No. 7902
(Revision of 7808)

COMMERCIAL BANKS AND BUSINESS LOANS: THIS RECOVERY AND THE FUTURE

by

Sydney Smith Hicks

March 1979

Research Paper

FEDERAL RESERVE BANK OF DALLAS

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I. Introduction

According to many observers the recovery period beginning in 1975 was very different from previous recoveries in the sense that business loans at commercial banks remained very weak. The existing models of business borrowing generally did not predict the decline in business loans in 1975. A better forecast of business borrowing would have enabled bankers to improve profitability by enabling them to make more accurate portfolio decisions. Was this business loan behavior a rare event defying explanation, or was this inability to forecast due to incomplete modeling of business loan behavior?

In order to assess the cause of this weakness in business borrowing a simple demand and supply model for the business loan market is examined after prior studies of business loan behavior are discussed in Section II. Based upon this model, equations for the change in business borrowing at large commercial banks and for the change in business borrowing from small commercial banks are estimated and discussed in Sections IV through VI. The major results of this study are that (1) large bank and small bank markets are structurally dissimilar and thus should not be aggregated; (2) superior forecasts for total business loans can be achieved by forecasting from large and small bank equations; and (3) the model does forecast the weak business loan

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A preliminary version of this paper was presented at the Financial Management Association Annual Meetings, Minneapolis, Minnesota, October 12-14, 1978. The author would like to thank an anonymous referee and Dale K. Osborne for helpful comments and Karen J. Harmeyer for her efficient research assistance throughout this study. Any remaining errors are my sole responsibility.

behavior in 1975, particularly at the large banks, and tracks the current period fairly well.

II. Previous Studies of Business Loan Behavior

Prior studies of business loan behavior generally fall into two categories: demand studies or demand and supply studies. Four recent studies--those by Harris [6], Goldfeld [5], Hendershott [7], and the FMP model [11]--are summarized on Table 1. Many studies of business loan behavior mention very little, if any, theoretical justification for the inclusion of certain explanatory variables. Thus, what is notable about the four lists of demand explanatory variables is their diversity. When there is general agreement that the variable should be included, there is lack of agreement about whether or not the variable should enter in level or first difference form. The FMP model includes the level of inventories; Hendershott and Harris include them in first difference form. When the lagged business loan variable is included, it is in level form in Goldfeld's study, in first difference form in Hendershott's study, but is in combination with another variable in the FMP formulation.

In the case of the interest rate variable in the demand specifications, the disagreement is more complex. First, there is relatively little agreement regarding which rate or rates should be included. The second issue is whether the chosen rate should enter in level form, first difference form, or in deviation from another rate. And thirdly, one of the models converts the interest rate variable into dollar terms, whereas the other models use percentage terms.

The supply specifications contained in the Hendershott and FMP models also display diversity. The only variable upon which both

Table 1

Previous Studies' Explanatory Variables for the Change in Business Loans

Demand Studies

Harris (1976)

ΔBook value of business inventories *
ΔBusiness fixed investment
Δ(Prime rate—commercial paper rate)
ΔCash flow

Goldfeld (1969)

Business loans lagged one period
Prime rate
Treasury bill rate
Quarterly dividend payments
Business sales
Time deposits lagged one period

Demand and Supply Studies

Hendershott Model (1968)

Demand
ΔBook value of business inventories
ΔCommercial loan rate
ΔBusiness loans lagged one period

Supply (variables determining Δ commercial loan rate)
Corporate Aaa rate
Monetary base
ΔBusiness loans lagged one period
Commercial loan rate lagged one period

FMP Model (1969)

Demand
Business inventories
Inventory adjustment factor
Expenditures on producers' durables
Expenditures on non-residential structures
GNP minus total investment (current and lagged)
(Treasury bill rate — commercial loan rate) (ΔTotal business product)
(Corporate Aaa rate — commercial loan rate) (ΔTotal business product)
(Amount of total investment adjusted for the inventory valuation adjustment — ΔBusiness loans), lagged one period

Supply (variables determining commercial loan rate)
Commercial and industrial loans/demand plus time deposits
Corporate bond rate
ΔFederal Reserve discount rate
Commercial paper rate, current and lagged one through five periods

* The symbol Δ stands for "change in".

models agree is that the corporate long-term bond rate should be included. It is the only interest rate in Hendershott's formulation, whereas the FMP model includes three different interest rates. The quantity constraint variable is the monetary base in Hendershott's model and is the ratio of business loans to the sum of demand and time deposits in the FMP model.

In 1976, Harris reestimated Goldfeld and Hendershott's models. With these reestimations of Goldfeld and Hendershott, his own model, and simulations of the FMP model, Harris generated forecasts of 1975 business loan behavior. The Goldfeld, Hendershott, and FMP models underpredicted the 1975 decline by $24 billion, $7 billion, and $8 billion with root-mean-square-errors of 6.56, 2.35, and 2.41, respectively. Harris over-predicted the decline by $.5 billion with a root-mean-square-error of 1.09. Depending upon the particular data base update utilized, reestimations the Harris model raised the root-mean-square-error to as much as 1.63.

