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

Prepared by Carlo Cottarelli and Angeliki Kourelis 1/

Authorized for Distribution by William E. Alexander

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Abstract

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.

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Summary

The stickiness of bank lending rates with respect to money market rates is often regarded as a serious obstacle to the smooth transmission of monetary policy impulses. This paper attempts to provide a systematic measure of the degree of lending rate stickiness across countries, and to explain the observed cross-country differences.

The degree of lending rate stickiness in 31 industrial and developing countries is measured by estimating simple dynamic models. More specifically, the lending rate in each country is regressed against lagged values of money market and discount rates. The degree of lending rate stickiness is measured by looking at the response of lending rates following a change in money market rates at different time lags (i.e., by estimating impact, interim, and long-term multipliers). It is shown that the degree of stickiness is quite different across countries, particularly in the short run. For example, the impact multiplier of changes in money market rates is close to unity in some countries, but is as low as zero in others. Significant differences in the response of lending rates can be observed three and six months after the change in money market rates, while in the long run the adjustment tends to be close to unity for most countries.

The paper then focuses on explaining the differences in the degree of stickiness observed across countries. This is done by regressing a cross section of impact, interim, and long-term multipliers against a set of variables measuring several features of the financial system. The results indicate that five structural factors are particularly relevant in reducing lending rate stickiness: the existence of a sizable market for short-term monetary instruments (such as certificates of deposits or treasury bills); the absence of constraints on capital movements; the absence of constraints on bank competition (particularly, barriers to entry); the private sector ownership of the banking system; and the containment of the random component of money market rates. It is also shown that prime lending rates adjust faster than other lending rates and that lending rate stickiness is lower in economies that have experienced relatively high inflation.

The econometric results also indicate that, by "signaling" monetary policy changes, movements in administered discount rates can speed up the adjustment of lending rates. It is shown that the discount rate is more important in countries where the response of lending rates to money market rates is lower. The paper argues that this phenomenon is due to a form of "discount rate addiction" of the banking system. In countries where the discount rate has systematically been used as a signaling device by the central bank, banks tend to postpone their reaction to changes to money market rates until the discount rate is also changed.

These results provide further evidence on the relationship between structural financial policies and monetary policy, and on the relevance of credit markets for the transmission mechanism of monetary policy.

I. Introduction

It is well known that the effectiveness of monetary policy hinges on a set of crucial structural parameters--not directly controlled by central banks--which describe how economic agents react to policy impulses stemming from money markets. It stands to reason that the value of these structural parameters (reflecting, essentially, the elasticities of the demand and supply of financial and real assets to money market interest rates) be related to the structure of the financial system, i.e., to the existence and degree of development of financial markets, the degree of competition of these markets, and the availability of foreign sources of finance. While economic theory has recognized this relation (e.g., Modigliani, and Papademos (1980), Vanhoose (1981), Kareken (1984), Faig-Aumalle (1987)), the empirical evidence on this subject is still limited and has mainly focused on the effect of structural changes in financial markets on the demand for money (e.g., Tseng and Corker (1991)).

An empirical aspect that has been almost completely disregarded (an exception is Pelzman (1969)) 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, i.e., the speed at which bank lending rates adjust to their long-run equilibrium value after a "shock" affecting money market rates.

The relevance of this issue for monetary policy cannot be underestimated. Economic literature has recently reexamined the importance of bank credit markets for the transmission mechanism of monetary policy (Bernanke and Blinder (1988), Bernanke and Gertler (1989), Bernanke (1993)). This literature stresses that banks are not neutral "conveyors" of monetary policy impulses. Consider, for example, a tightening of monetary policy 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. 1/ 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, remarkable that, between January and September 1992, when most European central banks were striving to defend the ERM parities by raising money market rates, the differential between the latter and bank lending rates increased substantially (by 100 basis points

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1/ 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)).

in the UK and Sweden, 200 basis points in Italy and Denmark, and over 300 basis points in Norway and Finland). Those increasing differentials suggest that lending rates were not fully adjusted to the changes in the money market rates.

In order to analyze the relation between bank lending rate stickiness and financial 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 obtain estimates of the effect on lending rates of shocks in money market rates, the so-called "multipliers", in the period when the shock occurs, after three months, after six months, and so on. 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, the size and the efficiency of the money market. 1/ We also examine the role of administratively set discount rates as instruments "signaling" changes in the stance of monetary policy, and their relation to bank lending rate stickiness.

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

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

1. Definition of lending rate stickiness and some prima facie evidence

In the case of the banking industry, the term "interest rate stickiness" has taken two related, but distinct, meanings. 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

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1/ 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 focussed on the relation between financial structure and the level of bank rates, or of 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.

used to indicate 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 in the long run (long-run stickiness). In this paper we will refer mainly to the second definition of stickiness. More specifically, we will focus on the reasons for the existence of "short-term" stickiness, an aspect which we will show to be empirically more relevant than its "long-run" equivalent, 1/ and thus on the adjustment lags between lending and money market rates.

Money market rates will be defined as rates on short-term financial instruments, which are not administratively controlled by the central bank. The reason to focus on these rates, rather than on administered short-term rates (such as discount rates), is that market determined rates are less likely to be subject to different forms of "attrition" (e.g., political pressures) that can delay their adjustment (see also point (a) in Section III.2, below).

The existence of lending rate stickiness is apparent in the simple statistics reported in Table 1. For the group of 31 countries considered in this paper (see Section IV), the table shows the correlation coefficient between the money market rate and the difference between the lending rate and the money market rate, together with its "t-statistic." 2/ The table highlights that in 24 countries the correlation coefficient is negative, implying that lending rates do not fully adjust to changes in money market rates.

This evidence is, however, only indicative. In the first place, the correlation coefficients in Table 1 are likely to underestimate the stickiness of lending rates, because these coefficients do not control for factors, such as changes in administered discount rates, which may speed up the response of lending rates to money market rates (see Section IV). Second, they do not allow a distinction between long- and short-run stickiness. A more precise measurement of lending rate stickiness will therefore be derived through time series regressions in Section IV.

2. The relevance of the financial structure

A comprehensive definition of the term "financial structure" goes beyond the purpose of this paper. We will use the term in a fairly wide sense as including a set of features such as the degree of development of money and financial markets, the degree of competition within the banking

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1/ As it will be shown, in most countries lending rates tend to adjust almost fully to money market rate changes in the long run.

2/ The "t-statistics" reported in the table are ratios of the correlation coefficients to an asymptotic approximation of their standard errors (i.e., to the inverse of the square root of the sample size; see Graybill (1961), theorem 10.14).

Table 1. Correlation Coefficient Between the Money Market Rate and the Difference Between the Lending Rate and the Money Market Rate 1/

Country	Sample Period	Correlation Coefficient	T-Statistic 2/
Australia	86:02-93:04	-0.37	-3.5
Belgium	85:05-93:03	-0.21	-2.0
Canada	81:01-92:10	0.12	1.4
Denmark	82:01-90:01	-0.77	-7.6
Finland	87:03-93:03	-0.86	-7.1
Germany	80:01-93:03	-0.22	-2.8
Greece	88:01-93:05	0.68	5.5
Hungary	89:10-93:05	-0.82	-5.4
Ireland	86:01-91:12	-0.24	-2.0
Israel	91:03-92:12	0.51	2.4
Italy	85:06-93:02	-0.42	-4.0
Japan	80:01-93:02	-0.80	-10.0
Malaysia	86:01-92:10	-0.81	-7.3
Netherlands	80:01-93:03	0.27	3.4
New Zealand	87:02-92:10	-0.89	-7.4
Philippines	86:01-93:02	-0.55	-5.1
Poland	91:06-93:06	-0.81	-4.0
Portugal	91:04-93:04	-0.30	-1.5
Singapore	80:01-93:03	-0.51	-6.4
South Africa	82:03-93:02	-0.36	-4.1
Spain	82:01-92:12	-0.32	-3.6
Sri Lanka	83:01-93:01	-0.84	-9.2
United Kingdom	80:01-93:03	0.15	1.9
United States	82:05-93:04	-0.10	-1.2
Colombia	86:09-93:04	-0.32	-2.9
Venezuela	90:05-93:03	-0.45	-2.7
Jamaica	91:10-93:03	-0.79	-3.4
Swaziland	88:01-93:01	-0.91	-7.1
Indonesia	89:09-93:02	-0.48	-3.1
Iceland	89:07-93:06	0.44	3.0
Mexico	90:03-93:05	0.81	5.2

1/ Computed from monthly data. The sample period varies across countries.

2/ The "t-statistic" is the ratio between the correlation coefficient and the inverse of the squared sample size.

system, and between banks and other intermediaries (as affected by both the regulatory environment, and by 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.

a. Adjustment costs and the elasticity of the demand for loans

Like any industry, the banking industry faces adjustment costs when prices (i.e., interest rates) are changed. The relevance of these costs in delaying the adjustment of lending rates to changes in money market rates can be shown to depend 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) under the assumption that the bank loan market is characterized by monopolistic competition, i.e., that each bank faces a downward sloping demand for bank loans. In this case (Klein (1971)), a profit maximizing bank that does not face adjustment costs will always set the lending rate at the level where the marginal revenue on loans is equal to an exogenously given money market interest rate (e.g., the yield of an alternative bank asset, such as the Treasury bill rate, or the cost of funding, i.e., the certificate of deposit rate). Thus, the lending rate would follow money market rates without delay. 1/ In the presence of fixed adjustment costs, however, the lending rate will be changed only if these costs are lower than the costs of keeping the lending rate out of its equilibrium. 2/ If the demand for loans is linear, the latter costs 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

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1/ However, in the monopolistic competition model, the change in the lending rate is not necessarily equal to the change in the money market rate. For example, in the linear version of that model (Monti (1972)) the derivative of the lending rate with respect to the money market rate is 0.5, regardless of the parameters of the demand curve (and as long as the demand for loans is not influenced by the money market rate). If the demand for loans is semiloglinear (i.e., the logarithm of the stock of loans is a function of the level of the lending rate), that derivative is one, regardless of the elasticity of the demand for loans. If, instead, the demand curve is loglinear, the derivative is a negative function of the elasticity and is always higher than 1.

2/ Equilibrium is here intended as the value of the lending rates in the absence of adjustment costs.

the discounted flow of lost profits arising from a nonequilibirum position exceeds the fixed costs of changing those rates.

