Bank of England

Discussion Paper No.12

Banks' international lending decisions and the determination of spreads on syndicated medium-term euro-credits

by

R.B.Johnston

September 1980

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The object of this series is to give a wider circulation to research work being undertaken in the Bank and to invite comment upon it; and any comments should be sent to the author at the address given below. The views expressed are his, and not necessarily those of the Bank of England.

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Introduction[1]

1 A frequently commented upon but comparatively unresearched area in the field of banking behaviour and capital flows is the relatively rapid expansion of the syndicated medium-term euro-credit market.[2] This is a market for 'roll-over' bank credits (denominated predominantly in dollars) which have been syndicated typically amongst an international group of banks. The term 'roll-over' reflects the fact that the cost of the loan is altered every three, six or twelve months, depending on the original loan agreement (which may give an option to alter, at roll-over dates, the length of the next roll-over period), in line with reigning inter-bank rates - typically the London inter-bank offered rate (LIBOR). The 'spread' over LIBOR - which is a premium charged by banks - is normally fixed[3] for the life of the loan.

2 The syndicated medium-term euro-credit market has become increasingly important in recent years as world payments imbalances have increased and many governments and government agencies, faced with a much greater need to borrow abroad, have turned to the banking system for finance, and to this market in particular, where the technique of syndicating credits provides economies of scale which allow very large amounts of funds to be raised in individual loans at comparatively low cost.

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[1] The author would like to acknowledge the extensive number of comments received on earlier versions of this paper. In particular he would like to thank John Flemming, Susan Howson and Richard Portes for their numerous comments and suggestions from which the paper and research benefited substantially; and members of the International Economics Study Group who made comments on an earlier version of the paper which was presented to their May meeting.

[2] The emphasis on this market reflects its 'visible' nature - banks typically publicise their participation in syndicated lending, often in the form of 'tombstone' advertisements in the press.

[3] In practice, loans have sometimes, when the general level of spreads has fallen, been renegotiated in order to reduce the spread.

3 At the same time, the trend to increasing financial integration has continued, encouraged by the relaxation of controls on capital movements. This process of internationalisation of portfolios by wealth holders and banks has been hastened by a number of innovations and the development of euro-currency markets and offshore intermediation, including syndicated euro-currency bank lending, in the main international reserve currency (the US dollar). The relative expansion of euro-currency lending has, however, led to concern about its possible inflationary role and the soundness of the international banking system. In addition, the sharp decline in the spreads banks charge on their loans (see Chart A on page 22) and the marked lengthening of loan maturities in the syndicated euro-credit market during 1978 and 1979 - the period of the so-called "borrowers' market" - have become a source of prudential concern both for the international banks and their supervisory authorities. This concern results not from the absolute level and length attained by spreads and maturities respectively, but from whether they are commensurate with the risks involved in such lending.

4 However, because of the comparative youth of the market and the very short period for which data are available, the nature of the syndicated medium-term credit market, which is dominated by public sector borrowers who may borrow very large amounts infrequently (as, for example, was the case for the UK Government), and the presence of 'shocks' (for example, the Herstatt banking failure in June 1974) which disturbed developments in the euro-currency banking system, it is extremely difficult to interpret developments in that market with any degree of confidence. The objective of the preliminary research reported in this paper was to attempt to provide a framework within which to analyse market developments and also to present preliminary econometric results for an equation explaining the level of euro-market spreads which has its basis in the analytical framework. Data limitations prohibit more ambitious testing of the model.

5 The approach adopted was to seek to investigate (both theoretically and statistically), in line with earlier work[1] the role of

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[1] See Johnston (1979a).

inter-relationships between the euro and domestic banking systems - specifically by considering theoretically the portfolio decisions of banks - as a way of explaining developments in the syndicated medium-term credit market; and, when explaining movements in spreads on syndicated euro-market loans, to examine the role of banks as financial intermediaries in the euro-currency market. In this analysis the spread is seen as an indicator of the clearing price in the market for intermediary services in the syndicated medium-term euro-credit market. These include the return to banks from accepting the lending risks associated with the possibility of default by borrowers and transforming short-term deposits into medium-term loans and funding risks associated with ensuring the liquidity of deposits. LIBOR can be considered the clearing price in the market for 'finance' determined largely outside the syndicated loan market in the global market for dollars (the domestic dollar market plus euro-dollar market).[1]

6 The theoretical research concentrates on the liability and asset management of the banks themselves and takes the initial supply of funds to the euro-market by non-bank wealth holders and final demand for credits largely as given. This is equivalent to assuming that in the syndicated medium-term credit market a number of factors can be treated as exogenous in a model of the bank lending process (for example, the supply and demand for funds and borrowing and lending conditions in national money markets) rather than attempting to analyse these simultaneously within a more general framework of several inter-related markets.[2] This is not to say that initial supplies or final demands for funds are unimportant in explaining the volume of syndicated medium-term credit lending or the development of this market. Indeed, it has already been observed that the emergence of a market for syndicated credits was the simultaneous outcome of increased borrowing demands for balance of payments finance and an increased supply of international loans by banks (and non-bank wealth holders). As regards the determination of euro-market spreads, however, the research takes as a working hypothesis a high elasticity of the supply of intermediation services

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[1] See Johnston (1979a).

[2] For an example of the alternative approach, see Freedman (1977).

to the euro-currency market by banks and a relatively inelastic demand for intermediation services by borrowers. Invariably, banks involved in international business have well established domestic lending bases which, combined with the free entry and exit of banks to and from the euro-currency market, suggest that the elasticity of supply of intermediation services in response to changes in relative returns on syndicated medium-term euro-credits should be high (subject to the absence of domestic restrictions). But in addition changes in the source of funds to banks in the euro-markets may - depending on how banks react to different supplies of deposits - influence absolute returns and therefore absolute spread movements on euro-currency lending. On the demand side, the predominance of sovereign borrowers in the market - often seeking balance of payments finance - suggests that demand may be fairly inelastic; this, when combined with the high elasticity of supply, implies that changes in demand would have a greater impact on the volume of loans than on the spread. The theoretical analysis is thus concerned only with the operation of banks in explaining spread movements, but in the empirical analysis some attempts were made to allow for possible simultaneous effects by investigating ad hoc and not completely satisfactory demand equations for syndicated medium-term euro-credits.

7 The outline of the paper is as follows: Section 2 provides a general overview of the analysis and a detailed description of one particular approach to modelling banks' international lending and the determination of euro-market spreads; Section 3 considers a number of data problems in estimating an equation for the level of spreads, discusses the estimation procedure and presents the results; and Section 4 details the conclusions and provides a summary of the theoretical and empirical analysis. The appendix presents a slightly more formal treatment of the portfolio approach to the explanation of banks' international lending behaviour.

2

A model of banks' international lending decisions and the determination of euro-market spreads

An overview

8 It has been observed that there are a number of very close links between the short-term euro-currency and national money markets;[1] it might thus be reasonable to suspect that similar links could exist between medium-term markets for bank credit in domestic and offshore money markets. Also, the development of syndicated medium-term euro-currency lending seemed to reflect a more general trend of internationalisation whereby wealth holders and financial institutions have increasingly orientated their investments towards international assets, and national economies have become increasingly integrated through the operation of multinational corporations. In particular, banks have undertaken a growing volume of lending and borrowing overseas (both in the domestic currencies of the countries in which they operate and in euro-currencies), either through head offices or their branches and subsidiaries in offshore centres.

9 Like non-bank wealth holders, banks can be expected to seek to diversify their asset holdings and to trade-off risks and returns in their portfolios. The search by banks for effective ways of hedging the risks of domestic loan portfolios, and their desire to take advantage of the increasing trend of internationalisation by wealth holders and borrowers, may be important elements explaining the rapid growth of international, and particularly euro-currency, bank lending. If, in general, domestic economic activity and the risks of domestic borrower defaults are cyclical, so that the risks in lending to domestic borrowers are positively correlated, the scope for hedging risks in purely domestic loan portfolios will be limited. The risks in international lending, however, may appear to banks to be independent of domestic economic conditions. International loans provide banks with an enhanced range of investment opportunities - which allow the diversification of cyclical, sovereign and currency risks - and could provide banks

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[1] Johnston (1979a).

with an attractive and effective means of increasing their lending activity and reducing overall portfolio risks.

10 The process of internationalisation has been hastened by the development of a number of innovations on both the assets and liabilities side. The introduction of floating-rate bank credits and the development of the technique of syndicating loans between banks allows risk sharing, provides economies of scale in lending, and permits participation by relatively small banks whose involvement in international lending might otherwise be limited by size or expertise. The development of the wholesale and inter-bank markets in euro-currencies has facilitated both liability management on the part of individual banks (which reduces funding risk) and the entry of non-US-based banks into dollar and other currency lending. The role of non-US-based banks has recently assumed particular importance in this market, which gained its initial momentum from the expansion of US banks. The US banks had benefited at the outset from possessing a natural deposit base in the international reserve currency - the US dollar.

