0.19)	(−1.27)	(−1.71)	(−1.35)	(3.95)	(0.57)	(0.40)	(−1.82)		

plier.[30] This is not surprising, as we noted that the variability of the multipliers across countries tends to fade away in time, so that it becomes more difficult (but also less relevant) to explain it. Nevertheless, it is notable that the signs and, to some extent, the significance of the coefficients remain unchanged, particularly up to the six-month multiplier equation.

Discussion of the Econometric Results

The above results support the following conclusions.

Effect of Inflation

The results indicate that the speed of adjustment of lending rates is higher in inflationary environments, a result that replicates that obtained for commodity prices by Cecchetti (1986). In all of the above specifications, the coefficient on INFLA is very significant and close to 0.01, indicating that an increase in the structural rate of inflation by 10 points raises the impact multiplier (and indeed the multipliers up to six months) by 10 basis points.

Type of Lending Rate

The results also indicate that the dynamics of the adjustment of lending rates vary depending on the type of lending rate. Prime posted rates adjust faster than actual rates (their multiplier is almost 20 basis points higher, for up to six months), while posted nonprime rates adjust more slowly, particularly in the very short run (their impact multiplier is 30 basis points lower than for actual rates, and 20 basis points lower after three months). This implies that, when assessing the effectiveness of the transmission mechanism of monetary policy, attention must be paid to the type of lending rate for which information is available. Only in the long run do all rates tend to change by the same amount.

Effect of Financial Structure

The econometric results also indicate that the stickiness of lending rates is strongly influenced by the structure of the financial system, including its regulatory environment. The effects of five structural variables have been identified (Table 6).[31]

First, the stickiness of lending rates has been shown to be influenced

[31] Table 6 suggests that the effect of changes in the different structural variables can be added. While the estimated model is, indeed, additive, it must be stressed that additivity probably does not hold for very high or very low values of the multipliers (see Section II).

Table 6. *Effect of Structural Changes on the Lending Rate Multiplier*

Structural Change	Impact	3-month	6-month
Removal of barriers to entry	0.14	—	—
Privatization of the banking system	0.23	0.34	0.27
Removal of capital controls	0.12	—	—
Creation of a money market (equal to 15 percent of GDP)	0.20	0.32	0.36
50 percent reduction of "noise" on the money market rate[a]	0.13	0.18	0.18

[a]Reduction from 10 percent to 5 percent in the ratio between the standard error of the random component of the money market rate series and its average value.

by the existence of constraints on competition among banks, and in particular, by the existence of barriers to entry (measured here by constraints in setting up new bank branches).[32] Based on the estimated regression coefficients, a shift from a regime of ad hoc authorization in the opening of branches to one of complete deregulation is estimated to increase the impact multiplier by 14–19 basis points.[33] The actual degree of concentration (measured by the market share of the five largest banks) seems to be less relevant. This is consistent with the view, stressed by the contestable market school, that very concentrated markets behave like competitive markets as long as they are subject to entry threat.[34]

Second, lending rates appear to be stickier in banking systems dominated by state banks, which may reflect the relative inefficiency of public banks or the existence of political constraints on interest rates changes. Privatizing a publicly owned banking system would substantially increase the flexibility of lending rates. The impact multiplier would be raised by over 20 basis points, and the effect would be even higher for the three- and six-month multipliers.

Third, capital controls reduce competitive pressures on the banking

[32] As mentioned, similar results have been obtained by using a measure of the actual diffusion of bank branches.

[33] At higher order lags, the effects are less clearly identified (the corresponding t-statistics are low) although the size of the estimated coefficient remains high up to the six-month multiplier.