Note that, 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, there exist alternative sources of finance to bank loans, even in thin financial markets. The difference between the short- and long- run elasticities explains why the financial structure may be particularly relevant in explaining why lending rates are sticky in the short run. If, in fact, the elasticity of demand increases over time, the cost of being outside the equilibrium position in each period and the discounted value of the stream of lost profits also rises. A bank will decide to raise lending rates only when the present value of the discounted stream of lost profits exceeds the fixed costs involved in changing them. If the elasticity of demand is lower in the short run, this will not occur until later in time.

Thus, the relation between lending rate stickiness and financial structure is therefore straightforward, as the latter clearly influences the elasticity of demand for loans. The demand for loans of each bank will indeed be less elastic in markets with fewer competitors, barriers to entry, or in the absence of sources of finance alternative to bank loans (e.g., other financial intermediaries, foreign capital markets, commercial paper or bankers' acceptances markets). In these markets lending rates may show a limited response to changes in money market rates. 1/

b. 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.

1/ According to a different approach, the stickiness-financial structure link can be explained within the class of monopolistic competition models by assuming the existence of "switching costs" faced by bank customers when changing banks (Klemperer (1987)). Switching costs can be explained by the fact that banks need to gather information on new customers. The cost of this activity will be passed to the new customer, for example, by way of a fixed up-front fee. Switching costs result in market segmentation. The higher the switching costs, the lower is the effect of money market rates on lending rates (Lowe and Rohlings (1992)). Moreover, banks may introduce artificial switching costs in the presence of barriers to entry, which provide link between financial structure and stickiness of lending rates.

c. Nonprofit maximizing behavior

The conclusion that bank lending rates should adjust promptly to changes in money market rates rests on the hypothesis that banks maximize profit. There may be conditions, however, that are related to the financial structure, for which this hypothesis does not hold. This may be the case, for example, of banking systems that are to a large extent government owned, particularly if barriers to entry are also present. In this case adjustments of lending rates may be delayed due to political pressures, or simply "inefficiency."

In general, it can be noted that banks will react more promptly to changes in money market conditions if nonprofit maximizing behavior is "penalized" by market forces. If these forces are weak (e.g., because of barriers to entry, absence of competition from nonbank intermediaries, constraints on international capital movements), inefficiency will not be penalized, which may result in lending rate stickiness. 1/

d. Oligopolistic competition models

Price stickiness has often been considered a feature of oligopolistic markets due to the uncertainty about the response of competitors to price changes, and/or to the fact that oligopolistic collusion may break down more easily when prices are changed. This approach does not imply a monotonic relation between the degree of stickiness and the concentration of the banking industry. However, it can justify some stickiness as the market deviates from perfect competition, at least until a clear market leader emerges. It also implies that the stickiness can be reduced if the central bank acts as a market leader by signaling, through changes in an administered discount rate, changes in the stance of monetary policy. The above argument has been used to explain the strong empirical relation between the discount rate and bank lending rates observed in many countries. 2/

1/ As discussed by Takeda (1985), interest rate stickiness may also be present if banks maximize their size rather than profits.

2/ If, however, money market changes have a strong random component, their signaling role will be reduced and discount rate changes will be more influential in speeding up the adjustment of lending rates (see (b) above and Kuroda (1980)).

III. The Empirical Model

1. Model presentation

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

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

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. 1/ Δ is the first difference operator, $u_{i,t}$ is an error term, and the β_is are parameters whose values vary across countries. Equation (1) reflects a fairly common approach to the modelling of the lending rate. Its steady state form (omitting the error term) is:

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

which is consistent with the monopolistic competition model relating the loan rate to the money market rate (i.e., 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 be influenced also 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 and because no detailed time series on the determinants of the demand for loans and on the possible indicators of riskiness (such as the bad loan to total loan ratio) were available. The possible omission of some variables explains why the error term in (1) cannot be assumed to be serially uncorrelated. We do assume, however, that $u_{i,t}$ is uncorrelated across countries. 2/

The dynamic specification reflects a partial adjustment model in which, along with the lagged dependent variable, the current and several lagged values of the money market rate are included. 3/ In addition, a

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1/ Notice that the sample period varies across countries (see Section IV.1).

2/ 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.

3/ This follows the prescriptions for dynamic model selection recommended, for example, by Harvey (1990).

polynomial distributed lag of the change in the discount rate is also included. This reflects the hypothesis, discussed at point d. in Section II. 2, that changes in the discount rate signal changes in the stance of monetary policy, thus speeding up the adjustment of lending rates, with no effect on their long-run equilibrium value. 1/

Given the cross country differences in the βs in (1), lending rates will react differently across countries, showing a different degree of stickiness to shocks in money market rates. To derive summary measures of the degree of stickiness, the following procedure was followed. From model (1) we derived sets of "multipliers" reflecting the adjustment of the lending rate during the period of the change of the money market rate (impact multipliers), and at different time lags (interim multipliers). These multipliers will be, in general, deterministic nonlinear functions of the βs:

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

where $h_{i,\ell}$ is the value of the multiplier for country i after ℓ periods, $\phi(.)$ is a nonlinear function (see Appendix I), 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:

$$h_{i,\ell} = Z_i \gamma_\ell + v_{i,\ell} \qquad (4)$$

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:

$$h_0 = Z\gamma_0 + v_0 \qquad (5)$$

. . . .

$$h_\ell = Z\gamma_\ell + v_\ell \qquad (6)$$

. . . .

$$h_L = Z\gamma_L + v_L \qquad (7)$$

where h_0 is a vector of impact multipliers (ℓ=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 after a shock in money market rates (all these vectors have M elements). Z is a (MxK) matrix of structural variables, and the v vectors are (Mx1) vectors of homoscedastic residuals, which are

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1/ For simplicity, no attempt was made to test whether the speed of adjustment of lending rates is faster for upward instead of downward changes of money market and discount rates, as sometimes argued (see the discussion in Hannan and Berger (1991)).

assumed to be independently distributed not only across countries, but also across time lags. 1/

The main focus of the paper was 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 IV), 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 V), the estimated vectors was regressed against the structural variables included in Z.

2. Model discussion

Before moving to the next sections, it is necessary to discuss some of the features of the above empirical model.

a. The definition of the multipliers

The multipliers defined above refer to the effect of a change in the money market rate on the lending rate, for 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, it is relevant to examine the reaction of lending rates to both money market and discount rates, since they are both controlled by the monetary authorities. The discount rate, however, is often not a market rate, but is set administratively. In those cases, we expect it to "signal" monetary policy changes even more effectively, and thus to speed up the adjustment of lending rates. Administered rates, however, may themselves show a high degree of stickiness, as they may be subject to more direct political pressures, and often require complex administrative procedures, or agreement among different monetary authorities (e.g., the central bank and the ministry of finance) before they are changed. 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.

1/ The absence of correlation across different time lags is a strong assumption (see point c. in Section 2 below).

b. The relation between the β coefficients and the h multipliers

In the above model the multipliers h, rather than the β coefficients, are modelled as a linear function of the structural variables Z. The reason is, that, as discussed in Section II, 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 βs and the Z matrix but such a relation would be inappropriate. Consider, for example, the following distributed lag model (the i subscript is omitted, for simplicity):

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

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

$$\beta_3 = Z\phi + \chi \qquad (9)$$

Based on the discussion in Section II, we expect that an increase in, say variable z_k will lead to a faster adjustment, i.e., to a larger multiplier after 2 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 (9). An increase in z_k may lead to an 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 coefficient we cannot infer the effect of z_k on one of the two.

c. The dynamic specification of the model and the two-step estimation procedure

Owing to the inclusion of the lagged dependent variable in equation (1), the relation between the β coefficients and the h multipliers is, as noted above, nonlinear. If (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 easily with standard econometric techniques. In this case, a two-step estimation process would not be necessary.

There are two reasons why the adopted specification was preferred. First, a dynamic specification including the lagged dependent variable is typically more parsimonious than the one based on distributed lags. Second, and more importantly, 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, in the right hand side, multiplied by several lags of the money market rate and of the discount rate. In the absence of a lagged dependent variable, the number of lags necessary to appropriately describe the dynamics of the lending rate is likely to be large. 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. 1/ This would make any serious specification search virtually impossible. In conclusion, there seems to be more to lose than to gain from a one step estimation procedure.

d. The relation between multipliers at different lags

The parameters γ in (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 does not involve simple linear constraints on the γs but nonlinear constraints on linear combinations of the γs (see Appendix I). Consequently, the existence of these constraints will be ignored in the second step of the estimation process.

e. The h multipliers are not observed but estimated

If the h multipliers were directly measured, the OLS estimates of equations (5)-(7) would be unbiased and efficient. However, the h multipliers are estimated from equation (1). Thus, for example, instead of h_0 we observe:

$$h_{0*} = h_0 + w_0 \qquad (10)$$

As the estimates of the various elements of vector h_0 are derived from different equations, they are likely to have different variance, i.e., the error term w_0 is likely to be heteroscedastic. If (10) is substituted in (5) we get:

$$h_{0*} = Z\gamma_0 + (v_0 + w_0) \qquad (11)$$

Therefore, the error term in (11) is also likely to be heteroscedastic due to the presence of w_0. The OLS estimates of (11) would still be unbiased, but not efficient. Moreover, the estimated standard errors of the γ coefficients would be biased, which would invalidate any hypothesis testing. The solution is to estimate equation (11) after adjusting for heteroscedasticity, i.e., through weighted least squares (Saxonhouse (1976), (1977)). 2/

1/ The multicollinearity arises not only from the presence of several lags of the money market and discount rates, but also from the fact that each of these lags would appear 10 times multiplied by the different structural variables.

2/ The use of weighted least squares implies that, in estimating (5) more weight will be given to the components of vector h_0 which have been estimated more accurately.

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 V will focus mainly on the impact multipliers, i.e., on the estimation of equation (5).

f. 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), which is in contrast with our theoretical discussion and with the experience of most countries. 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:

$$h = c \ / \ [1+\exp(-Z\gamma)] \qquad (12)$$

This way h would be constrained between 0 and c (a fixed parameter). By taking lags, equation (12) could be linearized:

$$lg(c/h - 1) = -Z\gamma \qquad (13)$$

This approach would not be problematic if h were observed. But, given (10), the error term would enter equation (11) non linearly (and, in addition, its variance would not be directly computable). On this account, the original linear formulation was maintained. As it will be shown, this does not seem to create problems in the estimation of equation (5) as all fitted values remained positive. 1/ However, the existence of minimum (and possibly maximum) values for h will have to be taken into account before using the estimated γ coefficients to project the effect of changes in the structure of the financial system.

