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**Intervention and the Dollar's Decline** **2**
by Owen F. Humpage

A sharp increase in U.S. exchange-market intervention accompanied the dollar's recent depreciation. The United States initially attempted to encourage a depreciation, but by 1987 sought to stabilize the dollar. This paper reviews our recent experience with intervention. The author finds that intervention did have a temporary impact on dollar exchange rates on a few occasions, but that overall it was not systematically related to daily exchange-rate movements.

**Using Financial Data to Identify Changes in Bank Condition** **17**
by Gary Whalen and James B. Thomson

The cost and complexity of examining banks has risen at a time when there is an increased need for oversight by regulators. To facilitate their work, bank examiners have developed off-site monitoring techniques, using information from failed-bank studies and from call-report data. This article discusses the use of logit regression analysis to predict deterioration in bank condition as measured by the CAMEL rating. The authors include nonperforming loans in the study and examine the use of factor analysis to mimic CAMEL rating procedures.

**Developing Country Lending and Current Banking Conditions** **27**
by Walker F. Todd

The debt of developing countries has created difficulties for the United States banking system in the 1980s. This article describes the evolutionary stages of the debt problem and the adjustments that U.S. banks and financial markets have made to accommodate that evolution. The magnitude and effect of the debt problem continue to change, and it is doubtful that the final stage of this evolution has occurred.

**Comment** **37**

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# Intervention and the Dollar's Decline

by Owen F. Humpage

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## Introduction

The past three years have witnessed a record decline in the exchange value of the U.S. dollar. This depreciation generally has been consistent with market fundamentals, such as the U.S. current-account deficit, movements in interest-rate spreads, changes in relative inflation rates, and divergent money-growth rates. A sharp increase in central-bank intervention, especially by the United States, also has accompanied the dollar's depreciation.

Many observers believe that this intervention contributed to the dollar's decline in 1985 and that it helped to stabilize the dollar in 1987. Indeed, at first glance, it might appear that the massive intervention of late 1985 pushed the dollar downward and that the heavy intervention in early 1987 helped to stabilize the dollar. As Copemicus demonstrated long ago, however, first glances can deceive.

This article takes a second look at our recent experiences, and asks if day-to-day intervention was related to day-to-day movements in dollar exchange rates. We find no systematic relationship, but we identify a few specific occasions when U.S. intervention seemed to alter exchange rates. Our review of circumstances surrounding these episodes suggests that intervention can produce a one-time shift in exchange rates by providing new information to the market about monetary and fiscal policies or about official attitudes concerning the dollar.

Section I of the paper provides background information about the theoretical channels through which intervention might alter exchange rates. Section II discusses the empirical methodology. We use regression techniques that distinguish between "initial" and "subsequent" intervention in our search for systematic relationships between intervention and exchange-rate movements. Section III analyzes U.S. intervention from August 1984 to August 1987. A case study of specific episodes of intervention supplements the statistical analysis, and we present three subsections that correspond to three different U.S. approaches to intervention during this period. Section IV summarizes the results and offers some policy conclusions.

## I. Intervention and Exchange Rates

Exchange-market intervention refers to official purchases or sales of currencies designed to influence exchange rates. These transactions alter the net foreign-currency position of the monetary authorities' balance sheet. Economic theory offers three possible channels through

which intervention can alter exchange rates: the monetary channel, the portfolio-adjustment channel, and the expectations channel.[1]

The most understood and accepted of these is the monetary channel. Intervention can alter the money supplies of both countries whose currencies are involved in the transactions. Other things equal, intervention will contract the money supply of the currency that is purchased and will expand the money supply of the currency that is sold. Economists generally agree that relative rates of money growth exert a strong influence on exchange rates. Such intervention will tend to depreciate the currency that is sold relative to the currency that is purchased.

Since the inception of floating exchange rates in 1973, major countries routinely have "sterilized," or offset, the monetary effects of their exchange-market intervention through transactions with other, more conventional instruments of monetary policy. For example, if the Federal Reserve wishes to prevent an intervention purchase of West German marks from increasing the U.S. money supply, it can sell an equivalent dollar amount of Treasury bills through open-market operations. The sale of Treasury bills reduces the U.S. money supply. Countries sterilize intervention because they wish to focus their monetary policies on domestic objectives, such as inflation or growth, and because they believe that they can conduct independent intervention and monetary policies.

One cannot easily distinguish sterilized intervention from nonsterilized intervention. To sterilize intervention, the offset need not be dollar-for-dollar. A central bank need only prevent intervention from altering the amount of reserves in its banking system from their target level. Since exchange-rate considerations can influence monetary policy decisions, the very idea of an independent, sterilized intervention sometimes becomes fuzzy.

The second channel through which intervention can influence exchange rates, the portfolio-adjustment channel, is open to sterilized intervention. Although it does not change relative rates of money growth, sterilized intervention alters the supply of bonds denominated in one currency relative to the supply of bonds denominated in another currency. In our example, the Federal Reserve sold Treasury bills to sterilize its intervention transactions and thereby increased the relative supply of U.S. Treasury bills in the market.

If international investors view securities with different currency denominations as imperfect substitutes, then the increase in Treasury bills could cause a portfolio diversification away from dollar-denominated assets. Interest rates would rise and the dollar would depreciate until international investors felt compensated for the risks of holding the now more abundant dollar-denominated assets. Although portfolio adjustment then provides a possible link between sterilized intervention and the spot exchange rate, empirical evidence suggests that it is at best a very weak link (see Hutchison, 1984).

Both sterilized and nonsterilized intervention can also influence exchange rates through a third channel, by altering expectations in the exchange market. The exchange market, like other financial-asset markets, is a highly efficient information processor.[2] Currency traders use all available information, including information about predictable future events and anticipated policies, in establishing current exchange quotes.

An empirical implication of market efficiency is that exchange rates will follow a "fair game":[3]

$$S_{t+1} = S_t + E(\Delta S_t | I_t) + a_t.$$

The spot exchange rate tomorrow, $S_{t+1}$, will equal today's spot rate, $S_t$, plus any expected change, $E(\Delta S_t | I_t)$, given all information, $I_t$, available today plus a random component $a_t$ that reflects unanticipated events, or "news." Empirical research often has found that log changes in exchange rates follow fair-game processes, specifically a random-walk process, where $E(\Delta S_t | I_t) = 0$, or a near random-walk process, where $E(\Delta S_t | I_t) =$ a constant.[4]

Intervention, to the extent that it improves the flow of information in a "disorderly" market, or to the extent that it provides new information about future policies, can alter current exchange rates. One would expect a one-time permanent shift in the exchange rate when the new information is received. If, however, the intervention provided no new information about pending changes in policy or in official attitudes about exchange markets, it would have no impact in an efficient market.

1 Humpage (1986) discusses these channels and reviews some important empirical literature.

2 See Fama (1970)

3 For a discussion of the relationship between efficiency, "fair games," and random walks, see Levich (1985).

4 See Meese and Rogoff (1983)

## BOX 1

## Regression Analysis

### Data

The exchange rates are daily opening New York quotes obtained from Bank of America through the DRI-FACS service. Intervention dummies are constructed from internal documents on U.S. intervention.

Because the exchange quotes are morning quotes on day "*t*," and because intervention pertains to purchases or sales throughout day "*t*," we lag intervention one period to ensure that the exchange-rate movements follow intervention.

Each equation is estimated from approximately one month before the first intervention transaction to approximately one month after the last intervention transaction. We indicate the exact dates on each table.

### Equation

We estimate the following equation in all cases, but we omit certain dummies when they are not relevant to a particular episode:

$$DM/\$ = BDA(-1) + BDB(-1) + SDA(-1) + SDB(-1) + DM/\$(-1)$$

and

$$Y/\$ = BYA(-1) + BYB(-1) + SYA(-1) + SYB(-1) + Y/\$(-1)$$

where the variables are defined as follows:

DM/$ = the log of the West German mark-U.S. dollar exchange rate;
Y/$ = the log of the Japanese yen-U.S. dollar exchange rate;
BDA = initial intervention purchases of West German marks;
BDB = subsequent intervention purchases of West German marks;
SDA = initial intervention sales of West German marks;
SDB = subsequent intervention sales of West German marks;
BYA = initial intervention purchases of Japanese yen;
BYB = subsequent intervention purchases of Japanese yen;
SYA = initial intervention sales of Japanese yen;
SYB = subsequent intervention sales of Japanese yen;

and where (-1) indicates a one-period lag.

The dummy variables for initial intervention take a value of 1 when the United States intervened after five previous business days during which no intervention took place, and the variables take a value of 0 at all other times. The dummy variables for subsequent intervention take a value of 1 when the United States has intervened within the previous five business days. This dummy is set equal to 0 at all other times. Each table lists the number of times per episode that each dummy takes a value of 1.

## II. Empirical Methodology

This paper uses an empirical methodology consistent with the efficient market view of exchange rates. Over each period of intervention, we regressed the log of the spot mark-dollar and/or yen-dollar exchange rate on its previous day's value and on two sets of dummy variables, corresponding to types of U.S. intervention (see box 1). One set of dummies measures "initial" U.S. intervention purchases or sales of dollars, and a second set measures "subsequent" U.S. intervention.

We distinguish between initial and subsequent intervention because the former could have an announcement effect that is not associated with the latter. We arbitrarily define initial intervention as an official transaction that follows a period of five business days with no intervention. The remaining transactions are classified as subsequent intervention. We do not include dummies for foreign intervention.

The coefficients associated with the dummy variables measure the average percentage change in the exchange rate on days of initial and subsequent intervention over each interven-

tion episode. If the coefficient on the intervention dummy is significantly different from zero, it suggests that intervention provided new information to the market that was not contained in the previous day's quote.

In splitting the dummy variables, we test to see if the information content of initial intervention is different from that of subsequent intervention. In all cases except one, the average dollar value of initial intervention was not greater than the average daily amount of subsequent intervention. Nevertheless, the "news" content of initial intervention could be substantially greater. The coefficients on the dummy variables should reflect differences in the news content and not dollar amounts.

We adopted this regression technique as a means of summarizing the day-to-day exchange-rate response to intervention. We consider five distinct time periods, rather than running a single regression over the entire period, to avoid having the coefficients on the dummy variables average the responses to different circumstances. Nevertheless, such regressions, even over very short time periods, risk this problem, as will shortly become apparent. Consequently, we also base our conclusions on a day-to-day inspection of events surrounding each episode of U.S. intervention.[5]

## III. Three Case Studies of Intervention: August 1984 to August 1987

Between August 1984 and August 1987, the United States seemed to adopt three different approaches to exchange-market intervention. Prior to the Group of Five (G5) meeting in September 1985, the U.S. approach to intervention seemed to be a continuation of the policy established in March 1981.[6] This approach viewed intervention as appropriate only on relatively few occasions to "calm disorderly markets." From August 1984 to the G5 meeting in September 1985, the United States intervened on two occasions, each of which was short in duration. U.S. intervention prior to the G5 agreement often was not closely coordinated with that of other central banks and often was not highly visible. The total dollar value of U.S. intervention over this period was $938 million.

U.S. intervention immediately following the G5 meeting departed from this earlier approach by encouraging a dollar depreciation through large, persistent dollar sales against West German marks and Japanese yen. This intervention, which amounted to approximately $3.2 billion, was more closely coordinated with that of other central banks and was very visible. The G5 episode of intervention lasted through November 1985; thereafter the United States did not intervene until early 1987.

A third intervention regime followed the Group of Seven (G7) meeting in February 1987.[7] In most respects the G7 approach to intervention was not much different from the G5 approach, except that central banks now aimed at stabilizing the dollar rather than promoting a further dollar depreciation. Rumors following the meeting suggested that the G7 countries were attempting to maintain reference zones for the mark-dollar and yen-dollar exchange rates. The United States intervened on two occasions following the G7 meeting, with gross intervention (purchases plus sales) over both periods exceeding $4.0 billion. The first lasted from March to June 1987, and the second occurred in August 1987.