Only the Harris demand model captured to any extent the extraordinary loan weakness in 1975. Harris' major conclusion about this period was that business loans were weak because of the lack in strength of inventory spending and because there was an exceptional recovery in business cash flows. However, these conclusions about the period are suspect for two major reasons. First, supply variables played no role in Harris' model and thus were not causative factors. Second, the demand specification is not theoretically correct. The business fixed investment variable entered the equation in first difference form, whereas it should have entered in level form as shown in the next section.1/

1/ One could also question the formulation of the interest rate variable if one makes the usual assumption that prices equate demand and supply, rather than the assumption that demand and supply will be equal at some particular gap between two prices.

III. The Business Loan Market

In order to understand the business loan market, an examination of the portfolios of the participants is necessary. Although commercial banks and nonfinancial businesses have very complex balance sheets, only simple representations are used as the basis for this study. Table 2 contains a concise summary of the model as well as an abbreviation key.

Nonfinancial business firms can be characterized as financing positions in cash (CSH_F), inventories (INV), and/or fixed capital (CAP) by means of loans from commercial banks (BL), other liabilities which can be short- or long-term (OL) and net worth (NW). The balance sheet contraint for these firms is (Table 2, Equation 4)

$$\overline{NW}_F = CSH_F + \overline{INV} + \overline{CAP} - BL - OL.$$

Assume that at a given point in time the amounts of fixed capital (CAP) and inventories (INV) the firm has are known to it, as well as the volume of net worth (NW_F). Given these three quantities, the level of bank loans demanded by the business firms (BL^d, Table 2, Equation 1) depends upon the interest rate charged by banks (the prime rate, r_p) and the interest rates on other short- and long-term liabilities firms can issue (the commercial paper rate, r_{cp}, and the long-term bond rate, r_{Aaa}).2/ The quantity of business loans demanded from banks varies inversely with the prime rate. However, the demand for business loans varies positively with interest rates on other types of liabilities, the level of business inventories and the level of fixed capital. It varies negatively with net worth.

The last variable which is presumed to affect the current level of business loan demand is the past loan level, BL_{t-1}. The reason for

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2/ The level of cash held by the firms is determined as a residual once the other factors on the balance sheet are known.

Table 2

A Simple Model of Business Loan Determination

Model

(1) $BL^d = d(r_p, r_{cp}, r_{Aaa}, INV, CAP, NW_F, BL_{t-1})$; $d_1, d_6 < o$
$d_2, d_3, d_4, d_5, d_7 > o$

(2) $BL^s = s(r_p, r_T, RAM, TLI, BL_{t-1})$; $s_2, s_3 < o$
$s_1, s_4, s_5 > o$

(3) $BL^d = BL^s = BL$

(4) $NW_F = CSH_F + INV + CAP - BL$

(5) $NW_B = CSH_B + R + L + I - DL$

(6) $\Delta CAP = BFI$

(7) $\Delta NW_F = CF$

Model Solution for BL

Level Form:

(8) $BL = f(r_{cp}, r_{Aaa}, r_T, RAM, TLI, INV, CAP, NW, BL_{t-1})$

First Difference Form:

(9) $\Delta BL = g(\Delta r_{cp}, \Delta r_{Aaa}, \Delta r_T, \Delta RAM, \Delta TLI, \Delta INV, BFI, CF, \Delta BL_{t-1}, \text{Constant})$

Model Key

BFI	Business fixed investment
CAP	Capital
CF	Cash flow
CSH_B	Commercial bank cash
CSH_F	Nonfinancial business cash
DL	Deposit liabilities
I	Securities
INV	Inventory investments
L	Total Loans
NW_B	Commercial bank net worth
NW_F	Nonfinancial business net worth
OL	Other Liabilities
RAM	Reserve Adjustment Magnitude
r_{Aaa}	Corporate Aaa rate
r_p	Prime rate
r_t	Treasury 3- to 6- month bill rate
r_{cp}	4- to 6-month commercial paper rate
TLI	Total loans and investments, L + I

including this variable is the existence of the bank-customer relationship, which was introduced to the literature by Donald R. Hodgman [10]. The relationship has been extensively discussed and tested for loan demand by J. H. Wood [13]. The existence of the bank-customer relationship means that business firms may borrow more today, other factors equal, in order to assure themselves of future loan availability. In other words, current loan demand depends on expected future loan levels. Furthermore, if future loan levels are a function of the past loan level, then BL_{t-1} is an explanatory variable in the demand equation.3/

Turning to the banking sector, banks can be characterized as financing positions in cash (CSH_B), required reserves, (R), loans (L), and securities (I) by means of deposit liabilities (DL) and net worth (NW_B). The balance sheet constraint for the commercial banks is (Table 2, Equation 5)

$$\overline{NW}_B = CSH_B + \overline{R} + L + I - \overline{DL}.$$

The banking system is assumed to have decided initially how many deposit liabilities it desires by the setting of interest rates and/or fees on the deposits to attract the funds. After subtracting required reserves (R) from the deposit liabilities (DL) and adding to that result the current amount of net worth (NW_B), the banks are assumed to allocate their "disposable assets" between securities (I) and loans (L) based on alternative