IV. Step One: Analysis of Stickiness

1. The data

Having laid down the scheme of the empirical model, we can proceed to its estimation. The estimation of equation (1) for different countries requires the availability of monthly series of lending rates, money market

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1/ In other words, the nonnegativity constraints would become binding only for extreme values of Z which do not actually occur in the data sample.

rates, and discount rates. 1/ These data must be available for a sufficiently long period in which lending rates were not administratively controlled by the central bank 2/ and direct controls on the amount of credit were not in place. 3/ 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.

As detailed in Appendix II, 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 has been ignored in the first step of the estimation process, but has been taken into account in the second step (see Section V.1). The data on money market rates usually refers 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 the 31 sample countries) was assessed using augmented Dickey-Fuller tests. In almost all cases the series were found to be nonstationary. The implication of stationarity is that the coefficients of the OLS estimate of equation (1) may have nonstandard distribution, 4/ and that, consequently, the corresponding standard errors computed from OLS residuals may be biased, thus invalidating a specification search based on t-statistics.

There is no easy solution to this problem, as econometric analysis of nonstationary series is still under evolution. The use of a the two-step estimation procedure pioneered by Engle and Granger has been recently subject to much criticism, and does not solve the problem of the possible nonstandard distribution of the coefficients in the first step of the procedure. Some attempts were made to recast equation (1) in an error correction mechanism (ECM) form, but the results were not very encouraging,

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1/ 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.

2/ 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 the estimating equation (1) in countries which experienced ceilings started at least six months after their removal.

3/ 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 between 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 (Angeloni and Galli (1985)).

4/ It must be recalled that nonstationarity does not necessarily imply nonstandard distribution of coefficients (West (1989)).

possibly because the ECM specification constrains to unity the long-term coefficient relating the lending rate to the money market rate, while specification (1) leaves it unconstrained.

We eventually decided to estimate equation (1) through OLS, thus relying on the possibility that the estimated standard errors are not excessively biased by the use of possibly nonstationary series. 1/ The model was also estimated in first differences, which in most cases was sufficient to remove the nonstationarity. 2/ We will discuss therefore two sets of results, referred to, respectively, as "Model 1" (estimates in levels) and "Model 2" (estimates in first differences) results.

2. Estimation results

Based on the previous discussion, equation (1) was estimated for the 31 sample countries both in levels and in first differences. 3/ While detailed results are presented in Appendix II, Table 2 shows the estimated multipliers of changes in money market rates at different time lags. With reference to Model 1, columns 1-4 report, respectively, the impact multiplier, the multiplier after three and 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 coefficient (i.e., the ratio between standard deviation and mean) of each column. Based on these results, Table 3 presents some correlation coefficients describing the relation between the sets of multipliers computed at different lags, and between the two different models. The following features clearly stand out.

1/ Clearly the reported t statistics must be interpreted with some caution. However, one cannot help remarking that the power of the commonly used stationarity tests (including the Dickey-Fuller test used here) has been subject to much debate. Indeed, the issue of nonstationarity of even the most commonly used series, such as U.S. GDP, is still debated.

2/ We have been initially reluctant to use first differences because, in differencing equation (1), the information embodied in the level of interest rates is lost, and because, if the error in the equation in levels were uncorrelated, first differencing would introduce residual autocorrelation. However, these shortcomings may not be too serious: first, because we are concerned mainly with the response of lending rates to changes in the money market rates (rather than the determinants of the level of lending rates); and second, because the presence of autocorrelation can be removed by standard procedures (e.g., Cochrane-Orcutt). Indeed, first differencing can explain why many of the equations estimated in this form showed negative autocorrelation, with an autocorrelation coefficient close to -0.5 (see Appendix II).

3/ 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 2. Multipliers (Effect on the Lending Rate of Changes in Money Market Rates)

	Model 1				Model 2			
Country	Impact	3 months	6 months	Long run	Impact	3 months	6 months	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
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
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
Japan	0.06	0.19	0.25	0.75	0.03	0.22	.35	0.53
Malaysia	0.16	0.29	0.39	0.91	0.13	0.28	0.37	0.44
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 1/	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
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
Colombia	0.42	0.87	0.97	1.03	0.44	0.76	1.06	1.06
Venezuela	0.38	1.03	1.30	1.48	0.24	0.75	0.75	0.75
Jamaica	0.15	0.38	0.66	0.92	0.24	0.37	0.77	0.77
Swaziland	0.48	0.52	0.54	0.57	0.54	0.66	0.66	0.66
Indonesia	0.19	0.59	0.84	1.21	0.20	0.74	0.74	1.00
Iceland	0.61	1.04	1.07	1.08	0.61	1.06	1.06	1.06
Mexico	0.83	1.40	1.34	1.29	0.72	1.30	1.10	1.30
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

1/ Model 2 was not estimated for Poland.

Table 3. Correlation Between Multipliers

At different lags

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

Between different models			Between absolute and percentage multipliers	
			Model 1	Model 2
h_0	0.97	h_0	0.94	0.94
h_3	0.91	h_3	0.86	0.81
h_6	0.86	h_6	0.77	0.47
h_L	0.74			

a. The results are robust with respect to the model specification

Models 1 and 2 yield very similar measures of the multipliers. As reported in Table 3 (bottom, left), the correlation coefficient between the impact multipliers of Model 1 and of Model 2 (i.e., between the first and fifth columns of Table 2) is 0.97. The correlation declines at longer lags, but remains fairly high even for the long-run multipliers (0.74). Thus, the results seem to be robust with respect to different model specifications.

b. The degree of stickiness is 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 in three fourths of all cases it falls within the range of 0.75-1.25), the impact multiplier is only one third of the long-run multiplier. 1/ 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 latter must be raised by 300 basis points. Also on average, after three and six months, respectively, about one third and one fourth of the adjustment still remains to be completed.

c. There are 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 in the short than in the long run. This result 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 V. 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.

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

1/ Given the similarity of the results of the two models, we will comment only the Model 1 estimates.

d. Absolute and percentage multipliers

It could be argued that, rather than looking at the absolute value of the multipliers, a better assessment of the short run stickiness of lending rates could be achieved by looking at the ratio between short-run and long-run multipliers (percentage multipliers), and that, consequently, such a ratio should appear as a dependent variable in equation (5). While we agree that such a ratio would provide a better measure of lending rate sluggishness, there are two reasons why the use of absolute values is preferable. First, from a policy perspective, absolute values are more relevant. Second, using the ratio between two estimated coefficients would require a linear approximation to their variance in the application of weighted least squares, which is best to avoid. From a practical point of view, however, the choice between absolute and percentage multipliers does not seem to be very relevant. As reported in Table 3 (bottom, right) the correlation between relative and percentage multipliers is very high, particularly for the impact multiplier.

e. The relevance of discount rate changes

Table 4 reports the effect of discount rate changes on lending rates for the countries in which such a variable was significant. The discount rate appears to be a powerful instrument in 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 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 from 26 to 89 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). 1/ It is natural to wonder whether the stickiness of lending rates and the effectiveness of the discount rate are not interrelated. 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 argued 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.

1/ Note also that, for the countries in which the discount rate is significant, the correlation between the size of the impact multiplier of money market rates and those of the discount rate is negative.

Table 4. 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	--	--
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	--	--
United States	0.49	0.21	0.09	0.29	--	--
Swaziland	0.32	0.19	0.11	0.23	--	--
Iceland	0.25	0.02	0.01	--	--	--
Mean	0.47	0.31	0.21	0.40	0.34	0.30

Both these interpretations involve a negative statistical relation between the impact multipliers of money market changes and those of discount rate changes. The first interpretation, however, 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 for 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, <u>in addition</u> 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 appear significant, and with negative sign, in the step two regression. The discount rate addiction hypothesis will be tested in Section V.

V. Step Two: The Determinants of the Stickiness of Lending Rates

1. The structural variables

Step two--the estimation of the relation between multipliers and structural variables--requires the identification and measurement of the relevant structural variables. Based on the discussion in Section II, four groups of structural variables (relating to the degree of bank competition, the degree of development of money markets 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 measured 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 presenting these variables, two caveats are necessary.

First, while the range of included structural variables 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 in interpreting the results. 1/

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. 2/ 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

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1/ 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 between banks and nonbanks.

2/ In a very limited number of cases (see Appendix III) no observation was available even for a single year of the sample. In this case, the missing observation was replaced by the average of the observations available for the other countries. This may not be optimal but is by far the simplest method to deal with the problem of missing observations (Maddala (1979)).

period. 1/ The selected structural variables are described in the next paragraphs.

a. Competition within the banking system

As in most studies of the banking structure-performance relation, the degree of competition within the banking system has been proxied by variables measuring the degree of concentration of the banking system, such as the market share of the largest five banks (MARSH) and the number of bank branches per 100,000 inhabitants (NOBRA). 2/ 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 multipliers). 3/

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 very concentrated markets can behave like competitive markets if firms are subject to the threat of entry of new competitors. On this account, we have 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

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1/ More precisely, to account for lags in the effect of structural changes, the averages were computed starting two years before the beginning, and ending two years before the end, of the sample period over which the step one equations were estimated.

2/ These are, admittedly, very imperfect measures of concentration (but see Revell (1988), for a different view). Herfindhal indexes, if available, would have been preferable.

3/ This, on account of the lower demand elasticity in less competitive markets, and of the presumed higher stickiness of oligopolistic prices. It has been noted in Section II 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 MARSH has also been introduced in terms of absolute deviations from its sample mean (so that very concentrated and very fragmented markets would behave similarly). However, this has not yielded substantially different results from those reported in Section V.1.

an expected positive sign. 1/ Moreover, in some regression specifications, the variable MARSH and NOBRA have been included in the following form:

$$MARSH^{*} = (4 - ENTRY)*MARSH \quad (12)$$
$$NOBRA^{*} = (4 - ENTRY)/NOBRA \quad (13)$$

Equations (12) and (13) imply that the degree of market concentration becomes relevant only in the presence of barriers to entry. 2/ The stronger those barriers, the greater the impact of market concentration on the multipliers.

b. The degree of development of the money market and the openness of the economy

The degree of development of the money market 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. That is because, in the presence of adjustments 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. 3/

The second aspect that has been 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

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1/ The reason to prefer an index based on the opening of new branches with respect to an index based on the licensing of new banks is that the legislation on new banks is relatively similar across countries (bank licenses are always requested, although the law may or may not set constraints on the freedom of the bank supervisor to grant licenses), so that the actual existence of barriers to entry will depend on the attitude of the bank supervisor, rather than on the law. There are sharper differences, instead, in the regulation on new branches, which is entirely free in some countries (bank supervisors have simply to be notified of new branch openings), requires approval on a case by case basis, or may be entirely prohibited (unit branching regulations in some U.S. states are an example).