11 The various innovations in banking, which have removed or reduced constraints on banks' international borrowing and lending behaviour and which have themselves encouraged faster market growth, also suggest that the international diversification of loan portfolios may have become an important element in banks' policy decisions, and also, to some extent, forced banks to rethink their management strategies. In some cases, banks heavily engaged in international activities have moved towards global management of the consolidated balance sheets and profit statements of the whole organisation.[1]

The model

12 To model elements influencing the general internationalisation of banking and also to allow for specific costs, risks and returns involved in external intermediation, the analysis initially considers the portfolio and optimal capital allocation decisions of a parent bank. For analytical simplicity, it is assumed that the management of the parent bank is not itself concerned with the detailed business

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[1] On the issues involved in global management, see Moscowitz (1979).

of banking - for example, with managing the level of deposits and loans - but reacts to profit and risk signals received from their branches, which, for the purpose of the analysis, can be divided into domestic and offshore branches. The former are assumed to make loans only to domestic customers and the latter loans to international borrowers.[1] It is further assumed that the way the management of the parent bank reacts to these signals is determined by its desire to maximise a (subjective) utility function[2] which, following general portfolio theory, has arguments in both the expected level and risk of return. It achieves its optimum utility by allocating varying proportions of its given total capital stock to its domestic and offshore branches.

13 The analytical approach adopted, which is described in detail in the appendix, is the Tobin-Markowitz mean-variance analysis[3] although this restricts the variables in the decision function. They are the ratio of expected returns to the capital base of the bank and the variance of return to the square of the capital base of the bank, on the assumption that the bank's capital places two constraints on management behaviour: the management of the bank seeks to earn a return on shareholders' capital, while the bank's capital provides the cushion to the bank against unexpected loan losses.[4][5]

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[1] This assumption is, of course, highly artificial, since domestic banks can and do make international loans, and is made only for illustrative purposes.

[2] Such a function need not exclude a decision by the bank to maximise short-run profits, but work on the decision policies of firms and observations of banking behaviour suggests that it is certainly not the only decision function. Other examples are the optimisation of size, rate of growth, market share or long-run return on equity.

[3] See Markowitz (1957) and Tobin (1965)

[4] In practice, banks will tend to make provisions out of their profits to cover expected loan losses.

[5] In this model, the capital base of the bank and the capital/asset ratios are given and fixed. It is, however, easy to see that, if international portfolio diversification by the bank reduces its overall lending risk, the bank may wish to reduce its capital/asset ratio and to expand its total lending as it diversifies its portfolio. This may introduce further competitive elements into the growth of international bank lending which complicates the statistical analysis (see below).

Following this approach and imposing a number of additional assumptions, it is shown that the optimal allocation of capital to a bank's offshore branches is a linear function of the difference between the ratio of expected returns to the standard deviation of returns on the bank's international and domestic lending. The function depends on the covariance of returns on domestic and external lending, and the ratio of the marginal utilities of expected returns to risks (as measured by the variance of returns) in the bank's utility function.

14 The total supply of capital, and therefore international loans, is the outcome of aggregating over individual banks, within and across a number of countries. Under the reasonably plausible assumptions that the demand for international loans is small relative to global bank credit aggregates (see the appendix, pages 44 and 45) and that there is a high elasticity of supply of intermediation services to the international banking system (in line with the freedom which banks have to enter or leave the international banking market), the aggregation over individual banks implies that in static equilibrium the ratio of expected returns to risks on international loans is a weighted average of the ratio of expected returns to risks on different banks' domestic lending. The weights depend on the size of the banks, the divergence between risks and returns on international and domestic lending, and the arguments in the banks' utility functions. The exact equation, which is given as equation 24 in the appendix, is written:

$$\frac{E(\pi_e)}{\sigma_e} = A + \frac{\sum_j B_j K_j \left[\frac{E(\pi_d)}{\sigma_d}\right]_j}{\sum_j B_j K_j}$$

where $j = 1,2....n$, $E(\pi_e)$ and $E(\pi_d)$ are respectively the expected returns on international and domestic lending, σ_e and σ_d are the standard deviations of returns on international and domestic portfolios, K is the total capital base of bank j, A is a constant term, and for each bank j, $B_j = -\left[\frac{a\, U_E}{4U_\sigma\ (1-\rho_{ed})}\right]_j$,

where U_E and U_σ are marginal utilities with respect to the ratio of expected returns to the capital base of the bank and the variance of returns to the square of the capital base of the banks, ρ_{ed} the coefficient of correlation between returns on external and domestic loan portfolios, and a is a constant (defined in the appendix).

15 This final form seems a plausible formalisation of what might be expected a priori from an application of more general portfolio theory. An interesting feature of the equation is that it may explain why several nationalities of banks are simultaneously involved in international bank lending. Even when international competition pushes returns on loans below those obtainable by some banks on their domestic lending, those banks may continue to lend because of the gains that portfolio diversification itself gives to the overall structure of the bank's portfolio. The equation also explains why at times banks of certain nationalities tend to be very aggressive in their international lending strategies, as this could reflect a relative decline in the expected returns these banks earn on their domestic loans.

16 Another possible reason for aggressive lending by certain banks which cannot be dealt with explicitly within this static portfolio framework, but which also seems consistent with the model, is the attempt by banks to adjust their loan portfolios following the removal or easing of restrictions on their international lending. This phenomenon may explain for example the expanding activity of Japanese banks in 1978 and 1979 in the euro-currency market for syndicated loans, following the easing by the Japanese Ministry of Finance of the guidelines on the foreign currency lending of their banks. It has also been argued that this was the reason for a rapid expansion of external lending by US banks following the removal of US capital controls in January 1974.[1] Such dynamic factors introduce additional problems into attempts to assess the factors influencing the movement in euro-market spreads; these problems are discussed when the empirical results are reported in Section 3.

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[1] See Llewellyn (1979).

External financial intermediation and the determination of euro-market spreads

17 Although portfolio theory in general, and equation 24 in particular, provides an explanation for the expansion of banks' international lending and for the equilibrium ratio of expected returns to risks on international loans, the approach does not by itself explain movements in the level of spreads on banks' syndicated medium-term lending. To investigate this, it is necessary also to allow for the various micro-economic costs, risks and returns involved in financial intermediation in external money markets.

18 The existence of highly-developed inter-bank markets in euro-currencies enables euro-banks to manage relatively easily and at low cost their total liabilities by borrowing (or lending) funds. A number of factors may, however, influence the actual cost of the funds at which an individual bank can borrow from other banks in the euro-currency market - for example its size, existing indebtedness to other banks and whether it regularly places funds in the inter-bank market. These various factors which influence the bank's credit standing with other banks in the market lead to some tiering of the interest rates which different banks pay for funds in their inter-bank borrowing. The management of liabilities in the inter-bank market means that, at least in the short run, the volume of euro-currency lending by an individual bank need not depend on the primary supply of deposits by non-bank wealth holders and that, in the absence of legal reserve requirements, euro-banks need be less concerned than domestic banks with maintaining liquid reserves to cover the possibility of withdrawals of funds. As a reasonable approximation, the balance sheet of a euro-bank could thus be written as:

$$L_e = D_{nb} + D_b + k_e \qquad (1)$$

where L_e is the volume of the euro-bank's loans, D_{nb} and D_b are respectively the supply of deposits by non-banks to the individual euro-bank and the volume of deposits which the euro-bank takes (or lends, in which case $D_b < 0$) from other banks in the inter-bank market, and k_e is the capital allocated to the euro-bank by its parent.

19 Assuming that all loans are made on a roll-over basis and charged on a variable short-term interest rate (LIBOR) plus spread basis and for simplicity considering only a one-period model, the individual euro-bank's profit equation can be written as:

$$\pi_e = (S+\bar{r})(1-f)L_e - fL_e - r_{nb}D_{nb} - rD_b \qquad (2)$$

where S is the spread; $\bar{r}$ is the short-term interest rate (LIBOR) charged on the loans at the beginning of the roll-over period and, like other average interest rates in the inter-bank market, is assumed to be determined exogenously by the arbitrage activity of domestic banks with the euro-currency market; f is the proportion of loans which default, such that $(S+\bar{r})(1-f)L_e$ is the return on non-defaulting loans, fL_e is the loss from defaulting loans; r_{nb} is the interest rate paid on non-bank deposits; and r is the cost of funds the bank borrows in the inter-bank market, which may equal r_{nb}. This profit equation ignores, however, fixed costs and also the cost of capital, since in this model capital is 'freely' endowed on the offshore branch by its parent in line with its optimal portfolio decisions, which depend, inter alia, on the profit and risk prospects of the external branch.