In sum, the three-year period between August 1984 and August 1987 provides us with five examples of U.S. intervention within three broad U.S. intervention regimes. Two episodes occurred prior to the G5 meeting, one immediately followed the G5 meeting, and two followed the G7 meeting.

### Intervention Prior to the Group of Five Meeting

By late 1984, the dollar increasingly seemed overvalued in terms of purchasing power parity or trade considerations. The growing U.S. current-account deficit reached a record $30 billion in the fourth quarter, bringing the deficit for all of 1984 to $106.0 billion, up sharply from $46.6 billion in the previous year.

The Federal Reserve System began to inject reserves into the banking system, as evidenced by a sharp reduction in the federal funds rate late in the year. The average effective federal

5 Three other case studies of intervention are by Greene: (1984a), (1984b), and (1984c).

6 The Group of Five industrial countries are France, West Germany, Japan, Ihe Uniled Kingdom, and the United States.

7 The Group of Seven industrial countries are Ihe G5 countries plus Canada and Italy.

## TABLE 1

I. Estimation Period: August 7, *1984* to November *19, 1984*

Dependent Variable: mark-dollar exchange rate

| Independent Variables | | Coefficient | T-statistic |
|---|---|---|---|
| Intervention dummies | | | |
| Initial purchases | (3) | -0.008 | -1.518[a] |
| Subsequent purchases | (2) | 0.002 | 0.342 |
| Initial sales | (0) | — | — |
| Subsequent sales | (0) | — | — |
| Lagged dependent | | 1.000 | 1001.5[b] |

Sum of Squared Residuals = 0.006
$R^2$ = 0.893
n = 74

II. Estimation Period: December 21, *1984* to April *9, 1985*

Dependent Variable: mark-dollar exchange rate

| Independent Variables | | Coefficient | T-statistic |
|---|---|---|---|
| Intervention dummies | | | |
| Initial purchases | (3) | 0.004 | 0.776 |
| Subsequent purchases | (4) | 0.005 | 1.183 |
| Initial sales | (0) | — | — |
| Subsequent sales | (0) | — | |
| Lagged dependent | | 0.999 | 1067.4[b] |

Sum of Squared Residuals = 0.005
$R^2$ = 0.920
n = 69

NOTE: Intervention refers to U.S. purchases or sales of foreign currencies. Numbers in parentheses indicate the number of times the dummy equals 1.
a. Significant at the 10% confidence level, using a one-tail test.
b. Significant at the 1% confidence level.
SOURCE: Author's calculations.

funds rate dropped from 11.6 percent in August to 8.4 percent in December. The Federal Reserve also cut its discount rate on two occasions, bringing it down to 8 percent from 9 percent. Slower economic activity and an easier monetary policy stance resulted in reduced U.S. long-term and short-term interest rates relative to similar rates in West Germany and Japan. Both long-term and short-term interest-rate spreads began to narrow in favor of a dollar depreciation.

Nevertheless, the dollar did not immediately depreciate. Strong inflows of foreign private savings continued to support the dollar, and real and nominal U.S. interest rates remained high relative to rates in West Germany and Japan.

Many observers believed that further reductions in interest-rate differentials were unlikely and that U.S. interest rates could rise again, primarily because of the prospects for continued large U.S. budget deficits. Many economists also believed that foreign central banks, especially in Europe, would lower interest rates along with the declines in U.S. interest rates to offset any appreciation of their currency against the dollar and to spur real growth in their economies.

The first episode of U.S. intervention, in September and October 1984, involved sporadic sales of dollars. In September 1984, as the dollar rose above 3 Deutsche marks (DM) for the first time, the Bundesbank aggressively sold dollars in the foreign-exchange market. Dollar sales by the Bundesbank amounted to DM 6.1 billion.[8] Some other large central banks also sold dollars, but Japan rarely intervened during this period.[9] The United States intervened three times in September 1984 and twice in October 1984, buying a moderate $279 million worth of DM (Cross, Spring 1985, p. 60).

The regression equations for this episode suggest that intervention influenced the mark-dollar exchange rate. The coefficient associated with the dummy variable for initial U.S. purchases of marks is statistically significant and correctly signed (see table 1). This coefficient suggests that, on average, initial intervention contributed to a 0.8 percent depreciation of the dollar.

An inspection of the day-to-day pattern, however, suggests that all of this influence reflects activity on a single day (September 24) when U.S. intervention followed very large, highly visible West German purchases of dollars (see figure 1). Outside of this one day, the dollar did not depreciate following initial intervention.

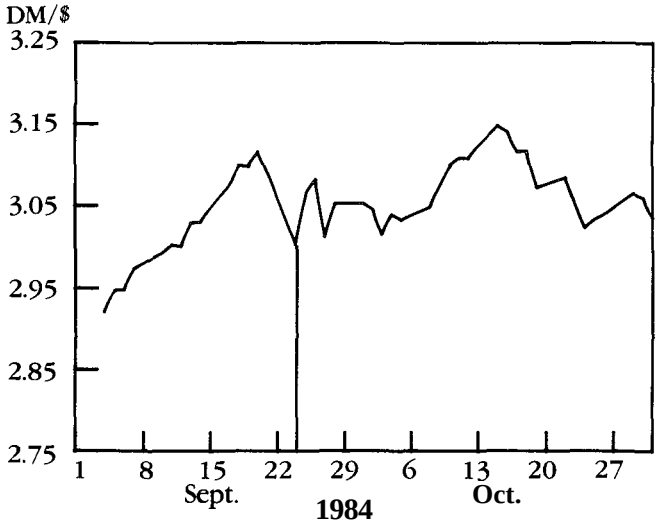
The coefficient associated with subsequent U.S. intervention, of which there was little, was not statistically significant. Subsequent intervention seemed to have no effect on exchange-rate movements. On balance, the dollar appreciated during this period.

**8** West German data are changes in foreign-exchange reserves. Changes in foreign-exchange reserves are only a proxy for intervention because they are influenced by various commercial transactions, by the receipt of "troop dollars" in West Germany, and by the receipt of interest earnings on these reserves and currency valuations. Nevertheless, one can infer the general magnitude of intervention from sharp changes in foreign-currency holdings at times when intervention is known to have occurred. Data on West German intervention versus dollars is from "Report of the Deutsche Bundesbank for the Year 1984," pp. 66-67.

**9** See Cross (Spring 1985).

FIGURE 1

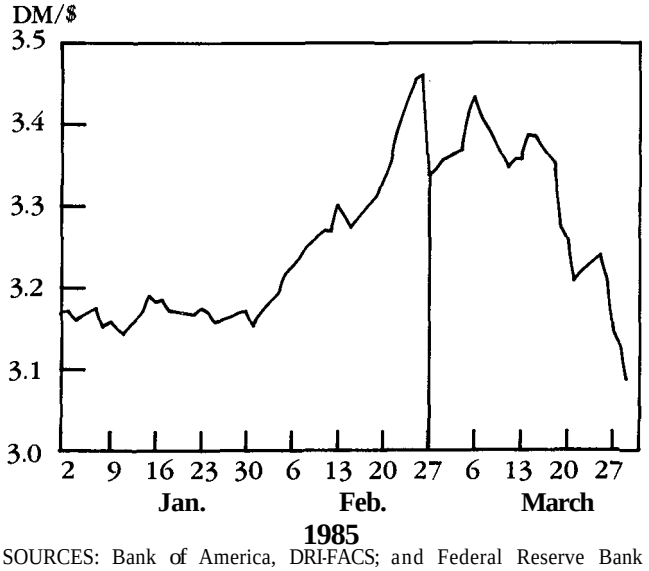
Exchange Rate, DM/$, September 1 to October 31, 1984




SOURCES: Bank of America, DRI-FACS; and Federal Reserve Bank of Cleveland.

FIGURE 2

Exchange Rate, DM/$, January 2 to March 31, 1985




SOURCES: Bank of America, DRI-FACS; and Federal Reserve Bank of Cleveland.

The second episode of U.S. intervention began in late January 1985 and continued through early March. Preceded by rumors of massive intervention and possible capital controls in West Germany and Japan, central-bank intervention increased sharply in January 1985. The volume of intervention from January through March was the heaviest since the floating-exchange-rate period began. Between late January and early March, the United States sold $659 million, and the other large central banks collectively sold approximately $10 billion.[10] Dollar sales by the West German Bundesbank amounted to nearly DM 13 billion, or approximately $4 billion, in the first quarter of 1985.[11] The Japanese also entered the market.

During this period, the United States intervened intermittently. On two occasions in late January, the United States bought $94 million worth of marks (Cross, Spring 1985, p. 60). On three occasions in the first three weeks of February, the Federal Reserve System bought $242.6 million worth of marks, $48.8 million of yen, and $16.4 million equivalent in British pounds (Cross, Autumn 1985, p. 58). In the last week of February and the first week of March, central-bank intervention was very heavy and included U.S. purchases of $257.6 million equivalent in marks (Cross, Autumn 1985, p. 58).

As summarized in our regression equations, U.S. intervention over this time frame had no perceptible impact on the day-to-day movements in the mark-dollar exchange rate (see table 1). Neither the coefficient on the dummy variable for initial intervention nor the coefficient on the dummy variable for subsequent intervention was statistically different from zero at standard confidence intervals.

These results, however, mask events on February 27. Prior to this episode, Federal Reserve Chairman Paul Volcker indicated in a statement to the House Banking Committee that intervention in January and early February had not been sufficient to influence exchange rates. He seemed to suggest that a larger volume of intervention was necessary on those occasions when central banks intervened.

European central banks began intervening heavily on February 27, and the United States began intervening when the New York market opened. The opening mark-dollar quote was 3.5 percent lower than the previous day's opening quote (see figure 2). The dollar began appreciating on February 28, reversing much of the depreciation over the next week. Thereafter, however, the dollar began a sustained depreciation against the West German mark and the Japanese yen.

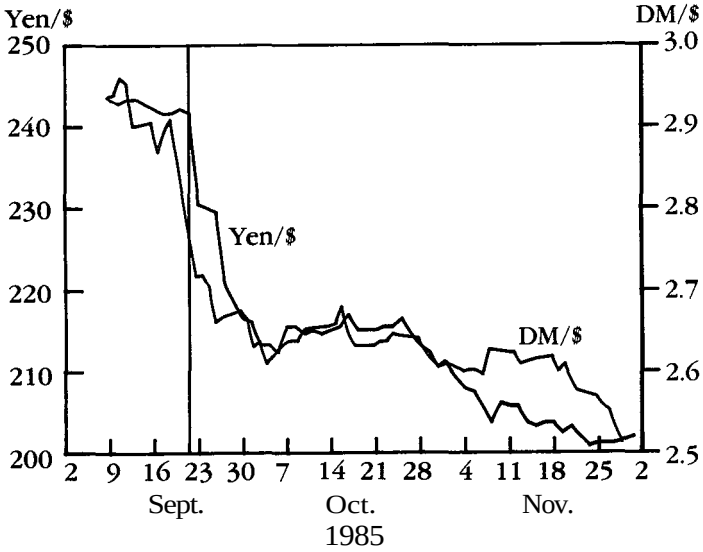
In both of these pre-G5 intervention episodes, U.S. intervention did not have a systematic

10 See Cross: (Spring 1985), (Summer 1985), and (Autumn 1985).

11 See "Report of the Deutsche Bundesbank for the Year 1984," pp. 66-67; and "Monthly Report of the Deutsche Bundesbank." vol. 37, no. 4.