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3/ By including only one lagged loan level the implicit assumption being made is that the information content of prior periods is impounded in BL_{t-1}. Some of the prior empirical models of business loan behavior (excluding Wood) assumed the existence of partial adjustment and thus a lagged business loan variable appeared in the estimated equation.

rates of return on each.4/ Since the volume of excess cash is small for the whole system, the "disposable assets" (or the portfolio constraint variable, TLI) can be measured either as the sum of deposit liabilities plus net worth less reserves or as total loans and securities. An increase in the size of this portfolio constraint variable will increase holdings of both loans and securities.5/

Given the portfolio constraint variable, the amount of funds allocated by commercial banks to business loans (BL^S, Table 2, Equation 2) is determined by what the banks can charge on the loans (the prime rate, r_P) and what the banks could earn on security investments (represented by the Treasury bill interest rate, r_T). When the prime rate increases and other factors remain the same, banks will increase the quantity of business loans supplied. When the Treasury bill rate increases, banks will decrease the supply of business loans because of the more attractive return on alternative investments.

The banks' allocation of total earning assets between business loans and other investments also depends on bank liquidity, which is affected by policy determined reserve requirements. For example, a bank facing a 5-percent reserve requirement would hold 5 cents in required reserves against $1 of deposits; if the $1 deposit was withdrawn, the bank would have to liquidate 95 cents of earning assets. A bank with a 15-percent reserve requirement would hold 15 cents in required re-

4/ "Disposable Assets" is a term used by William C. Brainard and James Tobin [2]. Brainard and Tobin make allowances for possible differences in the effect of time deposits and demand deposits on loan supply in their theoretical model. This complication is ignored here. The volume of cash is determined once all the other magnitudes are known; thus, the balance sheet constraint is satisfied.

5/ If the bank finances an increase in business loan demand by selling more liabilities then BL and TLI are simultaneously determined. The simultaneity problem is discussed in the next section.

serves and would need to liquidate only 85 cents of such assets. Thus, when reserve requirements are low, it behooves the banks to be invested more heavily in securities than loans because of the relative liquidity of securities. The higher the reserve requirement, the less need there is for liquidity and the greater loans should be relative to securities, all other factors equal.

A variable used previously in studies of the money supply process to measure the effects on reserves of changes in required reserves is the reserve adjustment magnitude, or RAM.6/ The reserve adjustment magnitude translates changes in reserve requirements relative to a base period into dollars of reserves freed up or absorbed. An increase in reserve requirements reduces RAM and, thus, should lead to an increase in business loans relative to securities because the total earning asset portfolio can be less liquid.7/

Finally, the lagged level of business loans (BL_{t-1}) will affect the current level of business loans supplied by banks, due to the existence of the bank-customer relationship. If all other factors are constant, banks may expand more loans today than they would otherwise

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6/ RAM is discussed in detail by Leonall C. Andersen and Jerry L. Jordan [1] and by Albert E. Burger and Robert H. Rasche [3]. RAM was originally calculated so that a comprehensive variable could be constructed to measure the total impact of Federal Reserve policy on the monetary aggregates. The monetary base, which includes RAM, would then reflect the extent of open market operation, borrowing at the discount window, and reserve requirement changes.

7/ In a simplified model, $RAM_t = (r_o - r_t) D_{t-2}$, where r_o is the required reserve ratio in the base period, r_t is the required reserve ratio in the current period, and D_{t-2} is the level of deposits two periods ago. Because the model for business loans is estimated in first-difference form, the first difference of RAM is used in the estimated model. The change in RAM captures the dollar amount of reserves freed or absorbed by concurrent changes in reserve requirements, adjusted for shifts in deposits among banks.

do, in order to assure future loan business. Future loan volume is unknown, but is assumed to be related to past loan volume (BL_{t-1}). The relation between last period's loan levels and today's loan levels is assumed positive.

The quantity of business loans at any point in time is such that the amount supplied equals the amount demanded (Table 2, Equation 3). The equilibrium quantity is obtained from the simultaneous solution of Equations (1) through (3), which yields Equation (6). Model Equation (6) cannot be estimated as it is because there are no accurate measures of the fixed capital stock (CAP) or the net worth (NW) of nonfinancial businesses. However, business fixed investment (BFI) measures the addition to capital stock each period, and an indication of the addition to net worth each period is undistributed corporate profits (CF).8/ As a result, the equation was estimated in first-difference form, as represented in Equation (7).

IV. Estimation of the Model

The model's equation for the change in business loans was estimated for all commercial banks, for large commercial banks (the weekly reporting banks), and for small commercial banks (all banks excluding the weekly reporting banks). [Table 3] The equations were

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8/ The CF variable is undistributed corporate profits plus the inventory valuation adjustment and depreciation. There exists the possibility of measurement error in the business loan series due to judgments regarding loan classification. Consequently, a constant should be and was added for econometric reasons. For a discussion of these problems, see Robert S. Pindyck and Daniel L. Rubinfeld [12, pp. 128-129].