20 A number of variables in the profit equation are in fact unknown to the euro-bank - for example, the proportion of loans which will default during the roll-over period; the volume of wealth holders' deposits which are withdrawn when they fall due for renewal [1] and thus the amount of borrowing the bank may have to make in the inter-bank market during the period to meet its loan commitments; and the interest rates which the bank will have to pay for funds it borrows in the inter-bank market during the roll-over

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[1] Deposits with euro-banks are predominantly time deposits of a specific term which can only be withdrawn after a specified date, e.g. three months hence.

period.[1] To account formally for these factors it is therefore also assumed:

$$f = \bar{f} + u_f = E(f) + u_f \tag{3}$$

$$r = \bar{r} + u_r = E(r) + u_r \tag{4}$$

$$D_{nb} = \bar{D}_{nb} + u_{nb} = E(D_{nb}) + u_{nb} \tag{5}$$

$$E(r_{nb}) = r_{nb} \tag{6}$$

Equations 3 to 5 state that default risks by borrowers, f, funding costs, r, and the non-bank supply of deposits, D_{nb}, are all stochastic variables which can differ from their expected values during the roll-over period.[2] Equation 6 states that the interest rate on non-bank deposits is non-stochastic and set by the bank. Clearly this analysis could be complicated significantly by allowing for interdependencies between the variables in equations 3 to 6 - for example, between r_{nb} and D_{nb} or between

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[1] Niehans and Hewson (1976) discuss a model of intermediation by euro-banks which emphasises the role of interest rate uncertainty and maturity transformation. These authors reject the view that uncertainty surrounding the supply of wealth holders' deposits could introduce additional risks into the lending policies of euro-banks and they emphasise instead the role of a 'nearly perfect market' which enables euro-banks to borrow '...any relevant amount at the going (but variable) rate...'. It has been noted that this is perhaps an exaggerated view. The present model therefore allows for the possibility that risk of non-renewal of deposits by wealth holders can have an impact on euro-banks' lending behaviour. In practical terms, however, the final form of the equation derived is very similar if it is assumed that the volume of wealth holders' deposits are given and fixed at the beginning of the roll-over period but banks undertake maturity transformation on their inter-bank liabilities, thus introducing uncertainty into the euro-bank's interest rate costs in proportion to the volume of inter-bank borrowing.

[2] To keep the analysis simple, in equation 4 the expected cost of funds in the inter-bank market, E(r), has been placed equal to that set on the roll-over credit, $\bar{r}$, and no allowance has been made for deviations from this inter-bank rate accounted for by the bank's credit standing.

f and r. This has not been done here. Instead, the error terms in the equations are regarded as the residuals after allowing for these inter-relationships which are already taken into account by the bank in forming its expectations.

21 Substituting equations 3 to 5 into equation 2, using the balance sheet identity (equation 1) to eliminate D_b, and assuming for simplicity that errors in the bank's expectations regarding the proportion of loans which default, interest rates in the inter-bank market and the volume of non-bank deposits are independent of each other - the latter independence assumption reflects the comparative interest inelasticity of non-bank flows to relative inter-bank rates[1][2] - it can be shown[3] that the ratio of expected profits to risk on the bank's external lending can be written approximately as:

$$\frac{E(\pi_e)}{\sigma_e} = \frac{[(S+\bar{r})(1-\bar{f})-\bar{r}-\bar{f}]L_e-(r_{nb}-\bar{r})\bar{D}_{nb}+\bar{r}k_e}{[(S+\bar{r}+1)^2L_e^2\sigma_f^2+\sigma_r^2(L_e-\bar{D}_{nb}-k_e)^2+(r_{nb}-\bar{r})^2\sigma_{nb}^2]^{1/2}} \qquad (7)$$

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[1] This view is an implication of earlier work on the determination of euro-currency interest rates, see Johnston (1979a), page 43.

[2] In practice, as noted above, interest rates in the inter-bank market will vary with factors influencing the individual bank's credit standing, including the size of loan losses and perhaps the size of the bank as measured by its non-bank deposit base. To this extent, the error terms in the equations may be correlated.

[3] The bank's profit equation can be written as:

$$\pi_e = E(\pi_e)+U_\pi$$

where:

$$E(\pi_e) = [(S+\bar{r})(1-\bar{f})-\bar{r}-\bar{f}]L_e-(r_{nb}-\bar{r})\bar{D}_{nb}+\bar{r}k_e$$

$$\text{and } U_\pi = -[(S+\bar{r})u_f+u_f+u_r]L_e+u_r\bar{D}_{nb}-(r_{nb}-\bar{r})u_{nb}+u_rk_e+u_ru_{nb}$$

The variance of profits is, therefore,

$$\sigma_e^2 = [S+\bar{r}+1]^2L_e^2\sigma_f^2+\sigma_r^2(L_e-\bar{D}_{nb}-k_e)^2+(r_{nb}-\bar{r})^2\sigma_{nb}^2$$

where:

$$\sigma_f^2 = E(u_f^2),\quad \sigma_r^2 = E(u_r^2),\quad \sigma_{nb}^2 = E(u_{nb}^2),$$

$$E(u_ru_f) = E(u_ru_{nb}) = E(u_fu_{nb}) = 0,$$

and, to simplify, the term in $E[(u_ru_{nb})^2]$ has been ignored.

If $r_{nb} = \bar{r}$ (i.e. the interest rate banks offer to pay for non-bank deposits is set at the level they expect to pay for deposits in the inter-bank market - which would be broadly consistent with competition between individual euro-banks for the aggregate supply of non-bank deposits to the euro-markets) and imposing an assumption utilised in the appendix (see equation 15) that $k_e = \alpha_e L_e$ (i.e. banks maintain a fixed capital/asset ratio) then equation 7 simplifies to:

$$\frac{E(\pi_e)}{\sigma_e} = \frac{(S+\bar{r})(1-\bar{f})-\bar{r}-\bar{f}+\bar{r}\alpha_e}{[(S+\bar{r}+1)^2\sigma_f^2+\sigma_r^2\,(1-\alpha_e-\frac{D_{nb}}{L_e})^2]^{1/2}} \qquad (8)$$

This shows that the ratio of expected returns to risk on banks' external lending is a (relatively complex) function of the spread, LIBOR, the capital/asset ratio, and funding and borrower default risks, but is largely independent of the volume of loans which only enters as a factor in the overall funding risk. This factor reflects the view implicit in equations 4 to 6 that residual inter-bank funding to meet, say, a withdrawal of non-bank deposits may have a detrimental effect on the funding costs and risks perceived by the bank, even when the expected level of interest rates on bank and non-bank deposits are the same, because of uncertainty about interest rates in the inter-bank market.[1]

22 Whether in fact this type of 'endowment' effect exists and international bank lending policy reflects at least in part the primary supply of deposits by non-bank wealth holders to the euro-currency market, or whether it is possible to regard euro-banks as perfect liability managers who treat deposits from non-banks as perfect substitutes for those taken in the inter-bank market, is an interesting empirical question which is considered below. If

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[1] If, in addition, on average the cost of non-bank deposits is somewhat less than inter-bank deposits $r_{nb}<\bar{r}$, perhaps because banks undertake more maturity transformation on non-bank than bank deposits, assuming a normal yield curve, non-bank flows could have a fairly strong impact on the overall cost of funds to banks in the euro-currency market.

non-bank deposits and inter-bank deposits taken by a euro-bank are perfect substitutes and if, in addition, the supply of deposits to the inter-bank market by domestic banks can be assumed to be perfectly elastic, as empirical evidence on the relationship between domestic and euro-currency interest rates would seem to suggest for three-month deposits, at least,[1] then international bank lending would be independent of the international portfolio decisions of non-banks and would depend only on the lending policy of the banks. Alternatively, and perhaps more realistically, if they are not perfect substitutes, then factors which may influence the supply of non-bank deposits to the euro-currency market - e.g. the structure of balances of payments in general and perhaps the size of the US current account deficit in particular - will be important determinants of the volumes and terms of international lending.

23 Another feature of equation 8 is the relationship between expected profits, LIBOR, the bank's capital/asset ratio and the spread. Looking only at the numerator of equation 8 and assuming that the proportion of loans expected to default ($\bar{f}$) is close to zero, per unit expected profit would be approximately given by:

$$\frac{E(\pi_e)}{L_e} = s + r\alpha_e \qquad (9)$$

A number of commentators [2] have noted the existence of an inverse relationship between spreads and short-term interest rates and attributed this to an endowment effect associated with funding loans both out of capital and borrowed funds, such that as LIBOR rises the rate of return on capital increases. With a fixed capital/asset ratio and a target profit rate or return on capital, a higher LIBOR would thus, as equation 9 shows, be associated with lower spreads. However, this argument creates logical difficulties; a corollary of the hypothesis, which is slightly paradoxical, is that, as equation 9 also shows, higher capital/asset ratios should then also be associated with lower spreads.

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[1] See Johnston (1979a).

[2] See, for example, Goodman (1980).

24 This model suggests that it is wrong to look at the return on capital on banks' external lending in isolation. The opportunity cost of using capital externally is not only the return on syndicated lending, but rather the relative level of expected profits (and risks) on domestic and international loans, which also depends on the capital/asset ratios on domestic and international lending. (Equation 19 in the appendix shows the complex relationship between optimal external lending, domestic and external capital/asset ratios and returns and risk.) Also, to the extent that LIBOR moves in line with the general level of (dollar and, through interest arbitrage, non-dollar) short-term interest rates, banks will be similarly 'endowed' in their domestic and international use of capital, and movements in LIBOR should not generally influence the level of spreads in the euro-currency market independent of lending margins in national banking systems.