FIGURE 3

Exchange Rates: Yen/$ and DM/$
(Foreign currency units per dollar)




SOURCES: Bank of America, DRI-FACS; and Federal Reserve Bank of Cleveland.

impact on day-to-day exchange-rate movements. Unlike foreign intervention, U.S. intervention was not very visible, nor was it closely coordinated with foreign intervention during this period. For the two occasions on which we note an appropriate change in the exchange rate, the response seems to be a reaction to foreign intervention and/or to remarks of the Federal Reserve Chairman rather than to U.S. intervention.

U.S. intervention over this period did not seem to represent a departure from previous U.S. intervention policy and did not signal a change in U.S. monetary or fiscal policies. Despite his comments about the volume of intervention, Chairman Volcker had reiterated his view that intervention by itself was of limited usefulness in affecting exchange rates, and the U.S. Treasury did not seem to favor increased intervention.

From mid-March 1985 through late August 1985, as the dollar depreciated against all of the major currencies, central banks generally did not intervene in the foreign-exchange market to influence the dollar's exchange value. Most foreign central banks bought dollars fairly steadily in moderate amounts to bolster foreign reserves. The United States, West Germany, and Japan did not enter the market during this period.[12]

■ 12 See Cross (Autumn 1985); and "Report of the Deutsche Bundesbank for the Year 1985."

## Group of Five Intervention: September 1985-December 1985

Economic developments continued to favor a dollar depreciation, especially during the first half of 1985. Interest rates continued to decline in the United States, but European central banks initially did not follow suit. International interest-rate spreads narrowed and promoted a dollar depreciation.

By mid-year, however, the exchange market seemed to become uncertain about the short-term prospects for further dollar depreciation. As economic growth abroad began to weaken, foreign central banks eased monetary policy through an injection of reserves and reductions in official interest rates. Interest-rate spreads began to flatten and reverse themselves. In addition, U.S. money growth (M1) remained well above target, suggesting that at some point the Federal Reserve System might tighten policy, and Chairman Volcker began to warn about the dangers of a too-rapid decline in the dollar. In late August and early September 1985, the dollar began to strengthen against the mark as expectations began to change.

The finance ministers of the G5 nations met in New York over the weekend of September 22 to discuss policies to resolve the huge international trade imbalances. The communique issued at the meeting suggested closer cooperation among the participants and listed a number of policies that individual countries would undertake to help correct existing trade imbalances. The communique also reaffirmed the participants' support for exchange-market intervention.

Immediately following the G5 meeting, the dollar fell sharply as news of the communique circulated. On Monday morning, September 23, the dollar had fallen 5.0 percent against the mark and 4.6 percent against the yen since the previous Friday (see figure 3). West Germany began intervening on Monday as trade opened. This was the first German intervention since March, and it confirmed expectations about intervention. The United States began intervening on Monday against the yen. With the Japanese market closed on the Monday following the G5 meeting, the Japanese began intervening on Tuesday (see Cross, Winter 1985-86). Combined dollar sales for the first three days of the G5 intervention were very heavy.

The dollar depreciated sharply against both the mark (8.7 percent) and the yen (12.1 percent) until October 4. The United States sold a total of $199 million against the West German mark and $262 million against the Japanese yen during the last week of September and the first week of

October (Cross, Winter 1985-86, p. 48). Japan's published foreign-exchange reserves dropped by nearly $1 billion during September (Cross, Winter 1985-86, p. 48). West Germany's foreign-exchange reserves declined DM 664 million in September and DM 2.0 billion in October (Bundesbank, 1985). As the dollar began to firm again after October 4, the United States intensified its intervention efforts, selling nearly $1.6 billion against marks and $617.6 million against yen during the middle two weeks of October (Cross, Winter 1985-86, p. 47).

After the week of November 20, all three countries ceased intervention. During the entire G5 episode, the United States sold $3.2 billion against the mark and yen. The other G5 nations sold approximately $5 billion, and the other large industrial countries sold approximately $2 billion.

Despite the difference in the approach to intervention over this period, the regression results are strikingly similar to those in the pre-G5 intervention regime (see table 2A). The G5 results suggest that the primary influence of intervention on the mark-dollar and the yen-dollar exchange rates came through the announcement effect of the G5 communique. Subsequent intervention was largely ineffectual.

In the regression for the mark-dollar exchange rate, the coefficient for initial intervention is not statistically significant at acceptable confidence intervals, unless the lag on the dummy variable is removed. When the lag is removed, the coefficient is highly significant and suggests that the G5 announcement resulted in an immediate 5 percent depreciation of the mark-dollar exchange rate. With the lag removed, the dummy variable captures the announcement of the G5 intentions and foreign and U.S. intervention in the Far Eastern and European markets that occurred on Monday, September 22, prior to the opening of the New York market.

As in the previous episodes, the coefficient on the variable for subsequent U.S. intervention purchases of marks was not statistically significant at conventional confidence intervals, nor does it have the expected sign. Unlike the previous episodes, intervention was more persistent throughout the September 22 to November 20 period.

We obtain similar results in the equation for the yen-dollar exchange rate. When the dummy variable for initial intervention is lagged, the coefficient is not statistically significant at acceptable confidence intervals. When the dummy variable is not lagged, the coefficient is highly significant and indicates that the initial intervention resulted in an average 2.7 percent depreciation of the dollar relative to the yen. Again, the coefficient on the term for subsequent U.S. intervention is not statistically significant.

An inspection of day-to-day events surrounding the G5 period, however, suggests some possible amendments to the results of the regression analysis. As figure 3 indicates, the dollar fell sharply relative to the mark and yen between September 22 and October 4. This decline seems related to the G5 intervention.

If, however, we split the dummy variables for subsequent intervention into periods before and after October 4, the results are not altered (see table 2B). The coefficients for subsequent intervention before October 4 are not significantly different from zero at acceptable confidence intervals. The G5 announcement could have produced this sharp decline in both the mark-

## TABLE 2A

### G5 Intervention

I. Estimation Period: August 23, 1985 to December 9, 1985

**A.** Dependent Variable: mark-dollar exchange rate

| Independent Variables | | Coefficient | T-statistic |
|---|---|---|---|
| Intervention dummies | | | |
| Initial purchases[a] | (1) | –0.052 | –6.455[b] |
| Subsequent purchases | (13) | 0.002 | 0.824 |
| Initial sales | (0) | — | — |
| Subsequent sales | (0) | — | — |
| Lagged dependent | | 0.999 | 1003.3[b] |

Sum of Squared Residuals = 0.00427
$R^2$ = 0.970
n = 75

**B.** Dependent Variable: yen-dollar exchange rate

| Independent Variables | | Coefficient | T-statistic |
|---|---|---|---|
| Intervention dummies | | | |
| Initial purchases[a] | (2) | –0.027 | –4.996[b] |
| Subsequent purchases | (17) | –0.0002 | –0.101 |
| Initial sales | (0) | — | — |
| Subsequent sales | (0) | — | — |
| lagged dependent | | 0.999 | 5272.1[b] |

Sum of Squared Residuals = 0.00421
$R^2$ = 0.987
n = 75

NOTE: Intervention refers to U.S. purchases or sales of foreign currencies. Numbers in parentheses indicate the number of times the dummy equals 1.
a. No lag on dummy.
b. Significant at the 1% confidence level.
SOURCE: Author's calculations.

## TABLE 2B

### G5 Intervention (Dummies split before and after October 4)

I. Estimation Period: August 23, 1985 to December 9, 1985

**A.** Dependent Variable: mark-dollar exchange rate

| Independent Variables | | Coefficient | T-statistic |
|---|---|---|---|
| Intervention dummies | | | |
| Initial purchases | (1) | -0.052 | -6.420 |
| Subsequent purchases before/on 10/4 | (3) | 0.004 | 0.837 |
| Subsequent purchases after 10/4 | (10) | 0.001 | 0.517 |
| Lagged dependent | | 0.999 | 998.0[a] |

Sum of Squared Residuals = 0.00426
$R^2$ = 0.970
n = 75

B. Dependent Variable: yen-dollar exchange rate

| Independent Variables | | Coefficient | T-statistic |
|---|---|---|---|
| Intervention dummies | | | |
| Initial purchases | (2) | 0.027 | -4.964[a] |
| Subsequent purchases before/on 10/4 | (5) | -0.001 | -0.290 |
| Subsequent purchases after 10/4 | (12) | 0.0001 | 0.054 |
| Iagged dependent | | 0.999 | 5238.4[a] |

Sum of Squared Residuals = 0.00421
$R^2$ = 0.897
n = 75

NOTE: Intervention refers to U.S. purchases or sales of foreign currencies. Numbers in parentheses indicate the number of times the dummy equals 1.
a. Significant at the 1%confidence level.
SOURCE: Author's calculations.

dollar and yen-dollar exchange rates prior to October 4, but the day-to-day movements in these exchange rates are not correlated with subsequent U.S. intervention before October 4. It is not clear that subsequent intervention prior to October 4 reinforced any announcement effect.

Thus, the G5 intervention seems to have been partially successful in producing a downward shift in the dollar.[13] It appears that intervention had a strong announcement effect on both the mark-dollar and yen-dollar exchange rates, which could have lasted through early October. Day-to-day movements in the dollar, however, were not correlated with day-to-day intervention. After October 4, intervention did not seem to contribute to the dollar's depreciation.

A number of events may explain this result. The G5 communique, which the U.S. reportedly initiated, seemed to have a major effect on market expectations. It appeared to represent a major departure from the previous U.S. position on intervention and a change in the administration's attitude toward a strong dollar. Previous official discussions of intervention typically indicated that operational goals were "to counter disorderly market conditions" or to prevent disruptive speculation. The communique now suggested that exchange rates were not correctly reflecting market developments:

> "Ministers and Governors were of the view that recent shifts in fundamental economic conditions among their countries, together with policy commitments for the future, have not been reflected fully in exchange markets."[14]

In addition, the G5 agreement seemed to eliminate any possibility that the Federal Reserve would tighten monetary policy in the near term, even though the aggregates were growing well above target. The communique indicated that the United States would take steps to reduce its federal budget deficit and that West Germany and Japan would adopt policies to stimulate their economies.

The intervention operations following the G5 agreement were large and highly visible. The degree of cooperation among West Germany, Japan, and the United States was greater than in the previous intervention episodes. In addition, the intervention was "leaning with the wind"; the dollar already had been depreciating, and market fundamentals generally favored a depreciation.

The effects of intervention began to wear off by early October, however, because policymakers in the G5 countries were no longer reinforcing or substantiating expectations of additional policy initiatives to drive the dollar lower. The dollar actually appreciated 3 percent against the mark between October 4 and October 16. The market, which anticipated additional policy initiatives on the part of the G5 countries at the International Monetary Fund/International Bank for Reconstruction and Development meetings

■ **13** Feldstein (1986) considers G5 intervention using similar regression techniques and using models that employ a time trend, "shift" dummies, and "slope" dummies. He finds evidence of a shift effect, but no evidence of a change in slope.

■ **14** See "Daily Report for Executives, No. 185." Washington, D.C.: The Bureau of National Affairs (September 24, 1985): M-1.

in Seoul, Korea, began to lose confidence that the G5 countries would take additional steps to encourage the dollar's depreciation when the meeting focused on the international-debt situation. Moreover, Bundesbank President Karl Otto Poehl expressed satisfaction with the extent of the dollar depreciation to date.

Monetary policies in the United States and in West Germany did not seem to support intervention, and central-bank officials did not actively promote the policy. The recently released August 1985 FOMC minutes indicated that the Federal Reserve Board did not want to supply additional reserves to the banking system, because the aggregates were well above the upper-target bound. Equally influential, the minutes expressed Chairman Volcker's concern about the speed of the dollar's depreciation.[15] By early November, central banks in both the United States and West Germany were busy denying the existence of any agreement to encourage a dollar depreciation by manipulating international interest-rate spreads (Cross, Winter 1985-86, p. 47).