Table 3

BUSINESS LOAN EQUATION

Explanatory Variable	Estimates All Banks	Large Banks	Small Banks
Constant (C)	.128 (.21)	.097 (.19)	-.381 (-2.13)
Change in:			
Commercial paper rate (Δr_{cp})	.932 (2.51)	1.232 (4.00)	-.063 (-.59)
Long-term corporate bond rate (Δr_{Aaa})	.003 (.003)	-.495 (-.69)	-.131 (-.54)
Reserve adjustment magnitude (ΔRAM)	.588 (2.04)	.717 (2.80)	-.112 (-1.24)
Treasury bill rate (Δr_T)	-.141 (-.30)	-.311 (-.74)	.151 (.95)
Total loans and investments at all banks (ΔTLIA)	.182 (4.79)	--	--
Total loans and investments at large banks (ΔTLIL)	--	.178 (4.52)	--
Total loans and investments at small banks (ΔTLIS)	--	--	.065 (3.85)
Inventories (ΔINV)	.438 (3.85)	.339 (3.29)	.053 (1.74)
Business fixed investment (BFI)	-.006 (-.56)	-.001 (-.13)	.011 (3.08)
Corporate cash flow (CF)*	.002 (.08)	-.003 (-.15)	-.008 (-1.05)
Lagged change in:			
Business loans at all banks (ΔBLA_{t-1})	.215 (2.19)	--	--
Business loans at large banks (ΔBLL_{t-1})	--	.228 (2.58)	--
Business loans at small banks (ΔBLS_{t-1})	--	--	-.162 (-1.06)
R^2 Adjusted	.866	.836	.811
D-W (Durbin-Watson autocorrelation test statistic)	1.999	1.834	1.982
SE (standard error of the regression)	.843	.758	.258

* Undistributed corporate profits plus the inventory valuation adjustment and depreciatic

NOTE: Equations estimated for 1960III through 1974IV
Figures in parentheses are t-statistics of the regression coefficients.

estimated from 1960III-1974IV; 1960III represents the beginning of the period for which bank data disaggregated by size is available and 1974IV is the last data point before the seemingly unusual business loan behavior began. All of the regressions are significant as measured by the F statistic.

In regressions with a lagged dependent variable the estimators will be consistent only if the disturbance terms are not serially correlated. Though the Durbin-Watson statistics (D-W) are close to 2.0, these statistics for regressions with a lagged dependent variable may be biased indices of autocorrelation. However, Durbin (4) has proposed the h-statistic to test for serial correlation when one lagged dependent variable is present. If $h > 1.645$, then the hypothesis of zero autocorrelation can be rejected at the 5 percent level. The calculated h-statistics for all bank and large bank equations were .056 and .845, respectively.9/ Consequently, the hypothesis of zero autocorrelation cannot be rejected.

Prior business loan studies have aggregated small and large bank business loan markets, without examining whether or not this aggregation is appropriate. Zellner [14] proposed a method for testing the hypothesis of no aggregation bias. Let us assume there exist two bank business loan markets which can be represented as follows:

(1) $\Delta BLL_t = \beta_0 + \beta_1 (SV) + \beta_2 \Delta TLIL + \beta_3 \Delta BLL_{t-1}$, and

(2) $\Delta BLS_t = \alpha_0 + \alpha_1 (SV) + \alpha_2 \Delta TLIS + \alpha_3 \Delta BLS_{t-1}$, where

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9/ The h-statistic for the small bank equation was undefined and in such cases an alternative test suggested by Durbin (4; p.420) was applied. The error term from the small bank equation was regressed on the lagged error term and the explanatory variables listed on Table 3. Since the coefficient on the lagged error term was not significantly different from zero, the hypothesis of zero autocorrelation could not be rejected.

β_1(SV) and α_1(SV) can be thought of as representing a vector of coefficients and explanatory variables; the explanatory variables (SV) are the same variables for both markets. Letting W_1 = ΔTLIL/ΔTLIA, W_2 = ΔBLL_{t-1}/ ΔBLA_{t-1},

and adding (1) and (2) yields

$$(3)\quad \Delta BLA = (\beta_0 + \alpha_0) + (\beta_1 + \alpha_1)\ (SV) + \beta_2 W_1 \Delta TLIA + \alpha_2(1-W_1)\Delta TLIA + \beta_3 W_2 \Delta BLA_{t-1} + \alpha_3(1-W_2)\Delta BLA_{t-1}, \text{ or}$$

$$(4)\quad \Delta BLA = (\beta_0 + \alpha_0) + (\beta_1 + \alpha_1)\ (SV) + \alpha_2 \Delta TLIA + (\beta_2 - \alpha_2)\Delta TLIL + \alpha_3 \Delta BLA_{t-1} + (\beta_3 - \alpha_3)\Delta BLL_{t-1}.$$

Equation (4) was estimated where the SV variables were Δr_{cp}, Δr_{Aaa}, Δr_T, ΔINV, BFI, and CF, as defined on Table 3.