25 Combining equation 24 (the equilibrium portfolio relationship between the ratio of expected returns to risks on parent banks' international and domestic loan portfolios, which can be simplified by writing A_j for $\frac{B_j K_j}{\Sigma B_j K_j}$) with equation 8 for the ratio of expected returns to risks in external financial intermediation would yield an equation to explain the level of spreads on syndicated medium-term euro-credits in terms of a weighting of the ratio of returns to risk on domestic lending, the banks' expected level of borrower default and funding risks, the capital/asset ratio they set on their external lending, LIBOR, and the non-bank supply of funds to the euro-currency market. The general equation for the spread could be written in a linear form as:

$$S = a_o + a_1 \bar{f} + a_2 \sigma_f + a_3 \bar{r} + a_4 \alpha_e + a_5 \sigma_r + a_6 \frac{D_{nb}}{L_e} + \Sigma_j A_j \left[\frac{E(\pi_d)}{\sigma_d} \right]_j + \varepsilon \qquad (10)$$

The estimation of an equation based on this model, which has to be simplified considerably compared with equation 10 because of many data limitations, is discussed in the next section.

3

Empirical investigation of an equation for the level of spreads on syndicated medium-term euro-credits

Data considerations

26 The development of a syndicated market in medium-term euro-credits is a relatively new phenomenon, dating only from the early 1970s. The collection of data by the Bank of England on the volume and terms of loans, which began with the early development of the market was, and to some extent still is, comparatively unsatisfactory because it depends almost entirely on published sources. At best, these data have allowed the construction of a reasonably satisfactory consistent quarterly series on spreads on syndicated medium-term loans beginning in 1974 Q1. Chart A illustrates the movements in the average spreads for public sector and public-guaranteed borrowings for the major OECD, minor OECD and non-oil less-developed country (LDC) groupings.

27 Even this series is not without its problems. First, the series is rather short for the confident application of econometric analysis and the period covered may be unrepresentative. As the chart illustrates, the spread movement between 1974 and 1979 shows only one 'cycle' in spreads. A succession of banking failures in 1974 - the most crucial of which was the collapse in June 1974 of the Cologne bank, I.D.Herstatt, due to heavy losses sustained in foreign exchange dealing - produced more general fears about the solvency of banks in the euro-currency market, caused sharp movements in euro-currency interest rates,[1] and led banks to withdraw, at least temporarily, from expanding their euro-currency business. In those circumstances, even though the Herstatt collapse primarily influenced confidence in certain banks and the banking system and not the risk of default by borrowers, it would not have been surprising if banks had sought sharply higher spreads on their syndicated medium-term euro-loans to compensate for the increased risks involved in funding loans, with the implication that the decline between 1976-1979 reflected only a

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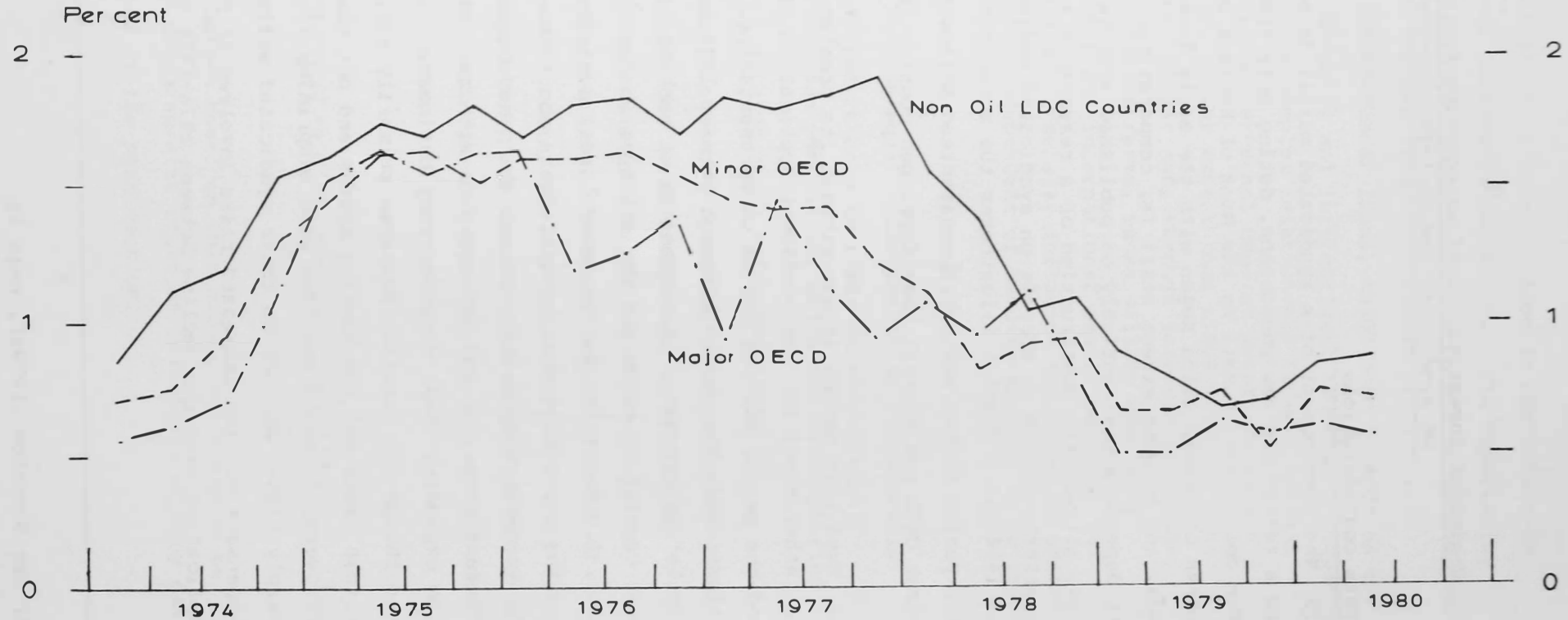
[1] See Johnston (1979a), page 39.

Chart A
Average spreads on syndicated medium-term euro-credits



recovery in confidence.[1] Specific allowance may therefore have to be made to test the significance of this event.

28 A further difficulty with looking only at the data on spreads is that it ignores the movement in other lending terms which may influence the profitability of euro-currency banking. The spread banks charge is only one element - although probably the most important - in a package of 'terms' negotiated on the loan by the syndicating banks with their customers. In addition to the spread, loans usually carry supplementary fees, a commitment fee payable on undrawn funds, a front-end fee payable to the lead and co-managers, and participation fees. Information on these fees is often not fully publicised. The available evidence tends to show that over time fees fluctuate directly with spreads,[2] although certain individual loans with low spreads have been known to conceal compensating high front-end fees.

29 The level of euro-market spreads might also be expected to vary directly with the maturity of loans in a similar way to a normal yield curve in a domestic money or bond market. However, a statistical investigation of a pooled time series and cross-section sample of over 550 observations covering the period 1974 Q1 to 1979 Q2, which was investigated using covariance analysis, failed to reveal any systematic relationship between spreads and maturities on different loans, although the practice of charging split spreads on an individual loan, with higher spreads applicable to the later stages of the loan, is quite common; and an analysis, under certain restrictive assumptions, of the time series of period means for certain country groupings found that any cross-section relationship was outweighed by a very high inverse correlation between spreads

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[1] The author has, however, shown that the recovery in inter-bank confidence was much more rapid and that short-term interest-rate differentials had returned to their 'normal' level by mid-1975, see Johnston (1979a).

[2] Ellis (1980) has undertaken a statistical examination of the time-series and cross-sectional relationship between spreads and fees which indicated this conclusion.

and maturities over time.[1] Chart B illustrates the average movement in maturities for public and public-guaranteed borrowers for certain country groupings.

30 Because no systematic cross-section relationship between spreads and maturities can be observed and the time-series movement of spreads is closely correlated with movements in maturities and available data on fees, the spread itself may be taken as an indicator of the return to banks for intermediary services in the syndicated medium-term euro-credit market in the econometric estimation.

31 The spread equation to be estimated was written as:

$$S = a_o + a_1 def + a_2 \sigma_r + a_3 \bar{r} + a_4 \frac{D_{nb}}{L_e} + \sum_j A_j \left[\frac{E(\pi_d)}{\sigma_d}\right]_j + \varepsilon \qquad (11)$$

which differs from the more general form (equation 10) by combining the two variables on the risk of default by borrowers ($\bar{f}$ and σ_f) into def,[2] a general proxy for default risk, and subsuming banks' capital/asset ratios (α_e) in the constant term.[3] Variables for the covariance of returns on domestic and external loans are included in the A_j terms. To this