The situation relative to the Japanese yen was similar. The yen gave up approximately 1 percent of its gains against the dollar between October 4 and October 7. Thereafter, through November 24, the yen-dollar exchange rate remained little changed. The slight difference between this rate and the mark-dollar exchange rate might have resulted because the Japanese monetary authorities were not as quick as their West German counterparts to disavow their currency's appreciation. Officials at the Bank of Japan and at the Japanese Finance Ministry had announced on October 15 additional policy changes to encourage a yen appreciation. Moreover, yen interest rates rose, especially short-term interest rates.

By late November, West Germany, Japan, and the United States had ceased intervention. The yen continued to appreciate against the dollar, as interest rates on yen-denominated assets rose relative to interest rates on dollar-denominated assets. The mark appreciation quickened because it now seemed out of line compared to the yen. Nominal interest rates in West Germany tended to firm, supporting a mark appreciation. In December 1985, the yen-dollar rate fell below Y200, and the mark-dollar rate broke DM 2.5.

The dollar depreciated on balance in a relatively orderly manner against all major currencies throughout 1986. The depreciation seemed consistent with the continuing worldwide trade imbalances and with general trends in interest-rate differentials. The United States did not intervene in 1986.

## Group of Seven Intervention: February 1987 to August 1987

Throughout 1987, the nominal U.S. current-account deficit continued to grow, but private foreigners were becoming increasingly reluctant to finance the current-account deficit.[16] The dollar continued to depreciate, but at a more modest pace, and interest-rate spreads widened to attract private capital. Money growth in the United States began to slow relative to money growth in West Germany and Japan as concerns about inflation increased.

West Germany and Japan became increasingly hesitant to stimulate their economies or to encourage further dollar depreciation. Both countries were experiencing money growth above target levels, and both began to see an increase in consumer prices, which had been falling.

In January 1987, the dollar came under heavy selling pressure and contributed to a realignment of the central rates in the European Monetary System (EMS). Despite the problems in the EMS, much of the dollar's movement in January occurred in relation to the Japanese yen. This prompted heavy Japanese intervention, and on January 28, the United States intervened in a "hectic and nervous" market, selling a small amount of yen (Cross, Spring 1987a). This intervention followed statements reaffirming cooperation among the major central banks and was followed by a 1.2 percent appreciation of the dollar relative to the yen. The appreciation was not offset in the day immediately following intervention; the yen remained relatively stable through mid-March.

The dollar seemed to stabilize in February, following the release of favorable trade data late in January. Over the weekend of February 20, the G7

**15** See Board of Governors of the Federal Reserve System, Annual Report 1985, p. 119.

**16** Private foreign investors acquired $20.6 billion in marketable Treasury securities in 1985, but acquired only $6.8 billion in 1986. During the first half of 1987, private foreign investors reduced their holdings of marketable Treasury securities by $1.3 billion. The data also indicate that increased official purchases offset much of the reduction in private foreign holdings of marketable U.S. Treasury securities. Official acquisitions of marketable U.S. Treasury securities increased from $8.1 billion in 1985, to $14.4 billion in 1986, to $18.7 billion during the first half of 1987. See Federal Reserve Bulletin, October 1987, p. A66. Loopesko and Johnson (1987) discuss these data.

## TABLE 3

### G7 Intervention

I. Estimation Period: February 23, 1987 to July 2, 1987

**A.** Dependent Variable: mark-dollar exchange rate

| Independent Variables | | Coefficient | T-statistic |
|---|---|---|---|
| Intervention dummies | | | |
| Initial purchases | (1) | -0.007 | -1.258 |
| Subsequent purchases | (0) | — | — |
| Initial sales | (3) | -0.006 | -1.911[a] |
| Subsequent sales | (2) | -0.008 | 1.468 |
| Lagged dependent | | 1.001 | 985.3' |

Sum of Squared Residuals = 0.0027
$R^2$ = 0.796
n = 90

**B.** Dependent Variable: yen-dollar exchange rate

| Independent Variables | | Coefficient | T-statistic |
|---|---|---|---|
| Intervention dummies | | | |
| Initial purchases | (0) | — | — |
| Subsequent purchases | (0) | — | — |
| Initial sales | (2) | -0.008 | -1.207 |
| Subsequent sales | (16) | -0.003 | -2.115[c] |
| Lagged dependent | | 1.000 | 0.766[b] |

Sum of Squared Residuals = 0.0034
$R^2$ = 0.9636
n = 90

NOTE: Intervention refers to U.S. purchases or sales of foreign currencies. Numbers in parentheses indicate the number of times the dummy equals 1
a. Significant at the 10% confidence level.
b. Significant at the 1% confidence level (two-tailed).
c. Significant at the 5% confidence level (two-tailed).
SOURCE: Author's calculations.

countries met in Paris. The resulting communique, the Louvre agreement, suggested that the participants had agreed informally to a set of reference zones for the yen-dollar and mark-dollar exchange rates. The market's belief that the G7 countries had adopted a set of reference zones for the major exchange rates seems to have reduced perceptions of exchange risk and seems to have increased demand for currencies with relatively high interest rates, including the dollar.[17]

Following the Paris meeting, the volume of foreign central-bank intervention increased and reinforced the market's belief in reference zones. The United States intervened on March 11, buying $30 million equivalent of West German marks as the dollar temporarily rose above 1.85 marks per dollar (Cross, Spring 1987b, p. 59). Less than two weeks later, the United States began to intervene frequently and very heavily in the foreign-exchange markets, as the dollar depreciated below 150 yen on fears of a trade war between the United States and Japan. Between March 23 and April 6, the United States sold $3 billion equivalent in yen, and foreign central banks bought an "extraordinary" amount of dollars (Cross, Spring 1987b, p. 62). Intervention continued intermittently throughout May and in early June, with the United States selling a small amount of yen ($123 million equivalent) and a relatively moderate amount of marks ($680 million equivalent) (Cross, Autumn 1987).

We estimated our regression over the period late February through early July (see table 3). For the West German mark, the regression coefficient on the dummy variable for initial ***purchases*** of marks was not statistically significant. The coefficient of the dummy variable for initial *sales* of marks was statistically different from zero, but its negative sign indicates that the dollar depreciated, on average, after the sales of marks. If intervention stabilized the exchange rate, one would expect a positive sign on coefficients associated with sales of foreign currencies for dollars. The coefficient for subsequent mark sales was not significantly different from zero.

For the Japanese yen, the coefficient on initial intervention was not significantly different from zero at standard confidence levels. The coefficient on subsequent intervention was significant at the 5 percent confidence range, but the sign of the coefficient was negative. This indicates that the depreciation of the dollar was larger, on average, on the days following subsequent intervention against the yen.

**As** in the G5 episode, the major central banks closely coordinated their intervention efforts during this period. Intervention also was highly visible; at various times, Chairman Volcker, Vice-Chairman Martin and U.S. Treasury Secretary Baker acknowledged that intervention was under way.

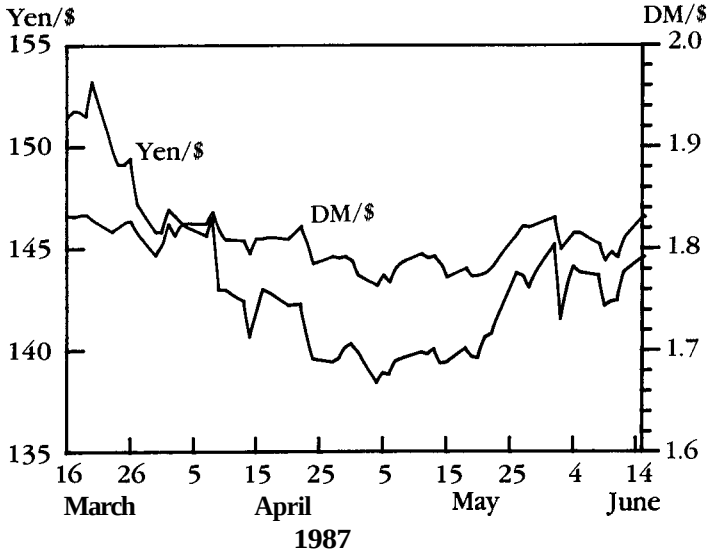
Unlike the G5 episode, however, the central banks were leaning against the wind instead of with it. During March and April, the G7 indicated no changes in monetary or fiscal policies that might have altered the fundamentals in the exchange market. Moreover, a clear signal about the administration's views on the dollar's depreciation did not emerge. Treasury Secretary Baker

17 For a discussion of these events, see Cross (Spring 1987b)

attempted to convince the market that the United States did not wish to see a further depreciation of the dollar, but U.S. trade representative Yeuter appeared to contradict this statement. Consequently, intervention did not appear to have an effect on the dollar's exchange rate. The dollar continued to depreciate against the yen at a rapid pace through April (see figure *4)*.

**FIGURE 4**

**Exchange Rates: Yen/$ and DM/$**
**(Foreign currency units per dollar)**




SOURCES: Bank of America, DRI-FACS; and Federal Reserve Bank of Cleveland.

At the end of April, Chairman Volcker indicated that the Federal Reserve System was "snugging" monetary policy, and Japanese Prime Minister Nakasone indicated that Japan would ease monetary policy. In May, the West German Bundesbank lowered some of its official money market rates. The dollar firmed on the belief that these changes in monetary policy would promote wider interest-rate spreads that favored dollar-denominated assets. In late May, the Japanese announced a sizable fiscal package designed to stimulate their economy and help reduce their trade surplus.

The United States intervened in May and June to counter the impact on the dollar of specific events, such as the announcement in May that money-center banks were adding loan-loss reserves against their outstanding developing-country loans, and the announcement in June that Chairman Volcker would not seek an additional term (Cross, Autumn *1987)*. Intervention may have affected the dollar in the former instance, but not in the latter. In any case, the effects of these announcements on the dollar were short-lived.

The dollar continued to firm until early August. Then, as the dollar rose above *1.85* marks, the United States intervened against marks. The United States sold *$631* million against marks between August *4* and August *10* (Cross, Winter 1987-88, p. *48)*. By mid-August, following the release of merchandise trade data showing an unexpectedly large deficit for June, the dollar began depreciating again. The United States undertook intervention purchases of dollars against yen late in August, buying *$389.5* million against yen between August *24* and September 2.[18]

U.S. intervention in August had no obvious influence on the dollar; neither the coefficients for initial intervention nor the coefficients for subsequent intervention in the mark-dollar and yen-dollar equations were significantly different from zero at acceptable confidence levels (see table *4)*. The market did not seem to associate this intervention with any change in U.S. or foreign policies.

## IV. Conclusion

Between August *1984* and August *1987*, the dollar depreciated sharply in response to a large and persistent current-account deficit and to changes in other market fundamentals, especially long-term interest-rate differentials. During this period, central-bank intervention also increased dramatically. We have identified three U.S. intervention regimes over this period, each of which is distinct in terms of the direction of intervention, the size and duration of intervention, the degree of visibility, or the extent of central-bank cooperation. The response of the exchange rate to intervention was not uniform over this period, but a pattern seems to emerge.

Generally, this study suggests that intervention *can* have a temporary announcement effect on the exchange rate. This announcement effect, however, is not universal. Between August *1984* and August *1987*, it was associated with initial interventions that were highly visible or that were coordinated with visible foreign intervention. This was the case in September *1984*, when U.S. intervention accompanied a highly visible West German intervention, and in February *1985*, when Chairman Volcker's comments about intervention and a highly visible West German transaction preceded U.S. intervention.