The hypothesis being tested is that there is no aggregation bias; that is, $\beta_2 = \alpha_2$ and $\beta_3 = \alpha_3$. If the estimated coefficients on ΔTLIL and ΔBLL_{t-1} are jointly significantly different from zero, then disaggregation is appropriate. The equation was estimated over the period 1960III-1974IV. The coefficient of ΔTLIL was positive with a t-statistic of 1.14, and the coefficient of ΔBLL_{t-1} was positive with a t-statistic of 4.24. The R^2 was .9216 (with an adjusted R^2 of .9029). An F-test conducted on the hypothesis that both coefficients equaled zero resulted in the rejection of the hypothesis.

To test the stability of this result, the equation was estimated over sample periods extended by one year at a time. The significance of ΔBLL_{t-1} fell while the significance of ΔTLIL grew.
In summary, disaggregation of the aggregate business loan market yields more information than the aggregate equation for business loan behavior.

If a bank responds in the current period to an increase in business loan demand by selling more liabilities contrary to the assumption made to this point, a portion of the portfolio constraint variable becomes endogenous. If this were true for all banks, we could not be sure whether an increase in the aggregate portfolio constraint variable led to an increase in business loans or vice versa. However, deposit liabilities and, thus, total earning assets for the whole banking system are importantly constrained by the total amount of reserve money supplied by the Federal Reserve System.10/ That the assumption of an exogenous portfolio constraint variable (ΔTLI) is a reasonable assumption has been confirmed by the two-stage least-squares estimates.11/ The two-stage estimates do not alter any of the major conclusions of the paper.

V. A Comparison of Large and Small Bank Business Loan Markets

A few interesting differences and similarities between small and large bank business loan markets can be noted by comparing the coefficient estimates in Table 3. Generally, the coefficient estimates have the positive or negative signs economists would expect given the prior behavioral assumptions. Despite problems of

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10/ The problem of simultaneous-equation bias in the ordinary least-squares estimation used here would remain if the Federal Reserve tended to supply or withdraw reserves automatically in response to variations in bank loan demand. Since the Trading Desk of the Federal Reserve follows an interest rate target between the monthly meetings of the Federal Open Market Committee, this could be a problem for data covering relatively short periods. But over the quarterly intervals used in this study there is often substantial movement in short-term interest rates, so total earning assets of banks can still be considered exogenous.

11/ Two-stage estimates are provided in the appendix.

collinearity among the variables (which reduces t-statistics), many of the explanatory variables are still significant.

At the large banks, for example, an increase in the commercial paper rate (Δr_{cp}) of one percentage point will increase business loans by $1.232 billion (as the alternative means of financing becomes more expensive). If either inventories (ΔINV) or total loans and investments (ΔTLIL) increase by $1 billion, business loans increase by $.34 and $.18 billion, respectively. Despite the view of some large banks that their business loans increase when business fixed investment (BFI) rises, these results do not indicate this.12/ Contrary to the Harris study, the results do not indicate a significant impact of cash flows on the change in business loans. And finally, the combined lagged adjustment of large banks and their customers results in a significantly positive lagged effect of last period's change in business loans on this period's change in business loans. A $1 billion increase in business loans last period will increase this period's business loans by about one quarter of a billion dollars.

The results for small banks are similar with respect to sign, but the magnitudes of the coefficients are much different. Multicollinearity among the interest rates (two short-term and one long-term) appears to be more of a problem in the small bank equation estimates; none of the interest rates have coefficients significantly different from zero. As with large banks, a billion dollar increase in either inventories or total loans and investments increases business loans significantly by $.05 billion or $.07 billion, respectively.

12/ See Herman [8]. The ΔRAM variable in the large bank equation was unexpectedly positive and significant, while the Δr_{Aaa} variable was unexpectedly negative. Due to the collinearity between the two series, it is possible that the ΔRAM variable is simply capturing the effect attributable to Δr_{Aaa} and, moreover, to Δr_{cp}.

Unlike the large bank regression, (1) rising levels of business fixed investment add to the current change in business loans, (2) increasing cash flows measurably depress borrowing at small banks (the t level is more negative, but still not significant) and (3) the lagged effect of the past period's change in business loans does not significantly affect the current change in business loans.

The lagged change in business loans coefficient can be interpreted as a measure of the importance of the bank-customer relationship in the small and large bank markets. The insignificant coefficient on ΔBLS_{t-1} does make sense if it is true that in the small bank markets firms do not have much choice as to where to bank, and the banks do not have much competition. In the large bank market, there may be relatively more competition among bankers and more of the large bank customers may have alternative financing options; as a result, the bank-customer relationship may become more significant as a tool for maintaining the banks' market shares.13/

VI. Forecasting Business Loans

Besides the fact that multicollinearity among many of the explanatory variables did mean that some coefficients were unexpectedly insignificant (for example, the cash flow variable), collinearity causes the estimates of the coefficients to change dramatically when sample periods are updated and when data are revised. One or more

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13/ The insignificant coefficient on the lagged change in small bank business loans remained robust for sample period endpoints ranging from 1970-1977I. When the 1977II-1978I data was added, the coefficient became significant and positive. Because the small bank equation is unstable in this period, more data is needed before this new result can be viewed as accurate.

variables could be eliminated to reduce collinearity; this would also reduce the number of variables which would have to be forecast before a business loan prediction could be generated. However, eliminating variables does result in specification error. To warrant confidence in the coefficient estimates and the predictions based on them, any specification that omits variables should predict outside the sample period at least as well as the whole model. Otherwise, the specification error introduced would be too costly for the gain in coefficient stability.