2/ Note that, in this specification, the expected sign of $NOBRA^{*}$ is now negative (as NOBRA appears in the denominator), while the expected sign on $MARSH^{*}$ continues to be negative.

3/ For simplicity, the same (2,1,2) ARIMA model was fitted to all series.

country's GDP. 1/ 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. 2/

An additional variable (CAPCO) has been introduced to capture the barriers to foreign competition. CAPCO, whose expected sign is negative, takes value 1 in the presence of constraints on capital flows and value zero otherwise. 3/

c. Banking system ownership

As more comprehensive measures of the degree of public sector ownership were not easily available, the public/private nature of the banking system, which is used as a proxy for its overall degree of efficiency, has been measured by a variable (PUBLI). PUBLI is equal to the number of public banks out of the five largest ones, and is expected to be negatively related to the impact multipliers.

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

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

i.e., 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 implied that the effect of OTHMA was approximately linear.

2/ Indeed, reducing the stickiness of lending rates was one of the reasons why negotiable CDs were introduced in Italy (Carosio (1982)).

3/ No attempt has been made to differentiate by type of controls on capital movements, or to measure their intensity. Annual information on these variable has been derived from Alesina, Grilli, and Milesi Ferretti (1993). Average annual values have been used.

d. The 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 remarkable correlation with the ratio between financial assets and GDP; 1/ 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.

e. Additional variables

In order 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 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 (Lowe and Rohling (1992)), and because adjustment costs for changing posted rates are lower than for actual rates. The variable POSTE takes 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 an 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 III). EDISC, which is defined as a dummy variable taking value 1 for the countries in which the discount rate was significant in the step one regressions, is expected to have negative sign if the addiction hypothesis is true.

1/ 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.

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 overestimate of the speed of adjustment. Therefore, we expect the sign of DUSHO to be positive.

2. Specification search and preferred equations

a. Impact multiplier equation

Tables 5-6 report the estimates of equation (5), i.e., of the relation between impact multipliers and the structural variables, for Model 1 and Model 2 respectively. Following the "from general to specific" approach, the specification search started with the inclusion of all exogenous variables listed above. 1/

With reference to Model 1, the estimates of the most general specifications are reported as equations (1)-(2) in Table 5, which refer, respectively, to the OLS and weighted least squares (WLS) results. While the two equations are quite similar, it is confirmed that the use of OLS would have produced artificially low coefficient standard errors (and correspondingly higher t-statistics). However, even the efficiently estimated equation (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. 2/ Out 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, 3/ leaving per capita GDP as the only significant variable with the "wrong" sign. As recalled, this variable acts as a proxy for the level of financial development, and thus is not important on its own. Therefore, it was dropped in equation 3, without any major change in the other coefficients and t-statistics.

1/ 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. Tables 5 and 6 only report the results for GDPPC, as M2GDP and M2OM1 were never significant. The DUSHO variable also was never significant and was dropped to save degrees of freedom.

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

3/ 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 5. Estimates of Equation (5) (Dependent Variable: Impact Multipliers from Model 1)

Estimation Technique	N	Constant	INFLA	PRIME	POSTE	CAPCO	RANDO	ENTMA	OTEMA	PUBLI	GDPPC	MARSH 1/	NOBRA 1/	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	0.087
		(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	0.23	-0.29	-0.14	-0.030	...	0.010	-0.027	...	...	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)	(0.81)	(-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)	(-3.71)		
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)		

1/ In equations 7-9 this variable is adjusted for the existence of barriers to entry (see Section V. 1)

Table 6. Estimates of Equation (5) (Dependent Variable: Impact Multipliers from Model 2)

Estimation Technique	N	Constant	INFLA	PRIME	POSTE	CAPCO	RANDO	ENTMA	OTHMA	PUBLI	GDPPC	MARSH 1/	NOBRA 1/	ENTRY	EDISC	AR^2	SE
OLS	1	0.51	0.011	0.26	-0.33	-0.16	-0.035	-0.004	0.011	-0.059	-1.11	0.070	0.002	0.030	-0.16	0.95	0.77
		(4.73)	(10.33)	(5.55)	(-6.25)	(-3.44)	(-7.28)	(-0.78)	(4.96)	(-5.45)	(-2.33)	(0.61)	(1.49)	(2.33)	(-4.40)		
WLS	2	0.54	0.013	0.25	-0.36	-0.20	-0.041	-0.002	0.014	-0.043	-1.39	0.076	0.003	0.026	-0.19	0.82	0.106
		(4.93)	(8.11)	(3.89)	(-3.46)	(-3.14)	(-6.30)	(-0.31)	(4.59)	(-3.10)	(-2.41)	(0.50)	(2.38)	(1.42)	(-3.77)		
WLS	3	0.33	0.012	0.29	-0.23	-0.12	-0.033	-0.013	0.011	-0.037	...	0.070	0.002	0.028	-0.23	0.78	0.116
		(4.31)	(6.86)	(4.16)	(-2.27)	(-1.94)	(-5.20)	(-1.75)	(3.57)	(-2.38)	...	(0.40)	(1.50)	(1.36)	(-4.30)		
WLS	4	0.28	0.012	0.27	-0.28	-0.09	-0.031	...	0.010	-0.027	...	...	0.002	0.029	-0.20	0.78	0.117
		(3.51)	(6.43)	(5.36)	(-3.80)	(-1.68)	(-4.90)	...	(3.58)	(-1.94)	...	...	(1.54)	(1.78)	(-3.70)		
WLS	5	0.33	0.013	0.31	-0.24	-0.06	-0.036	...	0.009	-0.022	...	...	0.004	...	-0.25	0.72	0.133
		(4.22)	(6.41)	(6.88)	(-3.23)	(-1.16)	(-6.33)	...	(3.03)	(-1.52)	...	...	(3.63)	...	(-5.44)		
WLS	6	0.27	0.011	0.23	-0.29	-0.08	-0.026	...	0.012	-0.040	...	...	...	0.046	-0.15	0.81	0.109
		(3.28)	(6.09)	(5.26)	(-3.77)	(1.47)	(-4.59)	...	(4.51)	(-3.57)	...	...	...	(3.80)	(-3.32)		
OLS	7	0.41	0.011	6.23	-0.33	-0.16	-0.031	-0.005	0.012	-0.065	-0.77	0.064	-0.066	0.069	-0.13	0.95	0.079
		(2.27)	(10.45)	(1.11)	(-5.90)	(-3.33)	(-6.65)	(-1.02)	(5.78)	(-6.53)	(-1.58)	(1.38)	(-0.50)	(3.04)	(-3.80)		
WLS	8	0.41	0.011	0.22	-0.32	-0.17	-0.032	-0.008	0.015	-0.058	-0.82	0.004	0.022	0.68	-0.14	0.85	0.097
		(2.58)	(6.84)	(3.48)	(-2.90)	(-2.49)	(-5.49)	(-0.92)	(5.20)	(-4.24)	(-0.99)	(0.62)	(0.12)	(2.90)	(-2.68)		
WLS	9	0.25	0.011	0.18	-0.34	-0.13	-0.028	...	0.014	-0.047	...	...	0.22	0.063	-0.14	0.82	.108
		(3.08)	(6.47)	(3.88)	(-4.28)	(-2.13)	(-5.05)	...	(4.99)	(-4.08)	...	...	(1.70)	(4.11)	(-3.28)		

1/ In equations 6-8 this variable is adjusted for the existence of barriers to entry (see Section V. 1).

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

In equations (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 nonsignificant. GDPPC is also not significant, while ENTRY is significant even in the most general specification. This confirms equation (6) as the preferred equation.

The results of the regressions based on Model 2 multipliers (Table 6) are very similar to those obtained using the Model 1 multipliers. The only appreciable difference between the two is the somewhat lower level of significance for the international capital flow constraints variable. Following a similar specification search as above, equation (6) emerges as the preferred equation.

b. Interim and long-term multiplier equations

While for the reasons discussed in Section III, the focus of the paper is on the impact multipliers, it is worthwhile to see how the estimated equations behave when applied to interim and long-term multipliers. 3/

1/ Their correlation coefficient is 0.52, i.e., the number of branches is higher in countries with lower barriers to opening new branches.

2/ It can be noted that the adjusted R^2 of equation (6) is almost as high as that of the overparametrized equation (2). This indicates that the significance of the "wrongly signed" GDPPC may have been spurious.

3/ As noted in Section III, 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.

These estimates, reported in Table 7-8 (again, for Model 1 and 2) together with the preferred impact equations, show a much worst fit. The adjusted R^2 drops to 0.50 for the three month multiplier, to 0.23 for the six month multiplier, and becomes negative for the long-run multiplier. 1/ This is not surprising, because, as noted, 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 remarkable that the signs and, to some extent the significance, of the coefficients remains unchanged, particularly up to the six month multiplier equation.

3. Discussion of the econometric results

The above results strongly support the analytical discussion of Section II.

a. The 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.

b. The 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.

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

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

Table 8. Estimates of the Interim and Long-Term Multiplier Equations
(Dependent Variable: Multipliers from Model 2)

Estimation Technique	Multi-plier	Constant	INFLA	PRIME	POSTE	CAPCO	RANDO	OTHMA	PUBLI	ENTRY	EDISC	AR^2	SE
WLS	Impact	0.27 (3.28)	0.011 (6.09)	0.23 (5.26)	-0.29 (-3.77)	-0.08 (-1.47)	-0.026 (-4.59)	0.012 (4.51)	-0.040 (-3.57)	0.046 (3.80)	-0.15 (-3.32)	0.81	0.109
WLS	3 months	0.64 (3.59)	0.015 (3.73)	0.23 (2.48)	-0.23 (-1.38)	-0.19 (-1.59)	-0.039 (-3.16)	0.022 (3.91)	-0.040 (-1.66)	0.041 (1.56)	-0.21 (-2.22)	0.34	0.241
WLS	6 months	0.85 (4.84)	0.012 (3.21)	0.14 (1.57)	-0.13 (-0.77)	-0.21 (-1.74)	-0.041 (-3.41)	0.022 (3.82)	-0.027 (-1.11)	0.031 (1.21)	-0.27 (-2.80)	0.01	0.245
WLS	Long run	1.10 (6.06)	0.011 (2.73)	0.04 (0.46)	-0.22 (-1.30)	-0.28 (-2.30)	-0.04 (-3.45)	0.021 (3.59)	-0.03 (-1.26)	0.008 (0.29)	-0.31 (-3.07)	-0.08	0.243

c. The 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 9). 1/

First, the stickiness of lending rates has been shown to be influenced by the existence of constraints on competition among banks, and in particular, by the existence of barriers to entry (here measured by constraints in setting up new bank branches). 2/ 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. 3/ 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. 4/

Second, lending rates appear to be stickier in publicly owned banking systems, 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, at least according to Model 1, the effect would be even higher for the three- and six-month multipliers.