18 Our sample period ends on August 28, 1987.

## TABLE 4

### G7 Intervention

I. Estimation Period: July 5, 1987 to August 28, 1987

**A.** Dependent Variable: mark-dollar exchange rate

| Independent Variables | | Coefficient | T-statistic |
|---|---|---|---|
| Intervention dummies | | | |
| Initial purchases | (1) | -0.002 | -0.344 |
| Subsequent purchases | (3) | 0.003 | 1.031 |
| Initial sales | (0) | — | — |
| Subsequent sales | (0) | — | — |
| Lagged dependent | | 0.9994 | 728.9" |

Sum of Squared Residuals = 0.0009
$R^2$ = 0.808
n = 38

**B.** Dependent Variable: yen-dollar exchange rate

| Independent Variables | | Coefficient | T-statistic |
|---|---|---|---|
| Intervention dummies | | | |
| Initial purchases | (0) | — | — |
| Subsequent purchases | (0) | — | — |
| Initial sales | (1) | -0.0093 | 1.186 |
| Subsequent sales | (0) | — | — |
| Lagged dependent | | 0.9999 | 3941.1" |

Sum of Squared Residuals = 0.00215
$R^2$ = 0.794
n = 38

NOTE: Intervention refers to U.S. purchases or sales of foreign currencies. Numbers in parentheses indicate the number of times the dummy equals 1.
a. Significant at the 1% confidence level.
SOURCE: Author's calculations.

The size and duration of any announcement effect seems greater when the market associates intervention with a change in monetary and fiscal policies. The biggest impact occurred during the G5 episode, when the market thought that the G5 countries would undertake more substantial monetary and fiscal policies to lower the exchange value of the dollar and reduce their trade imbalances.

An announcement effect is more likely to occur if market fundamentals are moving or just beginning to move in a manner consistent with the thrust of intervention. No apparent announcement effect was associated with intervention in 1987, when the United States attempted to lean against the wind. The dollar stabilized only after U.S., West German, and Japanese policymakers indicated changes in monetary policies that possibly could alter the direction of the wind.

In nearly all cases, the duration of any announcement effect is short, generally lasting only one day. An exception might be the G5 episode, when the market seemed to expect major policy changes; hence the dollar depreciated from September 20 through October 4, 1985. Nevertheless, our data show that subsequent intervention prior to October 4 was not related to day-to-day exchange-rate movements.

Beyond this temporary announcement effect, however, U.S. intervention had no apparent impact on the exchange value of the dollar. In nearly all instances, subsequent intervention did not appear to influence exchange rates. In the one exception, the G7 period, the coefficient did not have the expected sign. The dollar's depreciation during the period might have been much sharper in the absence of intervention, but this hypothesis is not testable.

Our results are consistent with previous empirical investigations of intervention, which find little support for a systematic exchange-rate response to intervention.[19] Our results for the G5 period also seem to agree with Feldstein (1986), who found that G5 intervention resulted in a one-time shift in exchange rates, but not a shift in the slope of the exchange-rate path. This seems consistent with the view that sterilized intervention operates through an expectations channel.

Finally, we find some support for the view that coordinated intervention is more effective than uncoordinated intervention. Loopesko (1983) found mixed results when testing the importance of coordination, but Greene (1984a) suggests that coordination increases the effectiveness of intervention.

Our conclusions about intervention also are consistent—in direction, if not in degree—with many of the official views expressed in the Jurgensen Report (1983). These views undoubtedly reflect the opinions and experiences of individuals who conduct intervention for major industrial countries. The Jurgensen Report indicates that intervention does not have a lasting effect on exchange rates, especially when the thrust of intervention is inconsistent with market fundamentals. Our failure to find a correlation between subsequent intervention and exchange-rate movements, or any correctly signed correlation during the G7 period, is consistent with this view. The

19 Humpage (1986) summarizes important empirical studies of intervention.

Jurgensen Report does maintain that intervention can have a temporary effect and suggests that this effect works primarily through an expectations channel. Our results tend to verify this view, but indicate that the times when intervention can have a temporary impact seem rare and depend on expectations about other policy developments.

The policy implications of these results are not substantially different from those found in the Jurgensen Report. First, exchange-market intervention does not afford countries an additional policy lever with which to influence exchange rates over the long term, independent of monetary and fiscal policies. Second, frequent or otherwise systematic intervention that does not provide new information to the market will not affect exchange rates. The size and duration of any announcement effect seems to depend on the extent to which the intervention creates expectations of changes in monetary and fiscal policies. Because this announcement effect has a very short duration, monetary authorities must reinforce intervention quickly with other policy initiatives. Third, beyond possible announcement effect, exchange-market intervention has no apparent influence on day-to-day exchange-rate movements.

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# Using Financial Data to Identify Changes in Bank Condition

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## Introduction

The 1980s have been characterized by record post-Depression bank failure rates, a record number of banks on the Federal Deposit Insurance Corporation's (FDIC's) problem bank list, and record losses to the FDIC in terms of total dollar losses and losses per dollar of failed bank assets.

Moreover, as the cost and complexity of examining banks have risen it has become increasingly more difficult for the bank regulators to attract and retain quality bank examiners. On the other hand, advances in computer technology give bank regulators the ability to monitor the condition of banks without conducting an on-site examination. Therefore, off-site monitoring of banks has become an important part of the regulatory examination umbrella.

Off-site monitoring tracks the condition of banks using the quarterly call report balance sheet and income statement data.[1] Banking regulators use these early-warning systems to complement on-site examination and as a way to allocate scarce examination resources. When off-site monitoring indicates a deterioration of a bank's financial health, an on-site exam can then be conducted.

The early-warning systems have been developed from an extensive number of studies relating bank condition to bank balance sheet and income statement data. These studies, which use financial data to evaluate financial condition, can be classified into two types. The first type is failed bank studies.[2] These studies use financial data to predict bank failures. Early-warning systems devised from this literature would use the characteristics of failed banks as the benchmark for identifying problem institutions.

The second type of research in this area uses financial data to classify banks into problem and nonproblem categories.[3] In other words, these studies attempt to predict a bank's examination rating using only publicly available data. Our study falls into this class. We use call-report data to predict deterioration in condition as measured by changes in CAMEL ratings.[4] Unlike previous

■ 1 The formal name for the call reports is the Federal Financial Institutions Examination Council's Consolidated Reports of Condition and Income.

■ 2 See Meyer and Pifer [1970], Hanweck [1977], Martin [1977], Pettway and Sinkey [1980], Bovenzi el al. [1983], Rose and Kolari [1985], Wesl [1985], Lane et al. [1986], Sinkey et al. [1987], and Pantalone and Platt [1987].

3 See Stuhr and Van Wicklen [1974], Sinkey [1975, 1977, 1978], Sinkey and Walker [1975], Korobow et al. [1977], and Korobow and Stuhr [1983].

4 CAMEL is an acronym for the five risk categories rated by the bank examiners: Capital adequacy, Asset quality, Management, Earnings, and Liquidily.

studies, however, we are able to include nonperforming loans in the analysis as a measure of asset quality. In addition, we explore the use of factor analysis as a way to statistically mimic the procedure used by examiners to assign CAMEL ratings.

The rest of the paper is organized as follows: Section I reviews the examination process and the assignment of CAMEL ratings as a measure of condition. Section II discusses the role of off-site monitoring in the examination process. Section III describes the data and the basic statistical methods we use in the study. The results of the analysis are reported in section IV and our conclusions appear in section V.

## I. The Role of Bank Supervision and Examination in the Regulatory Process

Bank supervision and regulation in the United States is frequently justified by the role that banking plays in the payments system. That is, the safety and soundness of the banking system is perceived to be inexorably intertwined with the stability of the economy. Futhermore, supervision and regulation reduce the moral hazard problem inherent in federal deposit insurance (see Jensen and Meckling [1976], Benston et al. [1986], and Buser et al. [1981]). By identifying problems early, regulators are able to force corrective action, or close the institution in a manner that minimizes losses to depositors and the deposit-insurance fund, and that minimizes the disruptive impact on the economy.

On-site examinations serve four basic functions in the regulatory process. First, they allow bank regulators to determine whether or not the bank is in violation of any state or federal banking laws and regulations. Second, a bank exam may be conducted to evaluate a bank's electronic funds transfer and on-line trading systems. Third, although bank exams are not specifically conducted for the purpose of detecting ill-advised or illegal activites on the part of bank officers, insiders and employees, on-site examinations are an effective method for detecting fraud and malfeasance. In fact, physical inspection of a bank's books is often the only way to detect irregularities in the operation of the bank that may indicate illegal or ill-advised actions by bank employees (see Benston et al. [1986]).[5]

The fourth role of on-site examinations is to determine the financial condition of a bank. Although banks are required to submit quarterly financial statements, known as the Federal Financial Institutions Examination Council's Reports of Condition and Income, to the bank regulators, the best way to determine the quality of a bank's assets and management is still an on-site examination and appraisal of its books and operations.

When the focus of the exam is to determine the financial condition of a bank, the examiner will rate the bank on a scale from one to five (one being the highest) in five basic areas. These five ratings are referred to as CAMEL ratings. The first component of the CAMEL rating is capital adequacy. Bank capital serves as the last line of defense against losses to uninsured depositors, general creditors, and the FDIC. The examiner assesses the level and quality of the bank's capital base and assigns the bank a rating based on that assessment.

Asset quality is the second component of a bank's CAMEL rating. Examiners wade through loan documentation and check the quality of collateral (if any) backing each loan. They make judgements as to the quality of each borrower and his ability to repay the loan. Furthermore, they look for excessive exposure of the bank to a single borrower or industry. The recent problems in the Texas banking industry are a stark reminder of the benefits of portfolio diversification.

The third component of a bank's CAMEL rating is based on the quality of its management. This is the most subjective of the ratings given by the examiner and is often influenced by the quality of the bank's other ratings. The management rating is based on the examiner's perception of the quality of the bank's officers and the efficiency of the management structure.

Earnings is the fourth component of the CAMEL rating. Earnings are rated on both recent performance and the historical stability of the earnings stream. Examiners will look at the composition of bank profits to determine whether they come from a solid operating base or are driven by one-time gains, such as those generated by the sale of assets. Examiners regard earnings as the first line of defense against loan defaults and other unforeseen events.

The fifth component of a bank's CAMEL rating is liquidity. Liquidity is a measure of a bank's

5 Historically, fraud and malfeasance have been a leading cause of bank failures and they still are an important cause of bank failures today. In fact, illegal acts (including fraud, misconduct, and risky speculation) by bank officers, employees, and insiders were cited as the primary cause of failure for over 33 percent of the 138 banks that were closed in 1986 (see Kathleen Doherty, "Who's Minding the Fraud?" *American Banker*, September 21, 1987, p. 15.).

ability to meet unforeseen deposit outflows. This is an important area of risk facing banks because a liquidity crisis may result in the failure of a solvent bank. Examiners look at the bank's funding sources as well as the liquidity of its assets in determining this rating.

The five component ratings are then subjectively weighted by the examiner to arrive at an overall CAMEL rating for the bank. This rating is then used to determine the degree of regulatory attention and resources that will be devoted to the bank. A composite rating of one is thought to indicate a strong bank that could weather adverse economic conditions. A composite rating of two means that the bank could be severely weakened by adverse economic conditions. A three-rated bank is thought to be at risk in an unfavorable economic environment. Four-rated banks are considered to be banks that are in danger of failing unless corrective actions are taken. Finally, a five rating indicates that the bank is likely to fail in the near future.

## II. Off-Site Monitoring and Bank Regulation

Although on-site examination of banks is the best tool for determining the financial condition of banks, staff and budget constraints do not allow state and federal banking regulators to examine the majority of banks more frequently than once every 12 to 24 months. The frequency at which a bank is to be examined is determined by its composite CAMEL rating at the time of its last exam. Problem banks (CAMEL rating of three, four, or five) are examined more frequently than banks with composite CAMELs of one or two.