[34] The existence of barriers to interstate branching, and hence to competition, would be one factor explaining the relatively high degree of stickiness of lending rates in the United States (Table 1), despite the low degree of market concentration. The same conclusion holds for Italy and Japan, which in the sample period maintained strong barriers to the opening of new branches. In contrast, the Canadian banking system, which is very concentrated but characterized by relatively low entry barriers, exhibits a faster adjustment. For a more detailed discussion on the relation between entry barriers and competition in the United States and Canada, see Shaffer (1993).

system (arising from foreign financial markets) and result in higher lending rate stickiness. The quantitative effect of removing capital controls, while significant for the impact multiplier, is relatively contained (12 basis points), and is statistically insignificant afterward. However, it must be recalled that the capital control variable has been measured in a very imprecise way, which may explain the relatively high standard error of the corresponding coefficient.[35]

Fourth, the development of a market for short-term instruments (particularly CDs and treasury bills) also enhances the flexibility of lending rates. For a market as large as, say, 15 percent of GDP, the effect would be between 20 and 30 basis points on all multipliers up to six months. We were unable to identify any effect of markets for short-term negotiable instruments issued by enterprises. One possible interpretation is that these instruments (particularly commercial paper) are issued mainly by very large enterprises, while in many countries, the bulk of commercial bank loans is granted to medium-sized and small enterprises and to households.

Fifth, quite intuitively, lending rates do not follow money market rates that move very erratically. If the ratio between the standard error of the random component of the money market rate and the average of the same rate declines by 5 percentage points, the multipliers increase substantially (10–20 basis points depending on the lag and the model). Thus, the growth of the money market can speed up the response of the banking system by reducing the volatility of the money market rate (under the assumption that interest rate volatility is, ceteris paribus, lower in larger markets). In general, the transmission mechanism will benefit from avoiding excessive fluctuations of money market rates.

Role of the Discount Rate

One feature of the regressions presented in Tables 4–5 is the statistical significance, and the negative sign, of the coefficient reflecting the discount rate policy of the central bank. The estimated coefficient implies that the use by the central bank of the discount rate as a monetary policy signal reduces the response of lending rates to changes in money market rates (when the discount rate is not moved) by 15–30 basis points (depending on the lag and model specification). The fact that this result has been obtained after controlling for a large number of structural variables affecting the stickiness of lending rates supports the "discount-rate addiction" hypothesis put forward at the end of Section III.

[35] Indeed, while the t-statistics of CAPCO fall after the impact multiplier, the estimated coefficient remains high.

Table 7. *United Kingdom and Canada: Estimates of the Lending Rate Equation*

(In percent)

Sample period	N	Constant	i_{-1}	m	m_{-1}	Δd	d	d_{-1}	d_{-2}	s.e.	H
					United Kingdom						
72:10-78:03	1	0.72	0.63	0.77	−0.41	−0.01	—	—	—	0.42	0.02
		(2.10)	(6.68)	(7.46)	(−2.80)	(−0.09)	—	—	—		
78:04-81:02	2	0.10	0.99	—	0.01	0.95	—	—	—	0.12	−2.87
		(0.73)	(39.52)	(0.11)	(0.38)	(32.73)	—	—	—		
78:04-81:02	3	0.98	0.03	—	—	—	0.97	—	—	0.09	0.03
		(5.26)	(0.15)	—	—	—	(5.40)	—	—		
81:03-93:03[a]	4	0.87	0.38	0.86	−0.23	—	—	—	—	0.33	0.03
		(5.16)	(6.04)	(18.82)	(−3.53)	—	—	—	—		
					Canada						
73:01-80:02	5	0.14	0.93	0.01	0.05	0.95	—	—	—	0.17	0.17
		(1.28)	(34.98)	(0.09)	(0.53)	(8.58)	—	—	—		
73:01-80:02	6	0.12	0.95	—	—	—	0.93	−0.68	−0.20	0.17	0.28
		(1.20)	(28.79)	—	—	—	(16.73)	(−7.27)	(−3.59)		
80:03-91:10	7	0.13	0.76	0.01	0.26	0.79	—	—	—	0.24	−1.49
		(1.45)	(17.51)	(0.14)	(4.51)	(13.11)	—	—	—		

[a]A dummy variable in January 1985 was also included (see Appendix III in Cottarelli and Kourelis (1994)).