In fact, some of the specifications of the model that omitted some interest rate and/or RAM variables did predict 1975 better than the whole model estimated through 1974IV, as judged by the root-mean-square-error statistic. From the alternative specifications of the model estimated with data available in June 1978, the following specifications for large and small banks (which subsequently will be called the restricted model equations) minimized the r-m-s-e for 1975:

(a) $\Delta BLL = f'\,(C, \Delta r_{Aaa}, \Delta r_T, \Delta TLIL, \Delta INV, BFI, CF, \Delta BLL_{t-1})$

and

(b) $\Delta BLS = g'\,(C, \Delta r_{Aaa}, \Delta r_T, \Delta RAM, \Delta TLIS, \Delta INV, BFI, CF, \Delta BLS_{t-1})$. 14/

The equation for large banks (a) excludes ΔRAM and Δr_{cp} from the theoretical model; only Δr_{cp} is removed from the small bank equation (b). Tables 4 and 5 contain the root-mean-square-errors of various prediction periods for the theoretical model and the restricted model, respectively.

14/ The coefficient estimates are presented in Hicks [9, p. 15]. The Δr_{Baa} variable was used instead of Δr_{Aaa} in the small bank regressions because Δr_{Baa} probably proxies the long-term borrowing costs of small bank customers better than Δr_{Aaa}. However, because of the statistical tests conducted on the model in this paper, it was necessary to use Δr_{Aaa} instead of the Δr_{Baa} variable.

TABLE 4

Root-Mean-Square-Error Statistics For the
Theoretical Model over Alternative Prediction Periods

Estimation Period	Prediction Period	Aggregate All Banks	Large Banks	Small Banks	Disaggregat --All Banks
1960III-1974IV	1975I-1975IV	2.563	1.975	.548	2.424
1960III-1974IV	1975I-1976IV	3.116	2.465	.648	3.012
1960III-1974IV	1975I-1978I	2.511	2.054	.966	2.436
1960III-1975IV	1976I-1978I	2.348	1.651	1.228	2.317
1960III-1976IV	1977I-1978I	2.192	1.160	1.528	2.226
1960III-1977IV	1978I	1.878	1.827	.276	1.550

* The disaggregate all bank r.m.s.e. statistics are generated from the errors of the individual large and small bank equations.

TABLE 5

Root-Mean-Square-Error Statistics For the
Restricted Model over Alternative Prediction Periods

Estimation Period	Perdiction Period	Large Banks	Small Banks	Disaggregate --All Banks
1960III-1974IV	1975I-1975IV	1.038	.556	1.480
1960III-1974IV	1975I-1976IV	1.740	.660	2.165
1960III-1974IV	1975I-1978I	1.465	.953	1.926
1960III-1975IV	1976I-1978I	1.629	1.218	2.243
1960III-1976IV	1977I-1978I	1.055	1.519	2.061
1960III-1977IV	1978I	1.656	.274	1.382

* The disaggregate all banks r.m.s.e. statistics are generated from the errors of the individual large and small bank equations.

No matter what specification was examined over the period of 1960III-1974IV, a superior total forecast for 1975 was always made by forecasting the small and large bank components and then adding them together. For example, this result may be observed from the first line of Table 4. When the theoretical model was estimated over estimation periods ending later than 1974IV and for longer prediction periods, the predictions for total business loans made from the disaggregated small and large bank equations were generally better than aggregate predictions. Only in one period was the aggregate prediction better than the disaggregated predictions and this occurred when the equation for small banks was unstable and thus could not be considered reliable.15/

The total business loan root-mean-square-error statistics improve dramatically from $2.56 billion for the aggregate bank theoretical model in 1975, to $1.48 billion for the restricted disaggregate predictions. The r-m-s-e statistics for 1975 generated from prior demand and supply studies were in the 2.4 range.

The model does predict the decline in total business loans in 1975 better than prior models.16/ (Chart 1) Most of the weakness in 1975 occurred at the large banks, while changes in small bank business loans remained stable. In 1976 and 1977 large bank predictions were good in the sense of not missing consistently in the same direction. On the other hand, the changes in small bank business loans in 1977

15/ See Hicks [9, p.16-17].

16/ The predictions were generated from the restricted model estimated from 1960III-1974IV.

were consistently underestimated. Structural stability tests presented elsewhere indicate relatively more structural instability in the current time period for the small bank business loan market than for the large bank market.17/ While the restricted model does a better job than prior models in predicting the change in total business loans, the error does remain approximately 49 percent of the average quarterly change in business loans in the 1970's (and declines to 36 percent when 1975I-1976II is excluded from the period).