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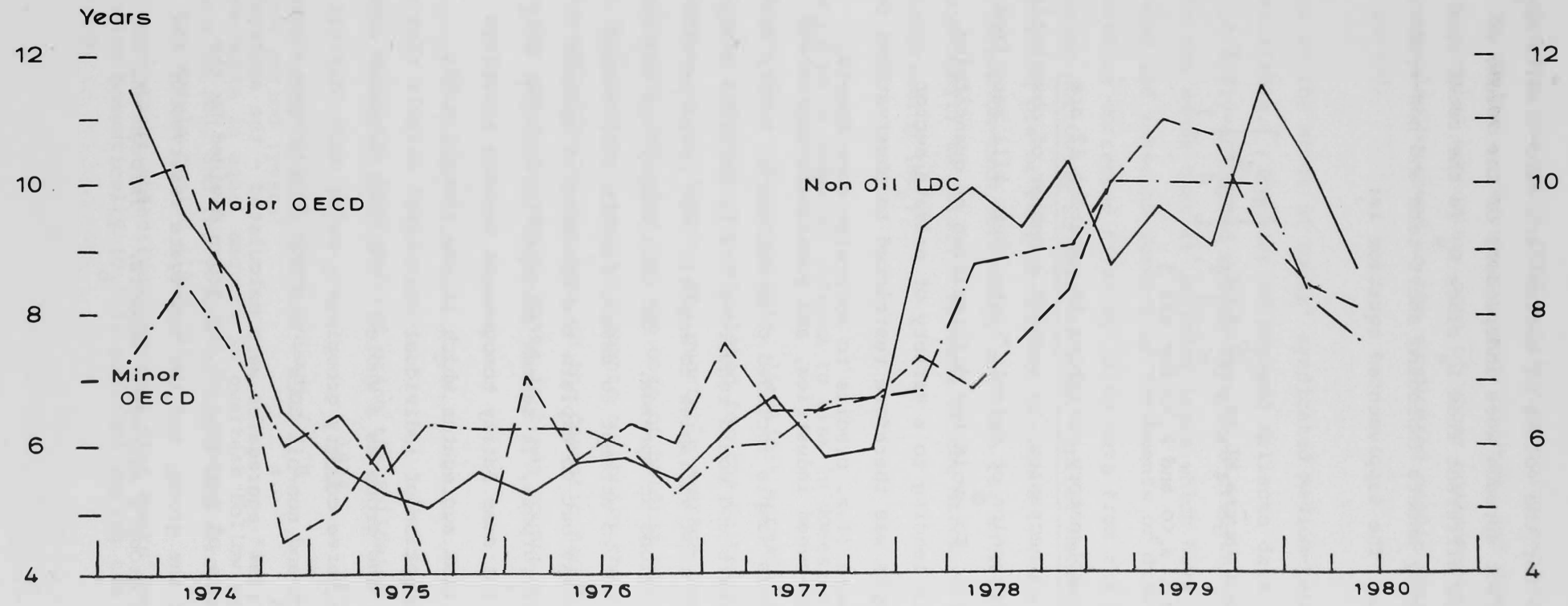
[1] The details of the analysis are contained in Johnston (1979b) The following reasons are suggested there for the failure to find a stable cross-section trade-off:
(i) a heterogeneous sample of country borrowers within any country group;
(ii) a different elasticity of the spread with respect to market conditions for each country grouping;
(iii) the possibility that the maturity elasticity of the spread is itself a function of market conditions;
(iv) a dependence between market conditions and the market's perceived risk of any individual borrowing group; and
(v) a short and unrepresentative sample.

[2] In this context, it may be noted that on any particular loan f is either 0 or 1 and $\sigma_f^2 = \bar{f}(1-\bar{f})$.

[3] Work on the level of banks' capital/asset ratios indicates that these change gradually over time and for some nationalities of banks have had a tendency to fall. But for the short run of data used here the assumption of constant capital/asset ratios may be reasonable.

Chart B

Average maturities of syndicated medium-term euro-credits



was added a variable for the volume of medium-term euro-credits ML_e, to test whether in fact spreads were independent of the volume of these loans. ML_e is different from L_e since L_e is the total size of banks' euro-currency assets including short-term and non-syndicated medium-term credits. The supplemented equation is:

$$S = a_o + a_1 def + a_2 \sigma_r + a_3 \bar{r} + a_4 ML_e + a_5 \frac{D_{nb}}{L_e} + \sum_j A_j \left[\frac{E(\pi_d)}{\sigma_d}\right]_j + \varepsilon \qquad (12)$$

with a_1, a_2, $a_4 > o$, a_3, $a_5 < o$ and $A_j > o$ for all j

32 The majority of explanatory variables in equation 12 are unobservable and it is necessary to suggest a number of observable proxies. Banks' perception of default risks, def, will vary from borrower to borrower. To avoid the difficulties of quantifying the risks involved in lending to a variety of private sector corporations the sample was therefore restricted to observations on public sector borrowers (i.e. credits to sovereign governments, nationalised or state-owned industries, and government-guaranteed credits). However, this sample included observations on a very diverse set of country borrowers and would require a fairly detailed analysis of borrowers' default risk variables to explain both cross-section and time-series variations in spreads. At this stage, the objective of the research was not to attempt to assess factors influencing individual country risks but to explain the movement in spreads over time. For this purpose, it seemed adequate to consider only the average spreads for some fairly homogeneous country groupings and some indicative risk aggregates which it was thought might influence banks' perception of individual countries' default risk and thus the average for the group as a whole. The data selected were therefore split into three country groupings - major OECD 'deficit' countries, minor OECD and non-oil LDCs - and for each of these groupings, two macro-economic 'risk' aggregates were calculated - the aggregate current account balance of payments of the group divided by the aggregate exports of the group, and the aggregate reserves of the group divided by the group's aggregate imports. Throughout, the

aggregates for the major OECD country grouping exclude the United States as the major reserve currency country, and West Germany and Japan as surplus economies, none of whose governments or public sector agencies borrowed in the syndicated credit market during the sample period.

33 Data on the stock of banks' syndicated medium-term euro-credits are unavailable. The Bank of England collects data on the published volume of newly-announced medium-term euro-credits; this series is gross in the sense that it includes loans which have been pre or refinanced and takes no account of repayments or draw-downs. It was therefore corrected first by using data from the World Bank publication Borrowing in International Capital Markets on the volume of identified pre or refinancings to obtain a measure of the net volume of medium-term borrowing, and then for estimates of the size of repayments[1] to obtain a measure of the stock of medium-term loans outstanding (ML_e).

34 The ratio of expected returns to risk in domestic lending $\frac{E(\pi_d)}{\sigma_d}$ is unobservable. To proxy this, 'implicit spreads' on domestic medium-term loans[2] were calculated for the United States and West Germany by subtracting the quarterly average level of three-month interest rates, adjusted for the cost of holding non-interest-bearing domestic reserve requirements to obtain the effective cost of short-term funding to the bank in the domestic market, from published data on the rates charged by banks in these countries on their

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[1] These estimates were derived using the following assumptions:

	1974	1975	1976
Average maturity of loans (years)	8	6	6
Grace period (years)	4	2	2

Repayments in equal amounts in quarters following the end of the grace period, and the volume of loans was zero at the beginning of the sample period (1974 Q1).

[2] This treatment effectively assumes that banks' perceived risk in lending domestically (σ_d) is constant during the estimation period.

domestic loans.[1] For the United States, the interest rates used were the US secondary market three-month certificate of deposit (CD) rate and the weighted average of interest rates on a survey of long-term commercial and industrial loans of all sizes, reported in the table 'Terms of lending at commercial banks' in the Federal Reserve Bulletin;[2] for West Germany, the three-month inter-bank rate and the lower of the spreads reported in Table V6 of the Deutsche Bundesbank Monthly Report for bank 'Credits in current account' of DM 1 million and over but less than DM 5 million. In other countries, it was less obvious what variables might be used and so no attempt was made to proxy these countries' banks' willingness to lend internationally, although this could introduce an important specification error into the equation, which is discussed later.

35 Data on the euro-currency market in London, which is the main centre for syndicated euro-credits, were taken from the table "UK banks' liabilities and assets by customer" published in the financial review of the Bank of England Quarterly Bulletin, and were used to measure euro-banks' foreign currency assets and liabilities. It was unclear what variable to use to proxy D_{nb} - the non-bank wealth holders' supply of funds - since, in addition to taking funds from private wealth holders, euro-banks also take deposits from central monetary institutions (CMI). For the estimates reported, D_{nb} is defined as the foreign currency liabilities of UK banks to 'other UK residents' and 'other non-residents'.[3]

36 Two alternative funding risk proxies for σ_r were considered, namely the change in $\bar{r}$, the quarterly average of three-month

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[1] The rationale for making the adjustments is to make the 'implicit' domestic spreads comparable with spreads charged by banks in the euro-currency market. In the euro-currency market, banks are not required to hold non-interest-bearing reserve requirements and therefore the nominal interest rate (LIBOR) is equivalent to the effective cost of funds to banks in the euro-currency market, and the spread banks charge on their medium-term loans could be viewed as the return on loans net of the marginal effective funding cost, i.e. LIBOR.

[2] Such loan rates seem to exclude, however, the cost of holding compensating balances with US banks.

[3] The profiles for $\frac{D_{nb}}{L_e}$, when D_{nb} was measured to exclude and include CMI holdings, were, however, broadly similar.

euro-dollar inter-bank rates and the difference between the three-month euro-dollar inter-bank rates and the cost of US secondary market three-month CDs adjusted for the costs of Federal Deposit Insurance and non-interest-bearing reserve requirements in the United States. The rationale for considering the latter variable was to investigate the influence of confidence effects and thus also the impact of the Herstatt banking collapse on the level of euro-market spreads. Finally, to remove possible trends, nominal quantities were deflated by the index of industrial countries' export prices reported in International Financial Statistics and seasonal dummies were added to the equations to allow for a possible seasonal pattern.

Estimation of the equations

37 As outlined, the sample was divided into three country groupings - major OECD, minor OECD and non-oil LDCs - giving three individual group equations of the form of equation 12.