It could be argued that, based on the estimated coefficient on EDISC, the stickiness attributed to discount-rate addictions is relatively contained, and that it is a reasonable price to pay for an effective instrument such as an administratively controlled discount rate. However, the discount rate is an effective instrument only insofar as it can be flexibly used. But, as argued above, administered rates may be relatively sticky. Moreover, the estimated effect of the discount-rate addiction reported above reflects the average response of the banking systems included in the sample, and it may therefore underestimate the effect in specific countries. Further evidence on this point can be derived by reviewing the experience of two countries in which the discount rate was used, but only for some periods, as an administered signaling device.

Table 7 focuses on the relation between the lending rate, money market rates, and the discount rate in the United Kingdom and in Canada. In the United Kingdom, between October 13, 1972, and April 11, 1978, the discount rate (that is, the Minimum Lending Rate of the Bank of England, or MLR) was set at 0.5 percent above the average treasury bill rate at the most recent tender (Temperton (1991), p. 162), and thus did not have any independent signaling effect. As indicated by the first estimate of the table, the lending rate in this period was primarily influenced by the money market rate, with a relatively short adjustment lag (the impact multiplier is 0.77). The MLR was administered between April 11, 1978, and August 20, 1981. Clearly, in this period, the relevance of money market rates dropped (equation (2)), and the MLR became the reference rate for banks. Indeed, the lending rate adjusts to the MLR almost simultaneously (equation (3)). While this may be believed to be an ideal condition for a central bank, Temperton (1991) notes that:

> Disenchantment with this regime soon set in. Changes in the official interest rate once again took a high political profile and this led to problems with the conduct of monetary policy. . . . On 20 August, 1981, it was stated that MLR would no longer be announced continuously: greater reliance was to be placed on market forces in the determination of interest rates, . . . (p. 163).

Equation (4) shows that, after the suspension of the MLR in August 1981, money market rates once again became the main determinant of lending rates, with very short adjustment lags.[36]

[36] In the late 1980s, a new administered rate (the so-called Band One Stop Rate, which is the minimum rate at which the Bank of England is willing to discount bills of less than 14 days maturity) gradually emerged as a signaling device of monetary policy changes. This rate has been shown to affect money market and bank interest rates quite rapidly (Dale (1993)). The differences compared with the MLR are that the changes in the Band One Stop Rate, while closely monitored by financial markets, do not receive the same attention by the media and have a lower political impact, and therefore can be used more flexibly.

Canada's experience was similar. Until March 1980, the discount rate was set administratively and played the role of signaling changes in the stance of monetary policy (Freedman and Dingle (1986), p. 28). Before that date, money market rates did not appear to influence lending rates (equation (5)). Indeed, the level of the lending rate appeared to be related uniquely to the level of the discount rate (equation (6)). In the following period, the discount rate was indexed to the level of the treasury bill rate, thus losing its role as a policy signal. As illustrated by equation (7), during the 1980s, lending rates were still statistically related to the discount rate, now to be interpreted as a proxy of the most recent treasury bill auction rate (see Cottarelli and Kourelis (1994), Appendix III).

These results confirm the quantitative relevance of the discount-rate addiction hypothesis. When the discount rate is used as a signaling device, banks become less reactive to money market changes that are unaccompanied by discount rate changes.[37]

V. Conclusions and Policy Implications

The stickiness of lending rates with respect to changes in money market rates has often been seen as a serious impediment to the smooth transmission of monetary policy impulses. Yet, no systematic attempt had previously been made to measure the different degree of stickiness of lending rates across countries or to explain the observed differences. This paper has attempted such a measurement and, by doing so, has provided a yardstick against which the degree of lending rate stickiness in individual countries can be assessed. It has shown that the degree of stickiness is quite different across countries, particularly in the very short run. The impact multiplier (defined as the change in the lending rate observed during the month in which the money market rate changes) is close to unity in some countries (i.e., the adjustment is completed in almost one month) but as low as zero in others. Significant differences can still be observed after three and six months, while, in the long run, the adjustment tends to be close to unity for most countries.