Unfortunately, the condition of a bank may have deteriorated since the time of its last examination and may merit more regulatory scrutiny than its last CAMEL rating indicates. The response to this problem has been the development of off-site monitoring of bank condition or early-warning models using quarterly call report data. Therefore, the off-site monitoring allows more current information to be brought into the supervisory process. When the early-warning system indicates a bank's condition is deteriorating, an exam can be triggered. That is, rather than being a substitute for on-site examination, off-site monitoring is a valuable tool for setting examination priorities. Moreover, because financial conditions tend to deteriorate over time, a reliable early-warning system would allow examiners to devote more time and resources to detecting fraud, malfeasance, and other irregularities in a bank's operations.

Two types of screens have been proposed for use in off-site monitoring. The first type utilizes quarterly balance sheet and income statement data from the call reports. These early warning models construct ratios from the call reports to proxy for the different types of risk targeted in the examination process. For example, published studies of early-warning systems (see Korobow et al. [1977] and Sinkey [1977, 1978]) have used capital-to-asset ratios to proxy capital adequacy. Other ratios such as net charge-offs to total loans, operating income to operating expenses, return on assets, and core deposits to total liabilities are some of the ratios that have been used in these studies to proxy the other four components of the CAMEL rating. Statistical procedures like logit analysis and discriminant analysis are then used to classify banks into problem and nonproblem categories on the basis of the ratios selected.[6]

Sinkey (1977) proposed a second type of early-warning system that uses stock-market data as a screen for deteriorating condition. These models assume stock markets are efficient and that the underlying stochastic process governing stock returns is stable. The market screen for declining condition is based on the analysis of residuals from market model regressions on individual bank stock returns. Tests are performed on these residuals to detect abnormal negative performance by a bank. Negative abnormal performance by a bank's stock indicates a deterioration in its condition. One drawback of this screen is that reliable stock-market data are available only for the largest 100 to 200 banks, making this screen infeasible for the bank of this country's more than 14,000 banks.[7]

## III. Data and Methods

### Data Set

The sample of banks analyzed in this study consists of 58 institutions examined by the Supervision and Regulation Department of the Federal Reserve Bank of Cleveland. These banks are located in Ohio, western Pennsylvania, eastern Kentucky, and the panhandle region of West Virginia.

The data set includes at least one actual composite CAMEL rating for each sample bank

□ 6 Call-report data is also used by bank regulators to construct non-statistical early-warning models that mimic the examination process.

■ 7 A second problem with the stock-market data is that most bank stock is issued at the holding company level. This introduces noise into the market screen.

**TABLE 1**

**List of Variables**

| Ratio Number | Definition |
|---|---|
| 1 | Primary capital/average assets |
| 2 | Payout ratio |
| 3 | Asset growth rate |
| 4 | Net loan and lease charge-offs/average total loans and leases |
| 5 | Current recoveries/prior charge-offs |
| 6 | Nonperforming loans and leases/primary capital |
| 7 | Loans and leases, past-due and nonaccrual/ gross loans and leases |
| 8 | Loan loss reserve/total loans and leases |
| 9 | Return on average assets |
| 10 | Adjusted return on average assets |
| 11 | Pretax return on average assets |
| 12 | Net interest margin |
| 13 | Overhead expense/average earning assets |
| 14 | Provision for loan losses/average earning assets |
| 15 | Securities gains or losses/average earning assets |
| 16 | One year GAP/equity capital |
| 17 | One year GAP/total assets |
| 18 | Average earning assets/interest bearing liabilities |
| 19 | Loans plus securities/total sources of funds |
| 20 | Volatile liabilities/total sources of funds |
| 21 | Net funds dependency |
| 22 | Brokered deposits/total deposits |

SOURCE: Authors.

assigned at an on-site examination between November 1983 and July 1986. Several of the banks in the sample were examined more than once over this time period and so a total of 70 composite CAMEL scores were available for the 58 sample banks.

The remainder of the data set is comprised of two sets of financial ratios constructed from publicly available quarterly call-report data. The definition of each ratio used in the study appears in table 1. The financial variables were preselected by the Supervision and Regulation Department of the Cleveland Federal Reserve Bank for use in a nonstatistical early-warning model developed to forecast CAMEL ratings for the same set of sample banks. Thus, each ratio is included because it provides insight on a dimension of the financial condition of the sample banks that is reflected in the actual composite CAMEL rating. The ratios generally are similar to those used in previous early-warning failure-prediction models.

One set of ratios (denoted by the prefix CURR, for current quarter) consists of the ratio values calculated using data from the quarterly call report immediately preceding the date at which the actual composite CAMEL was assigned. If this call date was less than two months before the exam date, the current-quarter ratios were calculated using data from the next closest prior quarter. This was done to reflect the typical two-month lag in the availability of quarterly call data.

The other set of ratios are labeled "previous quarter" (PREV). These are the same set of ratios calculated using call data drawn from reports dated four months before the quarter designated as current.

### The Statistical Models

The logit-regression technique was employed to construct several different versions of a model that could be used to predict changes in the CAMEL ratings or, alternatively, the financial condition of the sample banks. Logit analysis was used instead of ordinary least squares or discriminant analysis because the classification accuracy of models estimated using this technique has typically been found to be as good or better than that obtained using other methods.[8]

In all versions of the estimated equations, the dependent variable takes on a value of 1 for sample banks that are categorized as "high risk." These, in turn, are defined to be sample banks with composite CAMEL ratings of 3, 4 or 5. The dependent variable takes on a value of zero for "low risk" banks, in other words, those with CAMEL ratings of 1 or 2.[9]

Two different types of models were then estimated for each set of financial data (that is, "current quarter" and "previous quarter"). In one model, the dependent variable was related to subsets of the ratios appearing in table 1. In the other model, a two-step procedure was

■ 8 For a discussion of logit regression and its relative merits see Bovenzi, et al. (1983), Martin (1977) and Amemiya (1981).

□ 9 The decision to place three-rated banks in the high-risk category is somewhat arbitrary. However, while a CAMEL rating of 3 does not indicate that examiners believe the bank is close to failure, it does reflect their judgment that it is more vulnerable than 1- or 2-rated institutions and that there is need for some corrective action and closer regulatory supervision.

**TABLE 2**

**Logit Model 1 — Large Sample**

| Variable | Coefficient | T-Statistic | Chi-Square |
|---|---|---|---|
| Constant | –3.48450 | –4.61 | 32.03 |
| CURR06 | 0.108156 | 3.40 | |

| | Probability Cutoff Value | | | |
|---|---|---|---|---|
| | 0.5 | 0.4 | 0.3 | 0.2 |
| Classification accuracy (%) | 87.1 | 88.6 | 87.1 | 81.4 |
| Type I error rate (%) | 43.8 | 37.5 | 31.3 | 25.0 |
| Type II error rate (%) | 3.7 | 3.7 | 7.4 | 16.7 |

SOURCE: Authors.

**TABLE 3**

**Logit Model 2 — Large Sample**

| Variable | Coefficient | T-Statistic | Chi-Square |
|---|---|---|---|
| Constant | –4.75058 | –1.58 | 35.51 |
| CURR06 | 0.093926 | 2.69 | |
| CURR01 | 0.101593 | 0.48 | |
| CURR13 | 0.355459 | 0.64 | |
| CURR09 | –0.606462 | –0.77 | |

| | Probability Cutoff Value | | | |
|---|---|---|---|---|
| | 0.5 | 0.4 | 0.3 | 0.2 |
| Classification accuracy (%) | 90.0 | 90.0 | 88.6 | 85.7 |
| Type I error rate (%) | 31.3 | 31.3 | 25.0 | 25.0 |
| Type II error rate (%) | 3.7 | 3.7 | 7.4 | 11.1 |

SOURCE: Authors.

employed. First, factor analysis was used to convert the considerable number of correlated financial ratios into a much smaller number of composite variables or factors that are linear combinations of the original data.[10] The intended result is the creation of a small set of explanatory variables that contains basically the same information as the larger data set. This statistical procedure mimics the procedure used by bank examiners to construct the composite CAMELS assigned at exams. The set of generated factors were then used to construct factor scores for each sample bank. Logit regressions were then estimated using the constructed factor scores as independent variables.[11]

Given the definition of the dependent variable, the estimated coefficients of financial ratios or factors indicative of greater risk or financial weakness (that is, lower capital, lower asset quality, lower earnings, or less liquidity) are expected to be positive.

## IV. Empirical Results

Each type of logit model was estimated using three different samples. One, dubbed the "large sample," contained all 70 available observations for the 58 sample banks. Another, labeled the "small sample," contained only one observation for each of the 58 sample banks. These two samples were used to examine the in-sample classification accuracy of the estimated logit models. Since the results using the large and small samples are essentially the same, only the large sample results are reported. The third sample, called the "random sample" is a random sample of 40 banks drawn from the small sample, yielding a hold-out sample of 18 banks. The logit models were then estimated using the sample of 40 banks and used to classify the hold-out sample.

### Logit Analysis With Ratio Independent Variables

Estimated logit equations in which subsets of the nontransformed financial ratios were used as independent variables appear in tables 2 to 5. The equations reported are those that did the best job of in-sample classification, using a 50 percent probability cutoff to assign banks to the high-risk group.[12] In-sample classification results are also presented for alternative lower probability cutoff values.

The results demonstrate that the key predictive financial ratio is a measure of asset quality, defined as nonperforming loans and leases

10 The factor-analysis method used is principal-axis factor analysis with prior communality estimates set equal to the squared multiple correlations among variables. The rotation method used was varimax.

11 This is the same approach used in West (1985)

12 The probability cutoff value is the critical value used to assign the sample banks to a risk group, given the prediction of an estimated model. A predicted probability value above the cutoff implies that the bank should be placed in the high-risk group. A cutoff value of 0.5 assumes that the prior probabilities of group membership and the misclassification costs of Type I and Type II errors are equal. Lower cutoff values reflect the view that these assumptions are incorrect.

**TABLE 4**

**Logit Model 3 — Large Sample**

| Variable | Coefficient | T-Statistic | Chi-Square |
|---|---|---|---|
| Constant | -3.08714 | -4.72 | 27.88 |
| PREV06 | 0.084124 | 3.29 | |

| | Probability Cutoff Value | | | |
|---|---|---|---|---|
| | 0.5 | 0.4 | 0.3 | 0.2 |
| Classification accuracy (%) | 87.1 | 88.6 | 87.1 | 80.0 |
| Type I error rate (%) | 43.8 | 37.5 | 37.5 | 31.3 |
| Type II error rate (%) | 3.7 | 3.7 | 5.6 | 16.7 |

SOURCE: Authors.

**TABLE 5**

**Logit Model 4 — Large Sample**

| Variable | Coefficient | T-Statistic | Chi-Square |
|---|---|---|---|
| Constant | -11.98831 | -1.67 | 37.43 |
| PREV06 | 0.080440 | 2.35 | |
| PREV01 | 0.136849 | 0.64 | |
| PREV13 | 0.612464 | 0.92 | |
| PREV09 | -2.195222 | -2.05 | |
| PREV19 | 0.082736 | 1.28 | |

| | Probability Cutoff Value | | | |
|---|---|---|---|---|
| | 0.5 | 0.4 | 0.3 | 0.2 |
| Classification accuracy (%) | 91.4 | 88.6 | 85.7 | 84.3 |
| Type I error rate (%) | 31.3 | 31.3 | 25.0 | 18.8 |
| Type II error rate (%) | 1.9 | 5.6 | 11.1 | 14.8 |

SOURCE: Authors.

divided by primary capital (ratio 6). The estimated coefficient on this variable is positive as expected and is statistically significant in almost every case. The results obtained when additional ratios are included are less impressive. The estimated coefficients on the variables are rarely significant and sometimes even exhibit the "wrong sign." Further, adding these variables has only a marginal impact on classification accuracy.[13]

Depending on the sample, model, and chosen probability cutoff value, overall classification accuracy ranges from roughly 82 to 90 percent. For comparative purposes, the classification accuracy of a naive model (which predicts that a bank's current CAMEL is the same as the one assigned at its last exam) is 87.1 percent and 84.5 percent for the large and small samples, respectively.