38 In principle, it would be expected that a number of factors in these individual country group equations - specifically funding risks, the implicit domestic spreads, the level of LIBOR and the non-bank deposit variable - should influence the spread on banks' syndicated medium-term euro-credits equally for all groups of borrowers and so these restrictions were tested, found non-significant[1] and imposed on the equations.

39 Similarly, it might be expected that the error terms in one country group's equations could be correlated with the errors in the other country group equations. To allow for this possibility, the equations were estimated by a joint generalised least squares (GLS) procedure which allowed for contemporaneous covariance of the errors between equations. Otherwise it was assumed that the disturbances in each equation were homoscedastic and uncorrelated and that off-diagonal elements in the covariance matrix of the disturbances of two different equations vanish.[2]

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[1] See Theil (1971), pages 312-14, for an outline of the procedure. A typical F-test gave the value $F_{(10,39)} = 1.2$ but varied slightly depending on the proxies used.

[2] See Theil (1971), pages 306-12.

40 Because of the very short run of data - only twenty-two quarters in total - it was considered inappropriate when estimating the equations to investigate complex lag structures on the explanatory variables. Instead, the equation was simply fitted in current period form. Of the two proxies used to measure banks' perception of the probability of borrower default, the ratio of aggregate reserves to imports variable gave the best statistical results; the other proxy tended to be non-significant with an incorrect sign.[1] There may, however, be a difficulty with this proxy to the extent that market borrowing is used to add to countries' reserves. One of the proxies used to measure inter-bank funding risk, the change in the quarterly average of three-month euro-dollar rates, took the correct positive sign but was never found significant (with a t-ratio typically less than unity) in any of the equations and was therefore dropped in favour of the euro-dollar/US CD differential. In the equations, the three-month euro-dollar rate was found non-significant with a 'wrong' positive sign, suggesting that the observed inverse relationship between LIBOR and spreads was fully accounted for in the equation by the general movement in 'implicit' domestic speads. Of the seasonal dummies considered, only a first quarter seasonal appeared to improve the general explanatory power of the equations and so the results reported include only this variable.

41 The results for the GLS estimates of the equation estimated after dropping the three-month euro-dollar rate are reported in Table A. These provided a reasonable statistical fit with little evidence of significant positive autocorrelation. The coefficients on the implicit domestic spread variables and the non-bank supply of deposits variable were significant and took the right signs. Evaluated at period means the coefficients on the implicit US and West German domestic spreads imply that a one per cent change in these domestic spreads would lead to a 0.16% and 0.09% change respectively in the

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[1] Because of the omission of lags, this result is perhaps not very surprising if bankers react, in their country risk assessment, to data on country performance which are only available with a considerable lag. When the ratio of current balances to exports was lagged one period, it took the correct negative sign in some of the equations but remained non-significant.

Table A

Restricted GLS estimates

t-ratios in parentheses

Dependent variable the level of euro-dollar spreads (S) for different country groupings in the equation:

$$S = a_o + a_1 S_{us} + a_2 S_{DM} + a_3 (r_{ed} - r_{cda}) + a_4 \frac{D_{nb}}{L_e} + a_5 def + a_6 ML_e + a_7 D_1 + \varepsilon$$

Restricted coefficients

S_{us}	S_{DM}	$r_{ed} - r_{cda}$	$\frac{D_{nb}}{L_e}$
0.111	0.097	0.081	-10.380
(3.10)	(3.55)	(1.18)	(4.07)

Unrestricted coefficients

	Major OECD	Minor OECD	Non-oil LDC
Constant	2.364	3.197	4.867
	(5.02)	(6.55)	(8.50)
def	0.274	-0.584	-2.539
	(0.67)	(2.93)	(6.45)
ML_e	-0.0017	-0.0019	-0.0017
	(1.71)	(3.58)	(5.01)
D_1	-0.117	-0.070	-0.090
	(1.26)	(1.06)	(1.33)
$\bar{R}^2$	0.733	0.881	0.887
DW	1.97	1.89	1.81

F-test for restrictions $F_{(8,42)} = 1.28$

Where:

S_{us} = 'implicit' US domestic spread;

S_{DM} = 'implicit' West German domestic spread;

$r_{ed} - r_{cda}$ = differential between three-month euro-dollar rate and reserve adjusted cost of US three-month CDs;

def = ratio of aggregate reserve to imports;

D_1 = a first quarter seasonal dummy

$\frac{D_{nb}}{L_e}$, and ML_e, as defined in the text.

average level of euro-dollar spreads and that an increase of one per cent in the proportion of euro-banks' total liabilities due to non-banks (i.e. $\frac{D_{nb}}{L_e}$) would cause a 1.17% fall in the average level of spreads on syndicated medium-term euro-credits.

42 These 'implicit' domestic spread elasticities seem somewhat lower than might have been expected from the application of the Tobin-Markowitz portfolio analysis. Theoretically, the coefficients are a complex combination of factors, and it is therefore difficult to say a priori what their appropriate size should be. The use of proxy variables may introduce significant errors in variables, and the omission of any lags in the response of euro-market spreads to those in national markets may bias the coefficients downwards. Nevertheless, the low elasticity for the implicit level of US domestic spreads is consistent with the observation that the lending policy of US banks in the euro-currency market does not continuously dominate the level of euro-market spreads. It would also indicate that to US banks domestic and international loans, perhaps even after allowing for variations in the risk of returns (although this cannot be tested in the present equation), are less than perfect substitutes in the short run. For a large number of reasons - for example the period between lending policy decisions by parent banks and the time involved in meeting policy objectives with regard to expanding or contracting business by domestic or offshore branches - such a conclusion and result may not seem unreasonable.

43 The coefficient on the proxy for default risk - the ratio of aggregate reserves to imports, def - enters the minor OECD and non-oil LDC group equations with a correct and significant negative sign (i.e. a rise in reserves relative to imports reduces banks' perception that countries will default on their loans) but is, not surprisingly, non-significant in the major OECD equation. The results in Table A also provide some evidence that funding risk, as measured by the euro-dollar rate and reserve-adjusted US CD rate differential, has had a small positive impact on the level of euro-market spreads, but the t-ratio on this variable is low and in

other variants of the equation estimated the variable entered with the wrong sign and a negligible t-statistic.

44 A feature of the results is the negative and significant coefficient on the stock of syndicated medium-term euro-credits (ML_e). A priori it was expected that, in line with the theory developed, this variable would have been non-significant or at least would have entered the supply equation with a positive sign. One plausible explanation for this result may be that, as suggested previously, the use of implicit domestic spread variables on only US and West German domestic loans has failed to capture the competitive influence of banks of other nationalities on spreads in the euro-currency market. It would be expected that these competitive pressures would manifest themselves both in a fall in euro-market spreads and in an increase in the volume of syndicated medium-term lending, causing a significant negative correlation. Alternatively, the stock of loans variable may be picking up the longer-run trend by banks to internationalise their business and to compete down the average level of spreads. To test these hypotheses trend terms - a time trend and the total stock of loans - were entered into the equations; these failed to remove the significantly negative coefficients on ML_e.

45 An alternative explanation for the result is that the spread on syndicated medium-term euro-credits is the outcome of an interaction between the supply and demand for credits and that the negative coefficient on the volume of loans in the supply equation reflects simultaneous equation bias.[1] To investigate this possibility, a fairly ad hoc demand equation was estimated. The following variables were hypothesised as plausible factors which influence countries' demand for syndicated medium-term euro-credits: the spread and the level of short-term euro-currency interest rates, to measure the cost of borrowing syndicated medium-term euro-credits; the aggregate current account balance of payments of the country grouping

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[1] The lower than expected coefficients on the implicit domestic spread variables would suggest that simultaneous equation bias could be greater than had been expected a priori if they reflected a lower elasticity of supply of intermediation services to the euro-currency market by banks. Inoue (1980) has undertaken a theoretical supply and demand approach to the determination of euro-market spreads.

under investigation, to proxy the flow demand for balance of payments finance; and the ratio of aggregate reserves to imports for the country grouping, on the assumption that by borrowing in the euro-currency market countries seek to achieve an optimal ratio for the level of reserves to imports. All variables should enter the demand equation with a negative sign.

46 These factors gave a reasonable statistical explanation[1] of the demand for medium-term euro-market lending for the non-oil LDC and the minor OECD groupings but not for the major OECD countries where both the reserves to imports and aggregate current account balance of payments variables took the wrong sign. For all the country group equations, the coefficients on the level of spreads and LIBOR were negative and significant, but the average elasticity of the demand for syndicated medium-term euro-credits with respect to the spread, evaluated at period means (-1.3) was larger than with respect to LIBOR (-0.8).

47 The results for the supply equation normalised on the spread, and the demand equation normalised on the stock of loans estimated by a restricted two-stage least squares procedure (2SLS),[2] are reported in Table B. These simultaneous results for the supply equation are very similar to the GLS estimates (Table A) and tend to reject the hypothesis that simultaneous equation bias was a major problem or could account for the significantly negative coefficient on ML_e.

48 A further plausible explanation follows from the result (not reported in the tables) that the stock of syndicated medium-term euro-credits became non-significant when the absolute volume of non-bank deposits (D_{nb}) was entered into the equation instead of $\frac{D_{nb}}{L_e}$. This suggests a collinearity between D_{nb} and ML_e and hence

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[1] Durbin-Watson statistics on these equations were, however, low.