The paper has also documented the existence of a strong relation between the degree of interest rate stickiness and the structure of the financial system. Five structural features have been singled out as being particularly relevant in increasing lending rate flexibility: the existence of

[37] Admittedly, the above results may overstate the loss of significance of money market rates in the presence of an administered discount rate. Most likely, banks would stop using the discount rate as a reference rate if the latter were maintained excessively out of line with respect to money market rates. In this respect, it is interesting to note that between 1978 and 1981, the Bank of England kept the MLR relatively close to money market rates (Spencer (pp. 55–57)).

a market for negotiable short-term instruments (particularly CDs and treasury bills); the containment of "unnecessary" or random fluctuations in money market rates; the absence of constraints on international capital movements; the absence of constraints on bank competition (particularly, barriers to entry); and private ownership of the banking system. Market concentration and the existence of markets for instruments issued by enterprises (for example, commercial paper) did not appear to affect loan rate stickiness. These results were obtained after controlling for structural inflation (which tends to speed up the adjustment of lending rates) and for the type of lending rates used (posted prime rates adjust faster than actual rates, which in turn react faster than nonprime posted rates).

These results add a new dimension to the relation between regulation policies and monetary policy. The analysis of this relation has, in the past, focused on the aspect of "soundness," that is, on the fact that the financial system must be resilient enough to sustain strong monetary policy measures "until they begin to bite" (Revell (1980), Gardener (1978)). We focused primarily on the relation between competition and efficiency, on the one hand, and monetary policy, on the other. Based on our results, the transmission mechanism of monetary policy can be enhanced by policies aimed at enriching the financial structure of new markets (particularly for short-term marketable instruments), and by removing barriers to competition (such as barriers to entry and constraints on capital movements). Privatization policies also appear to affect the responsiveness of lending rates to monetary policy stimuli, possibly because private banks are more efficient, or because they are less subject to political constraints.

Policies aimed at reducing market concentration do not appear to be useful, possibly because competition is best guaranteed by the threat of entry, both on local and national markets, rather than by increasing the number of national competitors. Therefore, policies favoring bank mergers, such as those implemented by some European countries in the last few years, may not be inconsistent with competition.

It has been shown that the presence of a high level of noise in money market rates weakens their role as conveyers of monetary policy impulses, possibly by making it more difficult for banks to identify durable changes in interest rates. There may therefore be a case for policies aimed at smoothing money market rate fluctuations.[38]

The above results also have implications for the shift from direct to indirect monetary controls. Direct credit ceilings were common in many

[38] These policies may include structural regulatory changes, such as reserve averaging and lagged reserve requirements.

industrial countries during the 1960s and 1970s, and are still widely used in developing countries. As noted in a BIS report of the early 1970s:

> . . . quantitative credit ceilings . . . are seen to have the advantage of helping to limit the growth of credit and the money supply more quickly and precisely than would be possible by the use of conventional monetary instruments acting through bank liquidity and interest rates (BIS (1971), p. 1).

One of the reasons for the system's limited responsiveness to changes in indirect monetary instruments is the stickiness of bank lending rates. However, as argued above, this stickiness should not be taken for granted as it is influenced by factors that can be modified by structural reforms. Thus, before ruling out the possibility of shifting to indirect controls, consideration should be given to structural reforms aimed at enhancing the transmission mechanism of indirect monetary instruments.

Finally, the paper also has implications for the use of the discount rate as a monetary policy instrument. By signaling fundamental changes in the monetary policy stance, administrative changes in the discount rate stimulate the response of lending rates to money market changes. Therefore, in countries in which lending rates are sticky due to the weaknesses of the financial structure, there is a strong case for using an administered discount rate as part of the central bank policy arsenal, until the effect of structural financial reforms gradually begins to bite. At the same time, evidence has been presented supporting the so-called discount-rate addiction hypothesis, namely that the repeated use of the discount rate as a policy signal weakens the response of banks to money market changes that are not accompanied by discount rate changes. This may be a problem for monetary policy because administered discount rates may be more easily subject to political pressures of various forms, and present some degree of stickiness. Thus, in countries in which the structural barriers to lending rate flexibility have been removed, there is a case for de-emphasizing the discount rate as policy signal, for example, by linking it to money market rates.