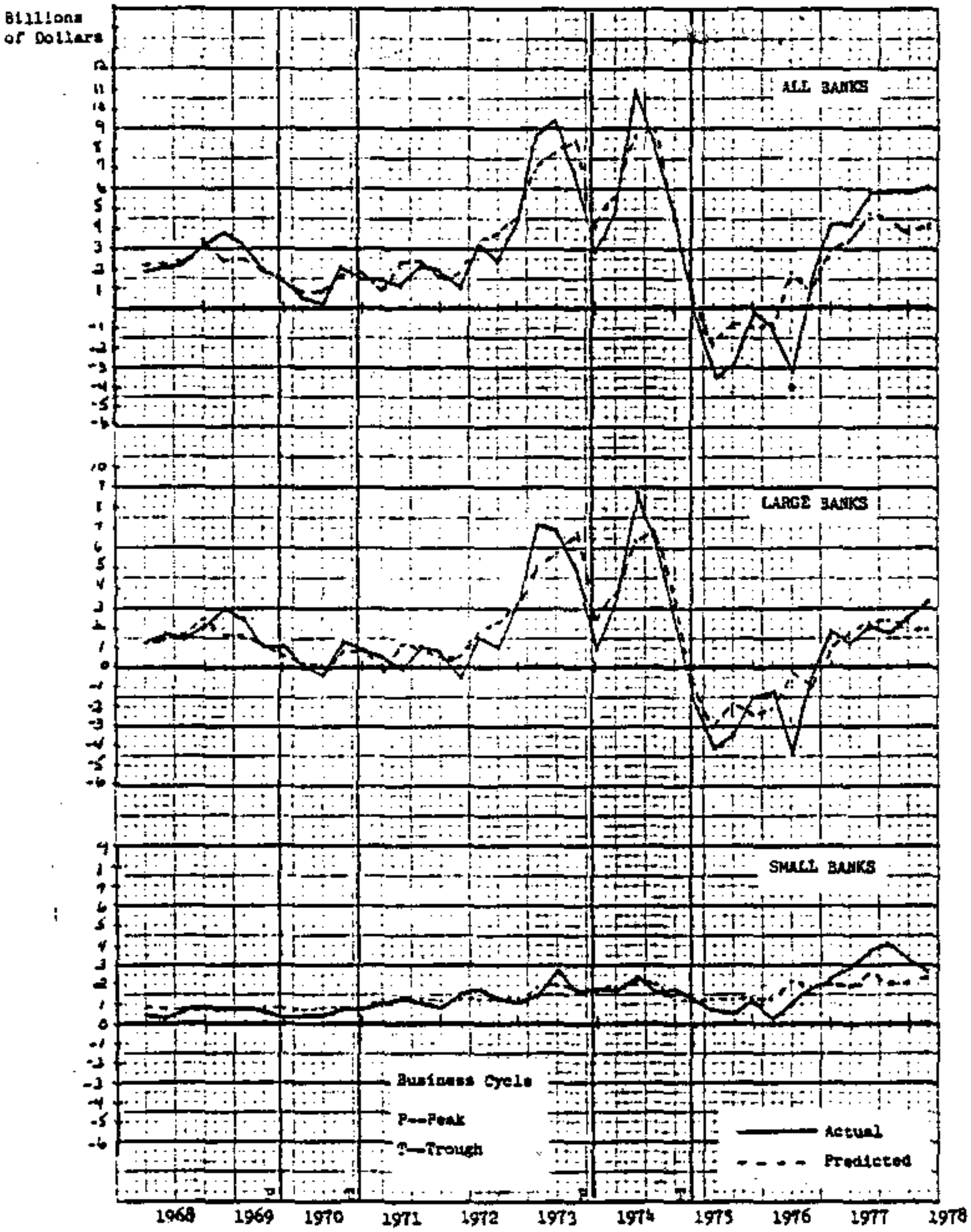
VII. Conclusion

Understanding changes in business loan behavior has proven to be a very difficult task. In the case of the business loan market, aggregation of small and large bank markets is not statistically appropriate. Given that large and small bank business loan equations should be disaggregated, the equation estimates provide interesting similarities as well as dissimilarities. One of the most interesting results is that last quarter's change in business loans in the small bank market provides no significant information about today's change in business loans, contrary to the results for the large bank business loan market.

Recognizing the structural diversity between large and small markets, as well as modeling both demand and supply sides of the market, rather dramatically increases the explanatory and predictive power of the model over alternative formulations. Estimated through 1974, the model predicts the decline in total business loans, as well as the relative weakness in the large bank loan market. To the extent the model increases the ability of bankers to predict business loan behavior, bankers will be able to improve profitability by making more accurate portfolio decisions.

17/ Hicks [9, p. 17-18].

CHART 1. Actual Versus Predicted Changes in Business Loans



*Reclassification of loans as of March 31, 1976, lowered the change in business loans by $1.2 billion in 1976-Q2.

NOTE: Predictions generated from model estimates for 1960-Q3 through 1974-Q4.