1/ Table 9 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 point (e) in Section III.2).

2/ As mentioned similar results have been obtained by using a measure of the actual diffusion of bank branches.

3/ 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.

4/ 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 2), 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 U.S. and Canada, see Shaffer (1993).

Table 9. Effect of Structural Changes on the Lending Rate Multiplier

	Model 1			Model 2		
Structural Change	Impact	3 months	6 months	Impact	3 months	6 months
Removal of barriers to entry	0.14	--	--	0.19	--	--
Privatization of the banking system	0.23	0.34	0.27	0.20	--	--
Removal of capital controls	0.12	--	--	--	--	--
Creation of a money market (equal to 15 percent of GDP)	0.20	0.32	0.36	0.18	0.33	0.33
50 percent reduction of "noise" on the money market rate 1/	0.13	0.18	0.18	0.13	0.20	0.11

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

Third, capital controls reduce competitive pressures on the banking 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 in Model 1), and is statistically insignificant afterwards. 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. 1/

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 point 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 and small enterprises, and to households.

Fifth, quite intuitively, lending rates do not follow money market rates which 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.

d. The role of the discount rate

One feature of the regressions presented in Tables 5-7 is the statistical significance, and the negative sign, on 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 by 15-30 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 IV.

It could be argued that, based on the estimated coefficient on EDISC, the stickiness attributed to "discount-rate-addictions" is relatively

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1/ Indeed, while the t-statistics of CAPCO fall after the impact multiplier, the estimated coefficient remains high for both Model 1 and 2.

contained, and that it is a reasonable price to pay to acquire an effective instrument such as an administratively controlled discount rate. However, it must be noted that 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 therefore, it may 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 <u>only for some periods</u>, as an administered signaling device.

Table 10 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 (i.e., 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 equation 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). Between April 11, 1978 and August 20, 1981 the MLR was administered. 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 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 August 20, 1981, it was stated that the MLR would no longer be announced continuously: greater reliance was to be placed on market forces in the determination of interest rates, ..." (page 163).

Equation (4) shows that, after the suspension of the MLR in August 1981, money market rates became once again the main determinant of lending rates, with very short adjustment lags. 1/

1/ It must be noted that, 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 signaling device of monetary policy changes. This rate has been shown to affect quite rapidly money market and bank interest rates (Dale (1993)). The differences, with respect to 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, have a lower political impact and, therefore, can be used more flexibly.

Table 10. 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 (2.10)	0.63 (6.68)	0.77 (7.46)	-0.41 (-2.80)	-0.01 (-0.09)	... ...	... ...	... ...	0.42	0.02
78:04-81:02	2	0.10 (0.73)	0.99 (39.52)	... (0.11)	0.01 (0.38)	0.95 (32.73)	... ...	... ...	... ...	0.12	-2.87
78:04-81:02	3	0.98 (5.26)	0.03 (0.15)	... ...	... ...	... ...	0.97 (5.40)	... ...	... ...	0.09	0.03
81:03-93:03 1/	4	0.87 (5.16)	0.38 (6.04)	0.86 (18.82)	-0.23 (-3.53)	... ...	... ...	... ...	... ...	0.33	0.03
Canada											
73:01-80:02	5	0.14 (1.28)	0.93 (34.98)	0.01 (0.09)	0.05 (0.53)	0.95 (8.58)	... ...	... ...	... ...	0.17	0.17
73:01-80:02	6	0.12 (1.20)	0.95 (28.79)	... ...	... ...	... ...	0.93 (16.73)	-0.68 (-7.27)	-0.20 (-3.59)	0.17	0.28
80:03-91:10	7	0.13 (1.45)	0.76 (17.51)	0.01 (0.14)	0.26 (4.51)	0.79 (13.11)	... ...	... ...	... ...	0.24	-1.49

1/ A dummy variable in January 1985 was also included (see Appendix III).

The experience of Canada was similar. Until March 1980 the discount rate was set on a discretionary basis 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 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. 1/

VI. Conclusions and Policy Implications

Several conclusions can be drawn from the above analysis, some of which have interesting policy implications.

1. Measurement of lending rate stickiness

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 been previously made to measure the different degree of stickiness of lending rate across countries and to explain the observed differences. This paper has attempted such a measurement and, by doing so, it 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 in the same month when

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1/ 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 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. 56-57)). The fact that the discount rate can be the reference rate for banks only if it is not excessively out of line with respect to money market rates has been recognized in the lending rate equation of the Bank of Italy econometric model. In this equation the impact coefficient of the discount rate is a negative function of the absolute difference between the discount rate and the treasury bill rate (Banca d'Italia (1986)).

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.

2. The relevance of structural financial variables

The paper has 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 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 (e.g., 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).

3. Regulation and monetary policy

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," i.e., 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 one side, 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 the barriers to competition (such as barriers to entry, and constraints on capital movements).

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. Policies favoring bank mergers, such as those implemented by some European countries in the last few years, may not be inconsistent with competition.

Privatization policies also appear to affect the responsiveness of lending rates to monetary policy stimuli, possibly because private banks are more efficient, or less subject to political constraints.

Finally, 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 more difficult for banks to identify durable changes in interest rates. There may therefore be a case for policies aiming at smoothing money market rate fluctuations. 1/

4. Implications for the shift from direct to indirect monetary controls

Direct credit ceilings were common in many industrial countries during the 1960s and 1970s, and are still widely used in developing countries. As noted by a report prepared by central bank economists in the early '70s:

> "... 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 liquidity and interest rates" (BIS (1971)).

One of the reasons for the limited responsiveness of the system 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.

5. Discount rate policy

The paper has implications also for the use of the discount rate as monetary policy instrument. By signalling fundamental changes in the stance of monetary policy, 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 may be a strong case for using an administered

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1/ These policies may include structural regulatory changes, such as reserve averaging and lagged reserve requirements.

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, i.e., by linking it to money market rates (as done in Canada) or by suspending its announcement (as done in the United Kingdom), and relying entirely on a transmission mechanism based on market determined interest rates.

Relation Between the γ Coefficients at Different Lags

As discussed in section III.2.d, 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: 1/

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

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) 2/ can be expressed in terms of β coefficients as:

$$h_0 = \beta_2 \qquad (I.2)$$

$$h_1 = \beta_2(1+\beta_1) \qquad (I.3)$$

$$h_2 = \beta_2(1+\beta_1 + \beta_1^2) \qquad (I.4)$$

Consistently with equation (4) in section III.1, the multipliers are expressed as a function of the structural variables (two in this example), denoted as z_1 and z_2:

$$h_0 = \gamma_{01}z_1 + \gamma_{02}z_2 + \epsilon_0 \qquad (I.5)$$

$$h_1 = \gamma_{11}z_1 + \gamma_{12}z_2 + \epsilon_1 \qquad (I.6)$$

$$h_2 = \gamma_{21}z_1 + \gamma_{22}z_2 + \epsilon_2 \qquad (I.7)$$

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

$$\beta_2 = \gamma_{01}z_1 + \gamma_{02}z_2 + \epsilon_0 \qquad (I.8)$$

$$\beta_2(1+\beta_1) = \gamma_{11}z_1 + \gamma_{12}z_2 + \epsilon_1 \qquad (I.9)$$

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

Using vector notation, equations (I.8)-(I.10) can be re-written as:

$$\beta_2 = Z'\gamma_0 + \epsilon_0 \qquad (I.11)$$

1/ All of the following equations should be considered as referring to a single country; for simplicity the subscript i used in section III has been dropped.

2/ We stop at lag 2 for simplicity. The algebra becomes increasingly complicated at longer lags.

$$\beta_2(1+\beta_1) = Z'\gamma_1 + \epsilon_1 \quad \text{(I.12)}$$

$$\beta_2(1+\beta_1+\beta_1{}^2) = Z'\gamma_2 + \epsilon_2 \quad \text{(I.13)}$$

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 (I.11) and (I.12) the following relation between γ_0 and γ_1 can be derived:

$$(Z'\gamma_0+\epsilon_0)(1+\beta_1) = Z'\gamma_1 + \epsilon_1 \quad \text{(I.14)}$$

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

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

Equation (I.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 (I.15) is on linear combinations of the elements of the γ vectors and not on the elements of the vectors.

Step One Regressions

Tables 11-12 report the OLS estimates of the step one regressions (equation (1) in the text) illustrating the relation between the lending rate (i), the money market rate (m), and the discount rate (d) in the countries included in our sample (see Table 13 for a definition of the lending and the money market rates used in each country). The tables report, for each country, the sample period, the estimated coefficients, the autocorrelation coefficient (when the equation was adjusted for residual autocorrelation through the Cochrane-Orcult procedure), the H-statistics or the Durbin-Watson statistics (respectively for the equations including and excluding the lagged dependent variable), the adjusted R^2, and the equation standard error as a percentage of the lending rate average.

Table 11 refers to the model estimated in levels (Model 1 in the text), while Table 12 refers to the model estimated in first differences (Model 2). In both cases the specification search started with an "overparametrized" specification including several lags for both the money market rate and the change in the discount rate, together with the lagged dependent variable. The tables report only the preferred equations, which were identified based on the coefficient t-statistics of the initial specifications. As indicated in the tables, in about one third of cases, use was also made of dummy variables to exclude months in which the residuals were particularly high (possibly due to errors in the original data). 1/

The main features of the results have already been discussed in the text. We comment here only on some additional features.

First, the estimated equations show a good fit, with standard errors exceeding 3 percent of the average lending rate only in 23 percent and 30 percent of the cases, respectively, for Model 1 and 2. Adjustment for residual autocorrelation was necessary in about 30 percent of cases.