While the overall classification accuracy of the estimated models is important, judging their usefulness as early-warning tools requires an examination of the Type I (classifying a high-risk bank as a low-risk one) and Type II (classifying a low-risk bank as a high-risk one) error rates of each. Type I errors are typically considered more serious, but if a statistical early-warning model is being developed to aid in the allocation of scarce examination resources, the Type II error rate is also of concern.

Not unexpectedly, the Type I and Type II error rates of the estimated models vary across models and vary with the probability cutoff values used for each one. In general, the Type I error rates are considerable for the estimated models when a 0.5 probability cutoff is employed, while the Type II error rates are very low. The Type I error rates are generally in excess of 30 percent. Reducing the probability cutoff values generally decreases the Type I error rate at the cost of some increase in the Type II rate. When a 0.2 probability cutoff is used (approximately equal to the sample proportion of high-risk banks), the Type I error rate is reduced to roughly 20 percent. The trade-off is a rise in the Type II rate to the 15 percent level. Again, for comparative purposes, the naive model has a Type I error rate of 37.5 percent for the large sample and 46.2 percent for the small one. The Type II error rates are 5.6 percent and 6.7 percent, respectively.

Interestingly, a comparison of the results obtained using current-quarter and previous-quarter ratios indicates only minor differences in the classification accuracy of the estimated models.

### Logit Analysis With Factor Scores as Explanatory Variables

Preliminary investigation indicated that most of the variation in the data set could be accounted for by a relatively small number of factors. Accordingly, factor analysis was used on various subsets of the financial ratios to extract two, three or four factors from the sample data. Logit regressions were then estimated using the sets of two-, three-, or four-factor scores produced and used to classify the sample banks into the two risk classes. This exercise revealed that the predictive accuracy of the three-and four-factor

■ 13 This result is similar to Sinkey [1977]. He finds that the ratio of primary capital net of classified assets to total assets (net capital ratio) is the best discriminator between problem and nonproblem banks.

models was no better than that of the two-factor variety. Thus, only the two-factor results are reported and discussed.

The rotated factor-loading matrices for the two-factor models used in the logit regressions reported immediately below appear in tables 6 and 7. These matrices provide insight on the relationship between the observed variables or ratios and the factors produced by the factor analysis. The factor loadings, in turn, are used to generate the coefficients that allow the ratios to be converted into factor scores that are ultimately used as explanatory variables in the logit regressions estimated. Relatively heavy loadings (that is, loadings close to one in absolute value) indicate a close relationship between that variable and the constructed factor and imply that the value of that ratio will have a relatively large impact on the value of the factor score. The sign of the loading indicates the relationship between that particular ratio and the factor score.

In general, an examination of the factor-loading matrices reveals that several asset-quality measures typically cluster together on the first factor. Two other earnings-efficiency-type ratios—return on assets and the overhead expense ratio—also tend to load on factor one, along with the asset-quality ratios. The signs of the loadings on the ratios imply that a sample bank's score on this factor will be higher, the lower its asset quality, the lower its profitability, and the higher its overhead expenses. Thus, higher scores on this factor are indicative of greater risk.

Two liquidity-type ratios—loans plus securities/total sources of funds and volatile liabilities/total sources of funds—typically load together on the second factor. The signs of the loadings imply that scores on this factor will be higher, the higher the former ratio and the lower the latter one. The sign of the loading on the volatile liability ratio suggests that higher levels of this ratio are indicative of more sophisticated liability management and this, in turn, suggests greater liquidity. Higher scores on this factor imply greater liquidity risk.

A third ratio, primary capital/average assets, also tends to load together with the two liquidity ratios. The sign of the loading is positive, implying higher factor scores for banks with higher capital ratios. The reason for the positive loading is unclear.

The estimated logit regressions reported in each table are very similar. In each, the coefficients on the factors exhibit the expected positive signs, but only the coefficient on the asset-quality-earnings factor is statistically significant.

The in-sample classification accuracy of this type of model does not differ markedly from models using simple ratio values. This is true regardless of the sample or type of data employed to construct the factor scores.

When the probability cutoff value is set at 0.5, roughly 90 percent of the sample banks are correctly classified. The Type I error rates of the factor score logits are roughly 30 percent. Type II error rates are generally less than 5 percent. Again, lowering the probability cutoff value lowers the Type I error rate at the cost of an increase in the Type II rate. The Type I error rate remains considerable, hovering around 25 percent even when the probability cutoff value is reduced to 0.2.

As was true for the models in which simple ratios were used, the predictive accuracy of the factor-score models estimated with previous-quarter data is generally no worse and sometimes even slightly better that that of the current-quarter-based counterparts.

**TABLE 6**

**Model 5—Large Sample Rotated Factor-Loading Matrix**

| | | |
|---|---|---|
| CURR06 | .886 | -.011 |
| CURR07 | .872 | .071 |
| CURR08 | .816 | -.018 |
| CURR14 | .748 | -.050 |
| CURR13 | .659 | .079 |
| CURR09 | -.673 | .235 |
| CURR19 | .019 | .891 |
| CURR01 | -.277 | .499 |
| CURR20 | -.209 | -.892 |

**Logit Model 5**

| Variable | Coefficient | T-Statistic | Chi-Square |
|---|---|---|---|
| Constant | -1.37361 | -3.14 | 37.53 |
| FACTOR1 | 4.24095 | 3.31 | |
| FACTOR2 | 0.86227 | 0.86 | |

| | Probability Cutoff Value | | | |
|---|---|---|---|---|
| | 0.5 | 0.4 | 0.3 | 0.2 |
| Classification accuracy (%) | 90.0 | 90.0 | 85.7 | 82.9 |
| Type I error rate (%) | 31.3 | 31.3 | 31.3 | 25.0 |
| Type II error rate (%) | 3.7 | 3.7 | 9.3 | 14.8 |

SOURCE: Authors.

**TABLE 7**

**Model 6 — Large Sample Rotated Factor-Loading Matrix**

| | | |
|---|---|---|
| PREV06 | .909 | .010 |
| PREV08 | .870 | 009 |
| PREV07 | .866 | .040 |
| PREV14 | .684 | –.124 |
| PREV13 | .596 | .158 |
| PREV09 | –.815 | .342 |
| PREV19 | .017 | .908 |
| PREVO1 | –.188 | .549 |
| PREV20 | –.186 | –.880 |

**Logit Model 6**

| Variable | Coefficient | T-Statistic | Chi-Square |
|---|---|---|---|
| Constant | –1.26098 | –3.05 | 35.10 |
| FACTOR1 | 4.55155 | 3.27 | |
| FACTOR2 | 0.86765 | 0.93 | |

| | Probability Cutoff Value | | | |
|---|---|---|---|---|
| | 0.5 | 0.4 | 0.3 | **0.2** |
| Classification accuracy (%) | 90.0 | 87.1 | 85.7 | 84.3 |
| Type I error rate (%) | 31.3 | 31.3 | 31.3 | 18.8 |
| Type II error rate (%) | 3.7 | 7.4 | 9.3 | 14.8 |

SOURCE: Authors.

### Out-of-Sample Model Forecasts

Each type of model was reestimated using a randomly selected sample of 40 sample banks and was used to classify a holdout sample of 18 banks. In general, the results mirror the findings already discussed above.

In particular, the most useful current-quarter ratio continues to be the nonperforming-loan ratio. The out-of-sample classification of the estimated equation in which this ratio is the only explanatory variable is relatively accurate, given the small size of the sample being examined. Generally, over 80 percent of the holdout sample is correctly classified. When probability cutoff values of 0.4 and 0.5 are used, the Type II error rate is very low, while the Type I rate is considerable. For lower probability cutoff values, the Type I error rate falls to roughly 20 percent without a marked increase in the Type II rate. When additional ratios are used in the estimated equations, the forecasting performance of the estimated models improves slightly.

The predictive accuracy of the estimated logit models is roughly the same when current-quarter factor scores are used as explanatory variables. This was found to be true regardless of the number of factors employed. The results obtained using previous-quarter data generally mirrored those obtained using current-quarter data.

## V. Summary and Conclusion

The results of this study are in accord with those reported by many others who have done previous empirical work on early-warning failure-prediction models. Specifically, the results demonstrate that relatively simple models constructed using only a limited number of financial ratios that are derived solely from publicly available information do a reasonably good job of classifying commercial banks into different risk classes. The overall classification accuracy and Type I and Type II error rates of the models estimated in this study are comparable to those reported by other researchers.[14]

In addition, the critical predictive role of asset quality and earnings measures detected in previous empirical work is confirmed.[15] Particularly noteworthy is the performance of the asset-quality proxy, nonperforming loans divided by primary capital. Models employing only this variable perform as well as more complicated models. Furthermore, nonperforming loans appear to be as good a proxy for asset quality as classified assets derived from examination reports (not publicly available). Previous studies were unable to employ asset-quality proxies using nonperforming loans because it was not available on the call reports before March 1983.

The results actually are somewhat better than expected given a number of circumstances. First, the sample size is very small, much smaller in fact than that used in many previous studies.

■ **14** For example, Wang, et al.(1987) examined a sample of over 2,900 S&L's in a similar study. They report in-sample classification accuracy of 74 percent and Type I and Type II error rates of 31 and 21 percent using a probability cutoff value of 0.5.

■ **15** Asset quality and earnings measures have been found lo be significant predictors of bank risk and/or failure in virtually every study reviewed. See, for example, Hirschhorn (1986).

Second, the set of potential explanatory variables was limited at the outset. Given the results obtained in previous work, it is possible that the use of several other variables and/or slightly different versions of ratios actually employed (all of which would be constructed from publicly available data) would have improved the predictive power of the estimated models.

In particular, a size measure might have proven useful, given that the dependent variable is constructed from examiner perceptions of bank risk. It is known that examiners incorporate bank size into their evaluations of the financial condition of banks and a size variable has been found to be useful in previous empirical studies.[16] Loan composition measures such as the ratio of commercial and industrial loans to total loans or assets have been found to be significant predictors of bank risk in other work and may have improved the classification accuracy of the models estimated in this study.[17]

Some researchers have reported that slightly different versions of the ratios available for use in this study improved the predictive power of their models. For example, the ratios of other operating expenses to total assets and primary capital divided by risk assets have been found to be superior to the expense and capital measures used in this study.[18]

Finally, the risk profile of the particular sample of banks used in this study made them difficult to accurately classify with a statistical model. A large proportion (roughly two-thirds) of the sample banks had CAMEL ratings of 2 or 3. Very few of the sample banks had CAMEL ratings of 4 or 5. Thus, the ratio values of the high-risk and low-risk banks in the sample were not markedly different. This may be one reason why the performance of the estimated models was not better and why the results can be characterized as relatively good.[19]

■ **16** A size variable is used in Barth, et al. (1985), Sinkey, et al. (1987), and West (1985), for example. See also the discussion in Bovenzi, et al. (1983), Korobow and Stuhr (1983) and Hirschhom (1986) about the usefulness of size data.

■ **17** The ratio of commercial and industrial loans to total loans was found to be significantly related to bank financial condition in Pantalone and Platt (1987) and Martin (1977), for example.

■ **18** The relative merits of alternative expense measures are discussed in Bovenzi, et al. (1983). The capital-to-risk asset ratio is used in Martin (1977).

■ **19** It should also be noted that the dependent variable is a subjective measure and reflects examiners' perceptions of bank risk. Further, one component of the CAMEL rating that is incompletely reflected in published financial statements is management quality. Thus, an incorrect classification does not necessarily mean that the model is in error.