SOURCES: Federal Reserve Bank of St. Louis.
Federal Reserve Bank of Dallas.

REFERENCES

1. Andersen, Leonall C. and Jordan, Jerry L. "The Monetary Base - Explanation and Analytical Use." Review of the Federal Reserve Bank of St. Louis (August 1968): 7-11.

2. Brainard, William C. and Tobin, James. "Pitfalls in Financial Model Building." American Economic Review 58, no. 2 (May 1968): 99-122.

3. Burger, Albert E. and Rasche, Robert H. "Revision of the Monetary Base." Review of the Federal Reserve Bank of St. Louis (July 1977): 13-28.

4. Durbin, J., "Testing for Serial Correlation in Least-Squares Regression when Some of the Regressors are Lagged Dependent Variables," Econometrica 38 (May 1970): 410-421.

5. Goldfeld, Stephen M. "An Extension of the Monetary Sector." in The Brookings Model: Some Further Results. Edited by James S. Duesenberry et al. Chicago: Rand McNally & Co., 1969, pp. 317-359.

6. Harris, Maury N. "An Econometric Examination of Business Loan Behavior." Federal Reserve Bank of New York, Research Paper No. 7615 (New York, 1976).

7. Hendershott, Patric H. "Recent Developments of the Financial Sector of Econometric Models." Journal of Finance 23 (March 1968): 41-66.

8. Herman, Tom. "New York Banks' Loan Demand Still Soft as Many Concerns Turn to Other Sources," Wall Street Journal, February 10, 1978, p.18.

9. Hicks, Sydney Smith. "Business Loans and Banks: Is This Cycle Unusual?" Voice of the Federal Reserve Bank of Dallas (June 1978): 1-18.

10. Hodgman, Donald R. "The Deposit Relationship and Commercial Bank Investment Behavior." Review of Economics and Statistics 43 (August 1961): 257-268.

11. Jaffee, Dwight M. Credit Rationing and the Commercial Loan Market: An Econometric Study of the Structure of the Commercial Loan Market. London and New York: John Wiley and Sons, Inc., 1968.

12. Pindyck, Robert S. and Rubinfeld, Daniel L. Econometric Models and Economic Forecasts. New York: McGraw-Hill Book Co., 1976.

13. Wood, J. H. Commercial Bank Loan and Investment Behavior. London and New York: John Wiley and Sons, 1975.

14. Zellner, Arnold. "An Efficient Method of Estimating Seemingly Unrelated Regressions and Tests for Aggregation Bias." Journal of the American Statistical Association 57 (June 1962): 348-368.

APPENDIX

The model of business loan behavior presented here is only part of the financial sector and actually should be embedded in a general equilibrium model of interest rates and output. The predetermined variables of that complete model would be the explanatory variables in the first stage of a two stage estimating process. A complete general equilibrium model was not specified; however, the first stage which was estimated (A.1 below) was chosen to be amenable to most economists.

$$(A.1)\ \Delta TLI = \alpha_0 + \alpha_1\ \Delta MBASE + \alpha_2 \Delta GOV,$$

where ΔTLI represents either ΔTLIL or ΔTLIS; ΔMBASE is the change in the nominal monetary base; and, ΔGOV is the change in nominal total government purchases of goods and services. All of the series were seasonally adjusted. The estimation period was 1960III through 1974IV.

The second stage estimates are presented in Table A.1. From a comparison of Table 3 and Table A.1 problems of simultaneity do not appear severe.

Table A.1

BUSINESS LOAN EQUATION - Second Stage Estimates 1960III-1974IV

Explanatory Variable	Estimates: Large Banks	Estimates: Small Banks
Constant (C)	.301 (.47)	-.374 (-1.83)
Change in:		
Commercial paper rate (Δr_{cp})	1.783 (5.41)	.111 (1.01)
Long-term corporate bond rate (Δr_{Aaa})	-1.109 (-1.42)	-.300 (-1.15)
Reserve adjustment magnitude (ΔRAM)	.688 (2.34)	-.101 (-1.02)
Treasury bill rate (Δr_T)	-.696 (-1.47)	-.034 (-.20)
Total loans and investments at large banks (ΔTLIL)	.287 (2.45)	--
Total loans and investments at small banks (ΔTLIS)	--	.065 (2.06)
Inventories (ΔINV)	.319 (2.57)	.029 (.90)
Business fixed investment (BFI)	-.010 (-.92)	.012 (2.75)
Corporate cash flow (CF)*	.003 (.13)	-.009 (-1.12)
Lagged change in:		
Business loans at large banks (ΔBLL_{t-1})	.284 (2.58)	--
Business loans at small banks (ΔBLS_{t-1})	--	-.078 (-.47)
R^2 Adjusted	.825	.808
	.792	.773
D-W (Durbin-Watson autocorrelation test statistic)	1.928	2.034
SE (standard error of the regression)	.853	.282

*Undistributed corporate profits plus the inventory valuation adjustment and depreciation.

NOTE: Equations estimated for 1960III through 1974IV.
Figures in parentheses are t-statistics of the regression coefficients.