Second, the number of lags included in the Model 2 equations is always larger than in Model 1 equations. In the former, with two exceptions, the lagged dependent variable is never significant. 2/

1/ We also checked that the estimated coefficients were not substantially affected by the inclusion of dummy variables. Dummy variables were included for Italy in the months in which ceilings on lending were temporarily reintroduced (first six months of 1986, and October-March 1987). The reason is that the relation between lending rates and money market rates is affected by the existence of credit ceilings (see Section IV. 1).

2/ The constant is never significant, since first differencing removes constant terms from the equations.

Third, in the case of Greece a linear trend was also included. This is introduced to capture the gradual reduction in the differential between lending rate and money market rate due to the removal of the constraints on the banking system during the sample period. 1/

Fourth, no first difference equation was estimated for Poland, due to the lack of sufficient degrees of freedom (as noted, first difference equations require longer lags).

Fifth, in the first difference equation for Sri Lanka the coefficients on the change in the money market rate showed a very low level of significance, a possible indication that in that country the discount rate is the only relevant variable affecting lending rates. However, despite their low significance level, they were maintained in the preferred equation for consistency with the Model 1 specification. Their estimated value is, anyway, quite low.

Finally, it must be noted that the equations for Canada include the change in the discount rate among the regressors. Yet, in Table 4 the discount rate is reported to have no independent effect on lending rates. The reason is that in Canada the discount rate is indexed to the latest Treasury bill auction rate which becomes available on the last Wednesday of the month. As expected, the discount rate does not affect the lending rate, which is also observed on Wednesdays. The latter is instead influenced by the contemporaneous discount rate, which is equal to the Treasury bill rate of the preceding Thursday plus 25 basis points. In conclusion, the discount rate replaces the Treasury bill rate prevailing one weak before the date when the lending rate is measured.

1/ Trend variables were initially included for some other countries, but were never significant.

Table 11. Model 1

(<u>In levels</u>)

Country	Estimation Period	Constant	i_{t-1}	m_t	m_{t-1}	m_{t-2}	m_{t-3}	Δd_t	Δd_{t-1}	ρ	H	Adjusted R^2	Standard Error 1/
Australia	86:01-93:04	0.31	0.90	0.11	--	--	--	0.20	--	--	-0.26	0.988	2.2
		(1.12)	(28.33)	(3.88)	--	--	--	(2.43)	--	--			
Belgium	85:05-93:03	0.75	0.80	0.20	--	--	--	0.68	--	--	-1.02	0.971	2.5
		(2.92)	(16.12)	(4.16)	--	--	--	(8.04)	--	--			
Canada	81:01-92:10	0.15	0.77	--	0.25	--	--	0.76	--	--	-1.55	0.995	2.0
		(1.70)	(18.99)	--	(5.97)	--	--	(23.71)	--	--			
Denmark	82:02-90:01	0.63	0.90	0.07	--	--	--	1.25	--	--	0.48	0.970	2.3
		(2.08)	(24.87)	(2.91)	--	--	--	(7.52)	--	--			
Finland	87:07-93:03	0.23	0.94	0.13	-0.09	--	--	0.45	--	--	0.12	0.990	1.0
		(1.64)	(46.48)	(8.11)	(-5.04)	--	--	(8.67)	--	--			
Germany	80:01-93:03	0.41	0.83	0.38	-0.20	--	--	0.23	--	--	0.63	0.995	1.8
		(4.65)	(30.68)	(8.60)	(-3.86)	--	--	(2.41)	--	--			
Greece 2/	88:01-93:05	0.43	0.79	--	--	0.23	--	--	--	--	-0.83	0.990	1.1
		(0.65)	(19.66)	--	--	(3.57)	--	--	--	--			
Hungary	89:01-93:05	0.76	0.90	0.09	--	--	--	--	--	--	-0.82	0.991	1.9
		(1.97)	(56.23)	(7.36)	--	--	--	--	--	--			
Ireland	86:01-91:12	...	0.69	0.32	--	--	--	0.36	0.24	--	-1.47	0.970	3.0
		...	(15.25)	(6.51)	--	--	--	(3.87)	(3.85)	--			

Table 11 (continued). Model 1

(In levels)

Country	Estimation Period	Constant	i_{t-1}	m_t	m_{t-1}	m_{t-2}	m_{t-3}	Δd_t	Δd_{t-1}	ρ	H	Adjusted R^2	Standard Error 1/
Israel 3/	91:03-92:12	1.89	0.38	0.77	--	--	--	--	--	0.92	-0.80	0.979	2.8
		(0.50)	(4.68)	(10.91)	--	--	--	--	--	(7.43)			
Italy 4/	85:06-93:02	-0.06	0.91	0.12	--	--	--	0.62	0.19	0.34	0.35	0.992	0.8
		(-0.28)	(49.74)	(6.94)	--	--	--	(8.82)	(3.02)	(3.08)			
Japan 5/	80:01-93:02	0.05	0.96	0.06	--	--	--	0.08	0.14	0.76	0.19	0.999	0.8
		(0.66)	(41.94)	(4.89)	--	--	--	(5.13)	(8.16)	(12.81)			
Malaysia	86:01-92:10	0.15	0.94	0.16	-0.19	0.16	-0.08	--	--	-0.50	0.36	0.971	2.8
		(1.31)	(55.96)	(6.39)	(-4.55)	(3.97)	(-3.12)	--	--	(-4.94)			
Netherlands	80:01-93:03	0.68	0.50	0.52	--	--	--	0.69	--	--	0.55	0.980	3.1
		(6.94)	(10.56)	(10.06)	--	--	--	(8.23)	--	--			
New Zealand	87:02-92:10	2.02	0.69	0.09	0.11	--	--	--	--	--	0.60	0.993	1.5
		(8.23)	(25.57)	(3.46)	(3.66)	--	--	--	--	--			
Philippines	86:01-93:02	0.83	0.78	0.27	0.20	-0.28	--	--	--	-0.52	-0.61	0.947	5.0
		(2.09)	(11.05)	(5.60)	(2.55)	(-4.37)	--	--	--	(-5.11)			
Poland 6/	91:06-93:06	2.07	0.93	0.04	--	--	--	1.03	--	--	-1.58	0.973	1.4
		(0.94)	(22.10)	(1.70)	--	--	--	(7.88)	--	--			
Portugal	91:02-93:04	0.21	0.75	0.28	--	--	--	--	--	-0.42	-0.42	0.946	1.9
		(0.29)	(8.92)	(3.55)	--	--	--	--	--	(-2.10)			

Table 11 (continued). Model 1

(In levels)

Country	Estimation Period	Constant	i_{t-1}	m_t	m_{t-1}	m_{t-2}	m_{t-3}	Δd_t	Δd_{t-1}	ρ	H	Adjusted R^2	Standard Error 1/
Singapore 7/	80:01-93:03	0.15	0.93	0.27	--	-0.12	--	--	--	--	0.04	0.992	2.6
		(1.78)	(36.01)	(16.70)	--	(-5.27)	--	--	--	--			
South Africa	82:03-93:02	0.69	0.82	0.61	-0.43	--	--	0.18	--	-0.22	-0.61	0.985	2.3
		(2.46)	(15.64)	(7.23)	(-4.11)	--	--	(2.23)	--	(-2.39)			
Spain	82:01-92:12	-0.05	0.75	0.35	-0.07	--	--	--	--	--	0.96	0.965	3.5
		(-0.18)	(23.34)	(12.50)	(-1.92)	--	--		--	--			
Sri Lanka 8/	83:01-93:01	3.12	0.64	--	0.11	--	--	0.15	0.39	--	1.51	0.710	6.3
		(4.79)	(9.88)	--	(3.08)	--	--	(1.89)	(5.02)	--			
United Kingdom 9/	80:01-93:03	0.59	0.44	0.82	-0.24	--	--	--	--	--	-0.39	0.980	2.8
		(3.81)	(7.15)	(17.22)	(-3.46)	--	--	--	--	--			
United States	82:03-93:04	0.53	0.76	0.32	-0.09	--	--	0.48	--	0.26	-0.85	0.996	1.5
		(4.94)	(19.08)	(8.52)	(-1.95)	--	--	(4.25)	--	(2.72)			
Colombia	86:03-93:04	2.47	0.71	0.42	--	-0.12	--	--	--	--	-1.01	0.978	1.3
		(2.89)	(12.52)	(12.54)	--	(-2.19)	--	--	--	--			
Venezuela	90:02-93:03	-3.38	0.74	0.38	--	--	--	--	--	--	-1.00	0.929	4.1
		(-1.71)	(13.05)	(8.09)	--	--	--	--	--	--			
Jamaica 10/	91:10-93:03	3.34	0.78	0.15	--	-0.13	0.18	--	--	--	-1.72	0.972	2.6
		(1.00)	(8.06)	(2.04)	--	(-1.39)	(2.05)	--	--	--			

Table 11 (concluded). Model 1

(In levels)

Country	Estimation Period	Constant	i_{t-1}	m_t	m_{t-1}	m_{t-2}	m_{t-3}	Δd_t	Δd_{t-1}	ρ	H	Adjusted R^2	Standard Error 1/
Swaziland	88:01-93:01	1.36	0.84	0.48	-0.39	--	--	0.32	--	--	-1.03	0.958	1.7
		(1.92)	(11.17)	(6.10)	(-4.57)	--	--	(2.69)	--	--			
Indonesia 11/	89:01-93:02	0.45	0.85	0.19	--	--	--	--	--	0.30	0.92	0.946	2.4
		(0.38)	(15.40)	(3.91)	--	--	--	--	--	(1.88)			
Iceland	89:07-93:06	1.34	0.43	0.61	--	--	--	0.24	--	--	-1.06	0.971	6.2
		(3.05)	(5.20)	(6.06)	--	--	--	(2.34)	--	--			
Mexico 12/	90:03-93:05	0.65	0.78	0.83	--	-0.55	--	--	--	-0.49	...	0.976	4.9
		(1.07)	(7.80)	(10.01)	--	(-4.93)	--	--	--	(-3.02)			

1/ As percentage of average dependent variable.
2/ A trend was also included with coefficient 0.04 and a t-statistic of 4.48. A dummy variable was included for 8/90.
3/ A dummy variable was included for 3/92.
4/ Dummy variables were included for 2/86 through 5/86 and 10/87.
5/ Δd_{t-2} was also included with coefficient 0.10 and a t-statistic of 6.39.
6/ Dummy variables were included for 7/91 and 2/93.
7/ m_{t-5} was also included with coefficient -0.07 and a t-statistic of 4.46.
8/ Dummy variables were included for 5/91 and 6/91.
9/ A dummy variable was included for 1/85.
10/ Dummy variables were included for 2/93 and 3/93.
11/ Dummy variables were inlcuded for 10/91 and 12/91.
12/ A dummy variable was included for 9/91.