[2] The choice of 2SLS reflected the relatively unsatisfactory specification of the demand equations. It is well-known that a three-stage least square (3SLS) on a poorly-specified model can worsen the consistency of the coefficient estimators as compared to a 2SLS estimator. See Theil (1971), pages 528-9 and 552. 3SLS estimates were in fact little different from the 2SLS reported.

Table B

2SLS restricted estimates

t - ratios in parentheses

Supply equation normalised on the spread:

$$S = a_o + a_1 S_{us} + a_2 S_{DM} + a_3 (r_{ed} - r_{cda}) + a_4 \frac{D_{nb}}{L_e} + a_5\, def + a_6 ML_e + a_7 D_1 + \varepsilon$$

Restricted coefficients

S_{us}	S_{DM}	$r_{ed} - r_{cda}$	$\frac{D_{nb}}{L_e}$
0.135	0.106	0.097	-9.964
(3.22)	(3.33)	(1.19)	(3.34)

Unrestricted coefficients

	Major OECD	Minor OECD	Non-oil LDC
Constant	2.379	2.951	4.20
	(3.60)	(5.77)	(6.93)
def	0.022	-0.499	-1.932
	(0.046)	(2.35)	(4.38)
ML_e	-0.0014	-0.0015	-0.0012
	(1.31)	(2.71)	(3.19)
D_1	-0.117	-0.079	-0.109
	(1.22)	(1.17)	(1.57)
$\bar{R}^2$	0.728	0.877	0.872
DW	1.97	1.74	1.60

F - test for restrictions $F_{(8,93)} = 1.13$

Demand equation normalised on ML_e:

$$ML_e = b_o + b_1 S + b_2 r_{ed} + b_3 Res/M + b_4 CA + \varepsilon$$

	Major OECD	Minor OECD	Non-oil LDC
Constant	294.70	866.925	1,769.732
	(2.88)	(1.30)	(6.93)
S	- 88.201	-113.125	- 340.691
	(2.57)	(4.30)	(4.08)
r_{ed}	- 17.828	- 12.188	- 23.564
	(3.16)	(3.13)	(1.92)
Res/M	202.546	-363.748	-1,197.728
	(2.18)	(8.75)	(6.32)
CA	0.621	3.727	- 0.380
	(1.16)	(7.64)	(3.64)
$\bar{R}^2$	0.230	0.836	0.736
DW	0.70	1.17	1.28

Where:

Res/M = ratio of aggregate reserves to aggregate imports;

CA = aggregate current account balance of payments; and

r_{ed} = average three-month euro-dollar rate.

that perhaps D_{nb} may act both as a factor determining euro-banks' funding costs, as in Table A, and also a factor explaining the longer-term internationalisation of banking which was otherwise picked up by the volume-of-loans term. If, indeed, this is the case it suggests, together with the highly significant value of the coefficient found on $\frac{D_{nb}}{L_e}$, that non-bank portfolio decisions - and the number of factors which are likely to influence these (balance of payments deficits, relative interest rates, confidence factors, etc.) - are of considerable importance in explaining the movement in spreads and the general internationalisation of banking.

4 Summary and conclusions

49 This paper has reported preliminary research on modelling international banking with the objective of explaining recent developments and the movement of spreads in the syndicated medium-term euro-credit market. The theoretical analysis concentrated on the operation of banks as financial intermediaries. It began by considering the general internationalisation of banking and by examining one aspect of the portfolio decisions of banks - their capital allocation policies - identified a possible theoretical link between the relative returns and risks on banks' domestic and international lending. This led to specific consideration of the costs, risks and returns involved in external intermediation to explain movements in the spreads on syndicated medium-term euro-credits. In addition to the links with returns on loans in national banking systems, this analysis identified perceived funding and borrower default risks, funding costs associated with the supply of funds to the euro-currency market by wealth holders, the level of LIBOR and euro-banks' capital/asset ratios as factors influencing the level of spreads on syndicated medium-term euro-credits.

50 A very large number of data considerations complicated statistical analysis of an equation to explain the level of spreads: the majority of variables in the theoretical equation are not observable; the period for which data are available is short and perhaps, because of the presence of shocks to the international banking system, unrepresentative; and the relative newness of the development of syndicated medium-term lending makes it difficult to interpret observed relationships between the expansion of this lending and the movement in euro-market spreads. In spite of these data problems, preliminary attempts at econometric investigations for the period 1974 to 1979 indicated statistically significant relationships between movements in euro-market spreads and calculated implicit spreads on loans in the US and West German domestic money markets, the supply of deposits by wealth holders to the euro-currency market, and a proxy for the perceived risk of default by borrowers. The coefficients on these variables would suggest the tentative conclusions that to banks domestic and international loans are close but not perfect substitutes in the short

run and that the primary supply of deposits by non-bank wealth holders is an important element explaining the movement in euro-market spreads.

51 The theoretical work also indicated that the absolute level of LIBOR and disturbances to funding costs in the inter-bank market, such as followed the Herstatt banking collapse, could contribute to the movement in banks' lending margins in the euro-currency market. Statistical analysis, however, rejects the hypothesis that funding risks were a major factor and that the cyclical movement in spreads observed during the period from 1974 was only the result of a shock to the euro-currency banking system. LIBOR was also statistically insignificant but this seemed to be accounted for through movements in the level of domestic spreads.

52 A result which is difficult to explain in terms of the static portfolio model is the negative relationship between the volume of lending and the level of euro-market spreads which appears to reflect dynamic features of the market's development such as banks' willingness to expand rapidly syndicated medium-term lending in the 1970s as the demand emerged. The reason for this comparatively rapid expansion, portfolio theory suggests, may be found in the search by banks for effective ways of hedging their loan portfolios and in a relative portfolio disequilibrium as regards the balance of domestic and external lending risks and returns. Statistical analysis also indicated that, to some extent, the willingness of wealth holders to place funds in euro-currency markets has influenced this process. This analytical approach would suggest that the rapid rate of growth of international bank lending is a catching-up process which will slow down as banks (and non-banks) move towards more balanced portfolios. It also suggests that the negative relationship observed between spreads and the volume of syndicated medium-term euro-credits in the 1970s will be reversed with implications for the future cost of borrowing funds in the syndicated medium-term euro-currency market.

Appendix

A mean-variance portfolio approach to banks' international lending decisions[1]

53 As an approach to analysing the internationalisation of banking, this appendix considers a model of the portfolio decisions of a (parent) bank. It is assumed that the management of the parent bank is concerned with the allocation of scarce capital resources to different parts of its operation - specifically in the model to its external (international or euro-currency) activities rather than to its domestic lending activities. The actual detailed business of banking - for example, the management of the level of deposits and loans, and requirements on the bank of maintaining liquid reserves - is the individual responsibility of the different branches or departments of the banks' overall operations.[2] The management of a parent bank makes its portfolio decisions so as to maximise a utility function which has as arguments the expected level of return and the risk of return.

54 Following Tobin (1965) it is also assumed that these arguments can be fully described by two statistics, the ratio of expected return (E) to the capital base of the bank (K) and the ratio of the standard deviation of return (σ) to the capital base of the bank (K).[3] The utility function is written without loss of generality in terms of $\frac{E}{K}$ and $\frac{\sigma^2}{K^2}$ as:

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[1] As constructed, this approach does not take account of dynamic features or the fact that the syndicated medium-term euro-currency market is relatively new and still emerging and that its rapid rate of growth may reflect a continuing learning process. In this respect, the model is inadequate. However, the static analysis provides a framework for gauging some of the dynamic aspects of the market's development and for identifying more rigorously factors which may be important in explaining the movement in euro-market spreads.

[2] At this stage, therefore, the model differs from other approaches which have been developed to model banking behaviour; see, for example, Baltensperger (1980).

[3] The capital base of the bank is assumed fixed over the decision period and non-stochastic.

$$U = U\left(\frac{E}{K}, \frac{\sigma^2}{K^2}\right)$$

where:

$$\frac{\partial U}{\partial \frac{E}{K}} = U_E > 0,$$

$$\frac{\partial U}{\partial \frac{\sigma^2}{K^2}} = U_\sigma < 0,$$

that is, it is assumed marginal utility is an increasing function of the ratio of expected returns to the capital base of the bank; and that parent banks are risk averse.

55 Total returns to the parent bank (R) can be divided into the profits derived from external lending and those derived from domestic lending:

$$R = \pi_e L_e + \pi_d L_d \qquad (13)$$

where π_e and π_d are respectively the per unit profit on external and domestic lending, and L_e and L_d are the volume of external and domestic loans, respectively.

56 Similarly the total capital of the bank can be divided into that allocated to external (k_e) and domestic operations (k_d).

$$K = k_e + k_d \qquad (14)$$

Moreover it will be assumed that the bank maintains a fixed relation between the volume of individual lending operations and the capital allocated to these operations.[1]

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[1] This assumption could be relaxed without significant loss of generality. Several studies have been carried out in which a bank may vary its capital ratio, according to returns available in the market, the cost of default loss, and the availability of finance from the central bank. See Baltensperger (1980).

$$\alpha_e L_e = k_e$$

$$\alpha_d L_d = k_d \qquad (15)$$

where α_e and α_d are the capital/asset ratios for external and domestic lending respectively.