APPENDIX

Relation Between the γ Coefficients at Different Lags

As discussed in Section II, the γ coefficients, expressing the relationship between structural variables and "multipliers" at different time lags, are not independent across lags. To explore this relationship, let us consider the simplest partial adjustment model for the lending rate:[39]

$$i = \beta_1 i_{-1} + \beta_2 m \qquad \text{(A.1)}$$

[39] All of the following equations should be considered as referring to a single country; for simplicity the subscript i used in Section II has been dropped.

where i is the lending rate, and m is the money market rate. The impact multiplier (h_0) and the interim multipliers up to lag 2 (h_1, h_2)[40] can be expressed in terms of β coefficients as:

$$h_0 = \beta_2 \tag{A.2}$$

$$h_1 = \beta_2(1 + \beta_1) \tag{A.3}$$

$$h_2 = \beta_2(1 + \beta_1 + \beta_1^2). \tag{A.4}$$

Consistently with equation (4) in Section II, the multipliers are expressed as a function of the structural variables (two in this example), denoted as z_1 and z_2:

$$h_0 = \gamma_{01}z_1 + \gamma_{02}z_2 + \epsilon_0 \tag{A.5}$$

$$h_1 = \gamma_{11}z_1 + \gamma_{12}z_2 + \epsilon_1 \tag{A.6}$$

$$h_2 = \gamma_{21}z_1 + \gamma_{22}z_2 + \epsilon_2, \tag{A.7}$$

where ϵ_0, ϵ_1, and ϵ_2 are the error terms. By combining equations (A.2)–(A.4) with (A.5)–(A.7) the relation between the β and the γ coefficients can be written as follows:

$$\beta_2 = \gamma_{01}z_1 + \gamma_{02}z_2 + \epsilon_0, \tag{A.8}$$

$$\beta_2(1 + \beta_1) = \gamma_{11}z_1 + \gamma_{12}z_2 + \epsilon_1, \text{ and} \tag{A.9}$$

$$\beta_2(1 + \beta_1 + \beta_1^2) = \gamma_{21}z_1 + \gamma_{22}z_2 + \epsilon_2. \tag{A.10}$$

Using vector notation, equations (A.8)–(A.10) can be rewritten as:

$$\beta_2 = Z'\gamma_0 + \epsilon_0, \tag{A.11}$$

$$\beta_2(1 + \beta_1) = Z'\gamma_1 + \epsilon_1, \text{ and} \tag{A.12}$$

$$\beta_2(1 + \beta_1 + \beta_1^2) = Z'\gamma_2 + \epsilon_2, \tag{A.13}$$

where $\gamma_0 = [\gamma_{01}, \gamma_{02}]'$, $\gamma_1 = [\gamma_{11}, \gamma_{12}]'$, $\gamma_2 = [\gamma_{21}, \gamma_{22}]'$, and $Z' = [z_1, z_2]$. From equations (A.11) and (A.12), the following relation between γ_0 and γ_1 can be derived:

$$(Z'\gamma_0 + \epsilon_0)(1 + \beta_1) = Z'\gamma_1 + \epsilon_1; \tag{A.14}$$

and from (A.12), (A.13), and (A.14):

$$(Z'\gamma_0 + \epsilon_0) - (Z'\gamma_1 + \epsilon_1) + [(Z'\gamma_1 + \epsilon_1)^2/(Z'\gamma_0 + \epsilon_0)] = Z'\gamma_2 + \epsilon_2. \tag{A.15}$$

Equation (A.15) shows that the relation between γ_0, γ_1, and γ_2 does not involve any further information on the βs. However, the elements of γ_2 cannot be derived from γ_0 and γ_1 because the constraint set by (A.15) is on linear combinations of the elements of the γ vectors and not on the elements of the vectors.

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[40] We stop at lag 2 for simplicity's sake. The algebra becomes increasingly complicated at longer lags.

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