Table 12. Model 2

(*In first differences*)

	Estimation Period	Δm_t	Δm_{t-1}	Δm_{t-2}	Δm_{t-3}	Δm_{t-4}	Δm_{t-5}	$\Delta\Delta d_t$	$\Delta\Delta d_{t-1}$	$\Delta\Delta d_{t-2}$	$\Delta\Delta d_{t-3}$	$\Delta\Delta d_{t-4}$	ρ	B	DW	Adjusted R^2	Standard Error 1/
Australia 2/	86:02-93:04	...	0.10	0.25	...	0.16	0.10	0.27	0.26	...	...	...	...	...	2.04	0.32	2.2
		...	(1.46)	(3.53)	...	(2.64)	(1.53)	(3.5)	(2.99)	...	...	...	...	...	...	...	...
Belgium	85:05-93:03	0.21	0.18	0.11	0.18	0.14	0.06	0.58	0.45	0.41	0.17	...	...	...	2.36	0.42	2.6
		(4.33)	(3.30)	(2.02)	(3.19)	(2.79)	(1.33)	(6.53)	(4.40)	(3.80)	(1.80)	...	...	...	...	...	...
Canada	81:01-92:10	...	0.16	...	0.24	0.30	0.23	0.78	0.71	0.75	0.48	0.22	...	...	2.42	0.83	2.0
		...	(1.76)	...	(2.34)	(3.63)	(2.37)	(18.31)	(6.23)	(7.11)	(4.16)	(2.63)	...	...	...	...	...
Denmark 3/	82:01-90:01	0.15	0.11	0.08	0.10	0.04	0.09	1.00	1.08	0.61	0.35	...	...	...	1.85	0.32	2.5
		(2.70)	(2.20)	(1.95)	(2.55)	(1.19)	(2.62)	(4.85)	(5.26)	(3.05)	(1.79)	...	...	...	...	...	...
Finland	87:07-93:03	0.13	0.04	0.06	...	...	0.05	0.42	0.41	0.34	0.19	...	...	...	1.60	0.70	1.0
		(6.80)	(1.99)	(3.09)	...	...	(2.75)	(7.62)	(6.33)	(5.27)	(3.23)	...	...	...	...	...	...
Germany 4/	80:01-93:03	0.37	0.24	0.09	0.16	...	0.08	0.17	0.29	...	...	...	...	...	1.94	0.65	1.7
		(8.88)	(5.93)	(2.42)	(4.34)	...	(2.31)	(2.09)	(3.63)	...	...	...	...	...	...	...	...
Greece 5/	88:01-93:05	...	...	0.38	0.23	0.21	...	...	...	...	...	...	...	...	2.26	0.36	1.2
		...	...	(3.44)	(2.05)	(2.00)	...	...	...	...	...	...	...	...	...	...	...
Hungary 6/	89:10-93:05	0.19	...	0.19	...	...	...	...	...	...	...	...	...	...	2.15	0.61	1.8
		(3.25)	...	(2.81)	...	...	...	...	...	...	...	...	...	...	...	...	...
Ireland	86:01-91:12	0.34	0.35	0.20	0.17	...	...	0.25	0.27	...	...	...	-0.26	...	2.04	0.80	3.4
		(4.41)	(4.29)	(2.97)	(3.19)	...	...	(2.88)	(3.23)	...	...	...	(-2.09)	...	...	...	...
Israel 7/	91:03-92:12	0.77	0.28	...	...	...	...	...	...	...	...	...	...	...	1.90	0.91	2.4
		(12.57)	(4.53)	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Italy 8/	85:06-93:02	0.12	0.10	0.07	...	...	...	0.52	0.11	...	...	...	...	-1.60	...	0.83	1.0
		(4.66)	(3.19)	(2.24)	...	...	...	(6.16)	(1.63)	...	...	...	...	...	...	...	...
Japan 9/	80:01-93:02	0.03	0.04	0.03	...	...	...	0.10	0.18	0.14	0.05	...	...	-0.83	...	0.92	0.7
		(2.12)	(2.97)	(2.04)	...	...	...	(6.63)	(9.16)	(8.18)	(4.25)	...	...	...	...	...	...
Malaysia 10/	86:01-92:10	0.13	...	0.06	0.08	...	0.09	...	...	...	...	...	-0.33	...	1.91	0.44	2.8
		(4.92)	...	(2.63)	(3.55)	...	(3.52)	...	...	...	...	...	(-2.98)	...	...	...	...
Netherlands	80:01-93:03	0.52	0.11	0.08	0.11	...	...	0.53	0.19	...	...	...	-0.28	...	2.14	0.60	3.2
		(11.68)	(3.18)	(2.52)	(3.44)	...	...	(6.61)	(2.48)	...	...	...	(-3.41)	...	...	...	...
New Zealand 11/	87:02-92:10	0.11	2.24	0.10	0.09	0.05	0.07	...	...	...	...	...	...	...	1.86	0.66	1.6
		(3.67)	(7.85)	(4.16)	(3.63)	(2.00)	(2.58)	...	...	...	...	...	...	...	...	...	...
Philippines	86:01-93:02	0.24	0.41	...	...	...	...	...	...	...	...	...	-0.56	...	2.16	0.60	5.2
		(5.00)	(8.68)	...	...	...	...	...	...	...	...	...	(-6.17)	...	...	...	...
Portugal	91:04-93:04	0.47	...	0.48	...	...	...	...	...	...	...	...	-0.36	...	1.79	0.30	2.2
		(3.36)	...	(2.88)	...	...	...	...	...	...	...	...	(-1.71)	...	...	...	...
Singapore 12/	80:01-93:03	0.27	0.22	0.11	0.11	0.11	...	...	...	...	...	...	...	...	2.19	0.68	2.5
		(11.18)	(9.24)	(4.67)	(4.67)	(4.71)	...	...	...	...	...	...	...	...	...	...	...
South Africa	82:03-93:02	0.73	0.10	0.12	...	...	...	0.09	...	...	...	...	-0.30	...	2.10	0.65	2.4
		(9.65)	(1.11)	(1.95)	...	...	...	(1.58)	...	...	...	...	(-3.51)	...	...	...	...
Spain 13/	82:01-92:12	0.36	0.24	0.11	0.07	...	0.07	...	...	...	...	...	...	...	2.19	0.62	3.3
		(13.08)	(8.68)	(4.06)	(2.64)	...	(2.66)	...	...	...	...	...	...	...	...	...	...
Sri Lanka 14/	83:01-93:01	...	0.03	0.06	0.04	0.06	...	0.19	0.48	...	...	...	...	...	2.18	0.59	5.5
		...	(0.54)	(0.99)	(0.60)	(0.98)	...	(3.91)	(9.88)	...	...	...	...	...	...	...	...

Table 12 (concluded). Model 2

(In first differences)

	Estimation Period	Δm_t	Δm_{t-1}	Δm_{t-2}	Δm_{t-3}	Δm_{t-4}	Δm_{t-5}	$\Delta\Delta d_t$	$\Delta\Delta d_{t-1}$	$\Delta\Delta d_{t-2}$	$\Delta\Delta d_{t-3}$	$\Delta\Delta d_{t-4}$	ρ	H	DW	Adjusted R^2	Standard Error 1/
United Kingdom 15/	80:01-93:03	0.87	...	0.06	...	...	...	...	...	...	...	...	-0.32	...	2.17	0.67	3.2
		(18.63)	...	(1.44)	...	...	...	...	...	...	...	...	(-4.17)	...	...	...	...
United States	82:05-93:04	0.41	0.31	0.15	0.10	...	...	0.29	...	...	...	...	...	...	2.09	0.81	1.4
		(12.28)	(10.28)	(5.03)	(3.78)	...	...	(3.08)	...	...	...	...	...	...	...	...	...
Colombia 16/	86:09-93:04	0.44	0.32	...	...	0.15	...	...	...	...	...	...	-0.28	...	2.10	0.65	1.4
		(7.41)	(5.63)	...	...	(3.00)	...	...	...	...	...	...	(-2.46)	...	...	...	...
Venezuela	90:05-93:03	0.24	0.35	...	0.15	...	...	...	...	...	...	...	...	...	2.34	0.62	3.8
		(4.23)	(6.11)	...	(2.57)	...	...	...	...	...	...	...	...	...	...	...	...
Jamaica 17/	91:10-93:03	0.24	0.13	...	...	0.16	...	...	...	...	...	...	0.67	...	1.56	0.96	1.9
		(4.43)	(2.42)	...	...	(3.46)	...	...	...	...	...	...	(2.61)	...	...	...	...
Swaziland	88:01-93:01	0.54	0.12	...	...	...	...	0.24	...	...	...	...	...	...	2.42	0.50	1.7
		(7.38)	(1.72)	...	...	...	...	(3.03)	...	...	...	...	...	...	...	...	...
Indonesia 18/	89:09-93:02	0.20	0.17	0.18	0.19	...	...	...	...	...	...	...	...	...	1.66	0.71	2.6
		(2.38)	(1.99)	(2.12)	(2.33)	...	...	...	...	...	...	...	...	...	...	...	...
Iceland	89:07-93:06	0.61	0.45	...	...	...	...	...	...	...	...	...	...	...	2.12	0.54	7.4
		(4.38)	(3.31)	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Mexico 19/	90:03-93:05	0.72	0.79	...	-0.21	...	...	...	...	...	...	...	-0.51	...	1.95	0.76	4.8
		(5.61)	(6.02)	...	(-2.04)	...	...	...	...	...	...	...	(-3.44)	...	...	...	...