57 Combining equations 13 to 15 the total returns (R) are written as:

$$R = \frac{\pi_e k_e}{\alpha_e} + \frac{\pi_d k_d}{\alpha_d} \qquad (16)$$

$$= \left[\frac{\pi_e}{\alpha_e} - \frac{\pi_d}{\alpha_d}\right] k_e + \frac{\pi_d}{\alpha_d} K$$

The ratio of the expected returns to capital is then:

$$\frac{E(R)}{K} = \left[\frac{E(\pi_e)}{\alpha_e} - \frac{E(\pi_d)}{\alpha_d}\right] \frac{k_e}{K} + \frac{E(\pi_d)}{\alpha_d} \qquad (17)$$

and the ratio of the variance of returns to capital squared is:

$$\frac{\sigma^2(R)}{K^2} = \left(\frac{\sigma_e^2}{\alpha_e^2} + \frac{\sigma_d^2}{\alpha_d^2} - \frac{2\rho_{ed}\sigma_e\sigma_d}{\alpha_e\alpha_d}\right) \frac{k_e^2}{K^2} + \frac{\sigma_d^2}{\alpha_d^2} + \frac{2k_e}{K}\left(\frac{\rho_{ed}\sigma_e\sigma_d}{\alpha_e\alpha_d} - \frac{\sigma_d^2}{\alpha_d^2}\right) \qquad (18)$$

where ρ_{ed} is the coefficient of correlation between returns on (aggregate) external and domestic lending and σ_e^2 and σ_d^2 are respectively the variance of returns on external and domestic portfolios.

58 Differentiating the bank's utility function with respect to k_e, the capital allocated to external lending, and setting $\frac{dU}{dk_e} = 0$

for a maximum,[1] yields the parent bank's optimal allocation of capital to external lending, k_e^*:

$$k_e^* = -\frac{\frac{U_E}{2U_\sigma}\left[\frac{E(\pi_e)}{\alpha_e} - \frac{E(\pi_d)}{\alpha_d}\right] - \rho_{ed}\frac{\sigma_e\sigma_d}{\alpha_e\alpha_d} + \frac{\sigma_d^2}{\alpha_d^2}}{\frac{\sigma_e^2}{\alpha_e^2} + \frac{\sigma_d^2}{\alpha_d^2} - \frac{2\rho_{ed}\sigma_e\sigma_d}{\alpha_e\alpha_d}} K \qquad (19)$$

59 If it is assumed that the capital/asset ratios of the bank, α_e and α_d are functions only of the respective lending risks, i.e. $\alpha_e = f_e(\sigma_e)$ and $\alpha_d = f_d(\sigma_d)$, and moreover that these functions are of the form $\alpha_e = a\sigma_e$ and $\alpha_d = a\sigma_d$, [2] then equation (19) can be simplified to:

$$k_e^* = \frac{-U_E a}{4U_\sigma} K \left[\frac{\frac{E(\pi_e)}{\sigma_e} - \frac{E(\pi_d)}{\sigma_d}}{(1 - \rho_{ed})}\right] + \frac{1}{2} K \qquad (20)$$

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[1] From equations 17 and 18 it can be easily shown:

$$\frac{dU}{dk_e} = U_E \frac{d^{E(R)}/K}{dk_e} + U_\sigma \frac{d\sigma^2(R)/K^2}{dk_e}$$

$$= \frac{U_E}{K}\left[\frac{E(\pi_e)}{\alpha_e} - \frac{E(\pi_d)}{\alpha_d}\right] + \frac{2U_\sigma}{K}\left[\frac{k_e}{K}\left(\frac{\sigma_e^2}{\alpha_e^2} + \frac{\sigma_d^2}{\alpha_d^2} - \frac{2\rho_{ed}\sigma_e\sigma_d}{\alpha_e\alpha_d}\right)\right.$$

$$\left. + \left(\frac{\rho_{ed}\sigma_e\sigma_d}{\alpha_e\alpha_d} - \frac{\sigma_d^2}{\alpha_d^2}\right)\right]$$

[2] That is banks' capital/asset ratios on domestic and external lending are fixed proportions, a, of the respective lending risks. In some countries, e.g. the Netherlands, banks are required to hold risk/asset ratios which vary with the riskiness of the loans.

60 Thus the optimal allocation of capital to external lending is a function of the difference between the ratios of expected returns to risk on external and domestic lending, the function depending on the covariance of returns on domestic and external lending, and the ratio of the marginal utilities of returns and risks in the bank's utility function. Furthermore, since $U_\sigma < 0$, and $-1 < \rho_{ed} < 1$, and since it is assumed $k_e = \alpha_e L_e$, individual banks will have upward-sloping supply curves with respect to the ratio of expected returns to risks on international loans.

Aggregation and the equilibrium returns and risk on external loans

61 Equation 20 described the optimal capital allocation of capital to external lending for an individual bank, j. By aggregating equation 20 over all banks, within and across countries, it is possible to derive the total allocation of capital for external lending as:

$$\sum_j k_e^*{}_j = \sum_j -\left(\frac{U_E a}{4U_\sigma K}\right)_j \frac{\left[\frac{E(\pi_e)}{\sigma_e} - \frac{E(\pi_d)}{\sigma_d}\right]_j}{(1-\rho_{ed})_j} + \frac{1}{2}\sum_j K_j. \qquad (21)$$

62 If $\left[\frac{E(\pi_e)}{\sigma_e}\right]_j = \frac{E(\pi_e)}{\sigma_e}$ for all j, that is all banks face the same returns and risks in their external lending operation, and setting

$$-\left[\frac{U_E a}{4U_\sigma(1-\rho_{ed})}\right]_j = B_j$$

then equation 21 can be written as:

$$\sum_j k_e^*{}_j = \frac{E(\pi_e)}{\sigma_e}\sum_j B_j K_j - \sum_j B_j K_j \left[\frac{E(\pi_d)}{\sigma_d}\right]_j + \frac{1}{2}\sum_j K_j. \qquad (22)$$

63 In equilibrium $\frac{E(\pi_e)}{\sigma_e}$ would be given as:

$$\frac{E(\pi_e)}{\sigma_e} = \frac{\Sigma k_e{}^*{}_j - \frac{1}{2}\Sigma K_j}{\Sigma B_j K_j} + \frac{\Sigma B_j K_j \left[\frac{E(\pi_d)}{\sigma_d}\right]_j}{\Sigma B_j K_j} \qquad (23)$$

This states that the ratio of expected returns to risk in external lending is determined by two sets of factors. The second is:

$$\frac{\Sigma B_j K_j \left[\frac{E(\pi_d)}{\sigma_d}\right]_j}{\Sigma B_j K_j}$$

a weighted average of the ratio of expected profit to risks on banks' domestic lending, the individual weights depending on the size of the individual bank, as measured by K_j, and the arguments in B_j (i.e. the covariance between individual banks' domestic and external lending risks, the size of individual capital ratios, and individual banks' marginal utilities with respect to expected returns and risks). The first is

$$\frac{\Sigma k_e{}^*{}_j - \frac{1}{2}\Sigma K_j}{\Sigma B_j K_j}$$

64 Under the assumption that $k_e{}^*{}_j = \alpha_{ej} L_e{}^*{}_j$, $\Sigma \frac{k_e{}^*{}_j}{\alpha_{ej}} = \Sigma L_e{}^*{}_j$ describes the total supply of international loans, or more specifically in this case syndicated medium-term euro-credits and equals, in equilibrium, the demand for international borrowing. In practical terms, the stock of syndicated medium-term credits is small compared with global bank credit aggregates. At end-September 1979, the outstanding stock of publicised syndicated loans was estimated at about $140 billion, which compares with outstanding domestic and international dollar lending of US commercial banks and savings banks of about $2,000 billion and the total assets, broadly defined, of banks of six major industrial countries (United States, United Kingdom, Japan, Germany, France and Switzerland) of $4,700 billion at end-December 1979. Also, because of the relative

newness of the emergence of demand for syndicated medium-term euro-credits and the involvement of an increasing range of banks of different nationalities as the market developed, who probably wished to allocate a larger fraction of their total capital to external lending than, perhaps, the net demands for new syndicated medium-term borrowing would accommodate in the short run, it would seem reasonable to ignore the term $\frac{\Sigma k_{e^*j}}{\Sigma B_j K_j}$ as being small and not influencing the ratio of expected profits to risk in syndicated medium-term credit lending. Equation 23 could then be approximated as:

$$\frac{E(\pi_e)}{\sigma_e} \simeq A + \frac{\sum_j B_j K_j \left[\frac{E(\pi_d)}{\sigma_d}\right]_j}{\sum_j B_j K_j} \qquad (24)$$

where $A = \frac{-1/2\Sigma K_j}{\Sigma B_j K_j}$.

65 Thus, where the number of banks who actually, or potentially, lend internationally is large, the ratio of expected profits to risks in the euro-markets would be determined largely independently of the volume of international loans; and the ratio of expected returns to risks in the euro-markets would then be given approximately as the weighted sum of the ratio of expected returns to risks on individual banks' domestic loans.

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