1/ As percentage of average dependent variable-in levels.
2/ Δm_{t-6}, Δm_{t-7}, Δ_{t-8}, Δ_{t-9} were also included. Their corresponding coefficients and a t-statistics (in parentheses) are: 0.06 (1.01), 0.03 (0.53), 0.06 (0.96), 0.05 (0.88).
3/ Δm_{t-6} and Δm_{t-7} were also included. Their corresponding coefficients and t-statistic (in parentheses) are: 0.06 (1.79), and (2.12).
4/ Δm_{t-7} was also included with a coefficient of 0.05 and a t-statistic of 1.39.
5/ A dummy variable and a trend were also included.
6/ Δm_{t-6} was also included with a coefficient of 0.26 and a t-statistic of 3.85.
7/ A dummy variable for 3/92 was also included.
8/ The lagged dependent variable, Δi_{t-1}, was also included with a coefficient of 0.91 and a t-statistic of 49.74.
9/ The lagged dependent variable, Δi_{t-1}, was also included with a coefficient of 0.83 and a t-statistic of 20.0. Dummy variables were included for 3/86 through 5/86 and 10/87.
10/ Δm_{t-7} was also included with a coefficient of 0.07 and a t-statistic of 3.03.
11/ Δm_{t-6} was also included with a coefficient of 0.08 and a t-statistic of 2.99.
12/ Δm_{t-8} was also included with a coefficient of 0.08 and a t-statistic of 3.06.
13/ Δm_{t-8} was also included with a coefficient of 0.08 and a t-statistic of 3.13.
14/ A dummy variable for 5/91 was also included.
15/ A dummy variable for 1/85 was also included.
16/ Δm_{t-6} was also included with a coefficient of 0.15 and a t-statistic of 2.97.
17/ Δm_{t-6} was also included with a coefficient of 0.23 and a t-statistic of 5.55. Dummy variables for 2/92 and 3/92 were included.
18/ Δm_{t-8} was also included with a coefficient of 0.26 and a t-statistic of 2.92. Dummy variables for 10/91 and 12/91 were included.
19/ A dummy variable for 9/91 was also included.

Table 13. Interest Rate Definitions

Country	Lending Rate	Money Market Rate
Australia	Minimum rate charged by major trading banks on overdrafts of less than $100,000.	Weighted average yield on 13-week treasury notes allotted at last tender of month.
Belgium	Maximum rate charged by deposit money banks to prime borrowers.	Beginning January 1991, the averages of borrowing and lending rates for three-month interbank transactions. Prior to that date, the call money rate.
Canada	Rate that chartered banks charge on large business loans to their most creditworthy customers; when there are differences among banks, the most typical rate is taken.	Weighted average of the yields on successful bids for three-month bills.
Denmark	Calculated from interest accrued on loan accounts divided by average loan balance (including nonperforming loans) in the quarter. Prior to 1990, weighted average rate on overdrafts.	Three-month average interbank rate.
Finland	Mean value of the end-of-month lending rates weighted by credit outstanding.	Three-month Helibor rate.
Germany	Rate on current account credit (1-5 million marks).	Period averages of 10 daily average quotations for day-to-day money.
Greece	Maximum rate charged by commercial banks on short-term loans to finance working capital for industry.	Three-month Treasury bill rate.
Hungary	Rate on loans of less than one year maturity.	Three-month Treasury bill rate.

Table 13 (continued). Interest Rate Definitions

Country	Lending Rate	Money Market Rate
Ireland	Rate charged by licensed banks on overdrafts offered to AAA customers in the primary, manufacturing, and services sectors.	Yield on Exchequer bills.
Israel	Average effective cost of all unindexed credit in Israeli currency, including overdraft credit.	Yield to maturity on short-term Treasury bills.
Italy	Average rate on all bank loans.	Three-month Treasury bill rate.
Japan	Weighted arithmetic average of contractual interest rates charged on short-term loans.	From November 1990, lending rate for collateral and overnight loans in the Tokyo Call Money Market. Previously, lending rate for collateral and unconditional loans.
Malaysia	Modes of the range of rates quoted for the base lending rate.	Daily averages of overnight interbank lending rates of ten banks.
Netherlands	Interest charged by banks on advances in current accounts, other than secured.	Average market rate paid on bankers' call loans.
New Zealand	Weighted average base business lending rate for New Zealand's four largest banks.	Tender rates on three-month Treasury bills.
Philippines	Average commercial lending rate.	Three-month Treasury bill rate.
Poland	Midpoint of the range of lending rates on loans with lowest risk.	Two-month Treasury bill rate.
Portugal	Rate on 91-180 day loans.	Six-month Treasury bill rate.
Singapore	Minimum lending rate reflecting the average rates quoted by 10 leading banks.	Modes of three-month interbank rates.
South Africa	Prime overdraft rate.	Tender rate on 91-day bills.

Table 13 (concluded). Interest Rate Definitions

Country	Lending Rate	Money Market Rate
Spain	Floating lending rate of all private banks.	Daily average rate on interbank operations.
Sri Lanka	Minimum rate charged by commercial banks on unsecured loans and overdrafts.	Discount rate of Treasury bills in the secondary market.
United Kingdom	Base rate.	Three-month Treasury bill rate.
United States	Prime rate.	Three-month rate for commercial paper for firms with AA bond rating.
Colombia	Weighted average rate charged by commercial banks, financial corporations, and commercial finance companies on loans.	Three-month certificate of deposit rate through June 1988. Average yield on all outstanding Cds thereafter.
Venezuela	Average rate on non-subsidized loans.	Average rate on three-month zero coupon bonds.
Jamaica	Commercial loan rate (excluding loans to the public sector).	Treasury bill rate.
Swaziland	Rate on most creditworthy customers on short-term loans.	Treasury bill rate.
Indonesia	Weighted average rate on working capital of nonpriority sectors.	Cut-off rate at the one month central bank paper auctions.
Iceland	Representative rate on general purpose loans (prime rate).	Treasury bill rate.
Mexico	Average rate-including commissions.	Rate on three-month bankers' acceptances.

Value of the Structural Variables Used in the Step Two Regression

Table 14 reports the value of the structural variables used for each country in the step two regressions. See Section V.1 for a definition of the variables. The expression n.a. indicates that the figures were not available. As indicated in the text, the figures for each country often refer to the average value of the variable during the period in which the step one equations were estimated. The data and the sources from which the information was obtained are available from the authors upon request.

Table 14. Value of the Structural Variables Included in the Step Two Regressions

Country	INFLA	PRIME	POSTE	CAPCO	RANDO	ENTMA
Australia	8.1	--	1	--	5.78	17.3
Belgium	4.5	--	1	--	9.43	--
Canada	5.9	1	--	--	6.14	7.6
Denmark	5.9	--	--	1	6.73	--
Finland	6.7	--	--	1	6.66	2.3
Germany	2.6	--	--	--	4.77	--
Greece	19	--	1	1	2.15	--
Hungary	10.6	--	--	1	5.2	--
Ireland	7.7	1	--	1	7.65	2.7
Israel	80.4	--	--	1	17.2	--
Italy	9.8	--	--	1	5.55	0.1
Japan	2	--	--	0.23	5.98	0.7
Malaysia	3.2	1	--	--	18.32	4.5
Netherlands	2.4	1	--	--	7.02	0.1
New Zealand	10.7	--	1	--	9.35	11.6
Philippines	14	--	--	1	12.14	0.8
Poland	71.8	--	1	1	14.02	--
Portugal	17.1	--	--	1	2.82	--
Singapore	2.2	1	--	--	11.37	7.2
South Africa	14.7	1	--	1	4.08	1.9
Spain	9.3	--	--	1	12.15	2.1
Sri Lanka	12.2	1	--	1	8.5	--
United Kingdom	6.6	1	--	0.8	5.47	5.4
United States	4.7	1	--	--	5.4	8.9
Colombia	23.6	--	--	1	3.32	--
Venezuela	23.3	--	--	1	11.95	--
Jamaica	14.8	--	--	1	12.56	--
Swaziland	13	1	--	1	4.01	--
Indonesia	8.6	--	--	--	6.72	--
Iceland	33.5	1	--	1	9.69	0.6
Mexico	65.2	--	--	1	8.22	5.3

Sources: The sources are too numerous to be listed here. Most data are derived from official publications. Interested readers can contact the authors for specific information.

Table 14. Value of the Structural Variables Included in the Step Two Regressions

Country	OTHMA	PUBLI	GDPPC	M2GDP	M2OM1
Australia	4.4	--	1,605	50	424
Belgium	26.8	--	1,295	47	248
Canada	5.3	--	1,965	50	342
Denmark	6.4	--	1,538	55	225
Finland	6.6	0.6	1,562	54	481
Germany	3.7	--	1,629	59	322
Greece	14	4	734	65	393
Hungary	1.5	5	619	50	204
Ireland	6.2	--	913	40	316
Israel	6.7	--	1,194	268	1,156
Italy	23.9	5	1,455	68	187
Japan	3.3	--	1,695	101	345
Malaysia	12.9	3	590	67	331
Netherlands	3.9	--	1,460	78	350
New Zealand	9.2	0.33	1,349	39	193
Philippines	11.6	1	232	31	387
Poland	--	5	453	29	223
Portugal	18.8	4.67	795	69	273
Singapore	6.3	--	1,492	81	334
South Africa	8.5	--	550	33	216
Spain	14.7	--	1,084	71	273
Sri Lanka	3.1	5	237	30	243
United Kingdom	25.7	--	1,496	65	243
United States	14.4	--	2,136	60	372
Colombia	7.1	3	495	20	175
Venezuela	5.7	1	674	33	269
Jamaica	16.6	1.5	303	47	287
Swaziland	2.2	1	300	35	340
Indonesia	1.6	5	235	36	315
Iceland	4	2	1,600	36	541
Mexico	23.2	5	598	22	268

Table 14. Value of the Structural Variables
Included in the Step Two Regressions

Country	MARSH	NOBRA	ENTRY	EDISC
Australia	55	68	4	1
Belgium	69	91	4	1
Canada	61	29	4	--
Denmark	72	67	4	1
Finland	65	66	4	1
Germany	32	69	4	1
Greece	69	14	--	--
Hungary	78	6.4	4	--
Ireland	45	23	--	1
Israel	49	22.3	1	--
Italy	54	23.5	1.1	1
Japan	25	37	0.5	1
Malaysia	51	8.2	--	--
Netherlands	86	48	4	1
New Zealand	43	40	4	--
Philippines	46	4.4	0.6	--
Poland	71	8.8	3	1
Portugal	67	15	1	--
Singapore	51	13.8	2	--
South Africa	97	11.9	4	1
Spain	41	82	3.2	--
Sri Lanka	80	4.5	--	1
United Kingdom	31	45	4	--
United States	14	24	1.1	1
Colombia	56	3.7	...	--
Venezuela	46	9.4	3.7	--
Jamaica	56	7.4	...	--
Swaziland	100	4.5	--	1
Indonesia	66	5.7	2.7	--
Iceland	90	...	4	--
Mexico	70	5.6	...	--

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