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# Developing Country Lending and Current Banking Conditions

by Walker F. Todd

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## Introduction

This article describes the general evolution of the present developing country debt problem and discusses some of the current efforts to deal with it.[1]

In a nutshell, the problem since 1982 has been that many debtor nations in the developing world have interrupted their normal external debt service from time to time and, in most instances, have had to rely on reschedulings and loans of additional funds from both commercial banks and official sources to maintain debt service.

Because of both the larger quantities of funds involved and the commitment of new commercial bank loans to assist the adjustment process, the current methods of debt resolution stand apart from prior balance of payments adjustment programs in the post-World War II era.

During the 1970s and early 1980s, the claims of United States banks on developing countries (also called "lesser developed countries," or "LDCs"), increased rapidly. The LDC debts raised difficult issues that have troubled borrowers, lenders, creditor country governments, and official multilateral lending agencies since the scope of the debt problem became clear in 1982.

Initially, lenders and their governments believed that restructured and rescheduled lending by creditors, and domestic policy adjustments by debtors, would be sufficient to resolve the debt problem in a reasonable period of time. Now, however, more than five years have passed and the debt problem is still unresolved.

Although economic conditions in the debtor countries may have improved somewhat from their 1982-1984 low point, by a number of objective criteria several important debtor countries seem little closer to being able to service their debts on an ongoing basis than was the case five years ago.

From the perspective of the U.S. banking system, an important characteristic of the LDC debt problem is the distribution of the debt among U.S. banking firms. By June 1987, nine money-center banks held 66 percent of all U.S. banks' claims on 15 heavily indebted countries, including the most heavily indebted Latin American countries.[2] In addition, those claims were equiva-

■ 1 Adjustments in debtor economies or among foreign bank creditors are beyond the scope of this article. See Federal Reserve Bank of Cleveland, *Annual* Report 1987, for discussion of these aspects of the LDC debt problem.

■ 2 The 15 heavily indebted countries are: Argentina ($9.1), Bolivia ($0.1) Brazil ($23.0), Chile ($6.2), Colombia ($2.0), Cote d' Ivoire ($0.4), Ecuador ($1.9), Mexico ($23.6), Morocco ($0.8), Nigeria ($0.6), Peru ($1.1), Philippines ($4.8), Uruguay ($0.9), Venezeula ($8.4), and Yugoslavia ($1.9). The amounts of all U.S. banks' claims on those countries, as of June 30, 1987, are indicated in parentheses (amounts in billions). In late 1987, Costa Rica (about $400 million) and Jamaica (about $200 million), also were added to the official schedule of heavily indebted countries.

**TABLE 1**

**Claims on Foreign Countries Held by U.S. Banking Offices and Foreign Branches of U.S. Banks**

**(New data series as of June 1987)**
**(Amounts in billions of dollars)**

| Year-end | Total | Latin America[1] |
|---|---|---|
| 1976 | 206.8 | 36.2 |
| 1977 | 240.0 | 40.8 |
| 1978 | 266.3 | 45.7 |
| 1979 | 303.9 | 52.5 |
| 1980 | 352.0 | 63.2 |
| 1981 | 414.4 | 76.5 |
| 1982 | 436.3 | 84.8 |
| 1983 | 434.0 | 86.7 |
| 1984 | 405.7 | 88.2 |
| 1985 | 391.9 | 84.6 |
| 1986 | 390.5 | 83.4 |
| 1987 (June) | 392.0 | 83.9 |
| 1987 (Sept.) | 392.7 | 82.3 |

1. Iatin America includes OPEC members Ecuador and Venezuela, but excludes Panama, the Bahamas, and other offshore (Caribbean) banking centers.
SOURCES: ***Federal Reserve Bulletins*** (Table ***3.21***).

lent to 113 percent of the total capital of the nine money-center banks. By comparison, bank claims on this same group of countries were equivalent to 64 percent of the total capital of 13 other large regional banks, and 27 percent of the total capital of all other U.S. banks.

## I. Beginnings

U.S. banks' lending to Iatin America increased rapidly during the 1970s and early 1980s. Although the data are not strictly comparable for different time periods, U.S. banks' claims on all of Latin America rose from $8 billion at year-end 1973 to $84.8 billion at year-end 1982. Despite a modest amount of new-money lending to rescheduling countries since 1982, claims on Iatin America were reduced to $83.9 billion by June 1987 and $82.3 billion by September 1987 (table 1).[3]

While foreign borrowings from U.S. banks increased rapidly from 1971 through 1973, an enormous increase in LDC debt materialized after the first oil-price shock (October-December 1973), possibly because of the methods used to cope with greatly increased capital outflows from oil-importing countries.* Initially, the expanded debt levels seemed acceptable to many creditors and debtors because the rate of increase of economic growth in many large debtor economies exceeded the rate of increase in their external debt levels.5

How far in advance lenders foresaw the Mexican debt difficulties in midyear 1982 is not clear. However, at least some lenders were caught unaware—at least one new, large, syndicated loan for Mexico, worth $100 million or more, still was being offered to lenders in July and August 1982. Banks' lending to Mexico accelerated until the onset of its payment difficulties—$6.4 billion of new Mexican debt was added into the $84 billion final total, before rescheduling, during the first six months of 1982 alone.6

A number of developments unforeseen by the borrowers or lenders suddenly disrupted the servicing of the LDC loans. The sharp recession and the onset of disinflation in 1982 certainly are among the foremost precipitating factors for the August 1982 crisis. The dramatic decline in inflation during the first half of 1982 reduced borrowers' planned receipts and increased their demand for credit to maintain living standards.

The extraordinary increase in interest rates that preceded the July 1981 to November 1982 recession also was a factor contributing to the crisis. Dollar interest rates were above prior post-World War II levels throughout the period. The prime

□ 3 Sources: Federal *Reserve* Bulletins, Table 3.18, display claims of all U.S. banks on foreigners. Beginning in 1976, a new series was started: claims on foreign countries held by U.S. banking offices and foreign branches of U.S. banks. This series, Table 3.21, pertains only to U.S.-chartered banks, while Table 3.18 data pertain to all banks in the United States, including U.S. offices of foreign banks. To obtain figures for Latin America using Table 3.21 data, one must add claims for all of Latin America, plus Latin American OPEC members Venezuela and Ecuador.

□ 4 See, for example, Margaret Garritsen De Vries, The IMF in a Changing World (1986). Data on U.S. banks' foreign claims in Federal Reserve Bulletins, Table 3.18, indicale thal U.S. banks' claims on foreign borrowers increased nearly 75 percent in 1974 alone; claims on Latin American bwrowers increased 90 per cent in 1974 alone. Total foreign lending of U.S. banks increased $19.7 billion during 1974, and loans lo Latin America constituted $7.1 billion (36 percent) of the increase. Other historians maintain that the seeds of the impetus for expanded foreign lending by U.S. banks were sown by the stimulus of the domestic economy by U.S. fiscal and monetary authorities in 1970-1972.

■ 5 Federal Reserve Bank of Cleveland, Annual Report 1987. Thus, Ihe Annual Report maintains, debt-service capacity increased at a rate that seemed to be consistent with future debt-service requirements. See "Developmenls in International Financial Markets," 1975 Federal Resewe Bulletin 605-617, for a tacit, official acceptance of the use of bank intermediaries for petrodollar recycling in the 1970s.

□ 6 Harold Lever and Christopher Huhne. Debt and Danger: The World *Financial Crisis.* 49-52 (1985, 1986). U.S. banks' exposure to Mexico increased by $3.5 billion in the first six months of 1982, a 32.4 percent annual rate of increase. 1983 Federal Resewe Bulletin A 63 (Table 3.21) (January 1983).

lending rate, which had peaked at 20.5 percent in August 1981 (monthly average), still was at 15 percent on August 15, 1982.[7] A large proportion of the LDC loans was negotiated at floating interest rates, with frequent interest rate fixing dates. Although these practices allowed LDCs to hedge against anticipated declines in interest rates, increasing amounts of debt had to be rolled over at increasingly shorter intervals.

## II. Confronting the Problem

Following the onset of Mexico's payment difficulties, in mid-August 1982, with only rare exceptions, the flow of voluntary, new-money lending to the heavily indebted countries gradually stopped. For a time, sovereign debt service problems were managed, on a country-by-country basis. Brazil still could roll over maturing short-term foreign bank credits until early December 1982, but then Brazil also temporarily stopped paying interest due on its loans, interrupting its debt service due to what was considered a "short-term liquidity crisis." One by one, Argentina, Venezuela, and eventually every continental country in Latin America, except Colombia and Paraguay, interrupted its foreign debt service. Each of those countries arranged reschedulings or restructurings of its external debt, usually under the auspices of the International Monetary Fund (IMF).

The initial approach to resolving Mexico's payments difficulties in 1982 contained several novel elements, such as a substantial amount of new-money lending by banks, together with customary IMF assistance and a three-year adjustment program.

After the program was implemented in February 1983, analysts began to observe that a pattern of continued real growth in the industrial economies of 3 percent per year would enable significant improvements in the LDCs' debt-service capacities to occur and identified real growth in the industrial economies as the most important international influence on the LDCs' debt position.[8]

At the same time, U.S. economic policy stimulated domestic economic growth aggressively through both fiscal and monetary measures, a development that, among other economic policy objectives, encouraged imports from the LDCs, who reciprocally were reducing their own imports from industrial economies, thereby enabling the LDCs to maintain their external debt service. U.S. authorities also encouraged other industrial countries to stimulate their economies, partly in order to facilitate LDC debt service, but such stimulation was comparatively slow in coming, due to concerns about renewed inflation abroad.

The 1982-85 era was a period in which debtors negotiated the first round of adjustments necessary for redressing their external-account imbalances and made significant progress toward that goal. The reschedulings were a necessary component of the official effort to buy time to enable the debtor countries to complete the adjustments required to service the debt. The adjustments were extremely difficult and, in many instances, caused cutbacks in the degree of longstanding and highly developed state involvement in, and subsidization of, domestic economies in countries like Mexico, Brazil, and Argentina.[9] The reschedulings, however, have continued down to the present in most debtor countries, including a few repeat reschedulings of principal for which the grace periods under earlier reschedulings expired.

New loans extended in connection with reschedulings allowed LDC debtors to keep interest payments current after mid-1982. They also increased the outstanding principal owed by debtors to the creditors. The foreign debts of Mexico and Brazil (that is, debt for all classes of borrowers owed to all classes of foreign creditors), for example, increased from approximately $80 billion each in mid-1982 to $105 billion for Mexico and $114 billion for Brazil at midyear 1987, with very little in the way of new, usable funds provided in the interim. External debt as a percentage of exports of goods and services of the heavily indebted countries increased from 33.5 percent in 1980 to 46.3 percent in 1982 and 60.8 percent in 1986.[10]

Another purpose of the reschedulings and new-money loans was to provide enough time for orderly adjustments in the creditor countries, especially within their banking systems. The

7 1983 Federal *Reserve* Bulletin A 27 (Table 1.33) (January 1983). The prime rate was cul to 14.5 percent on August 16, 1982.

8 See Bergsten, C. Fred, William R. Cline, and John Williamson. Bank Lending to Developing Countries: The Policy Alternatives 7, 18, Institute for International Economics, 10 Policy Analysis in International Economics (April 1985).

9 For a description of the types of debtor-country adjustments lhat were made, see Federal Reserve Bank of Cleveland, Annual *Report 1987*.

10 World Bank, 1 World Debt Tables: *1987-1988*, xiv, 33 (1988).

**TABLE 2**

**U.S. Banks' Cross-Border, Nonlocal Currency Exposures to 15 Heavily Indebted Countries[1]**

| | Exposure | | Total Capital | | Total Assets | |
|---|---|---|---|---|---|---|
| | 1982 | 1987 | 1982 | 1987 | 1982 | 1987 |
| Nine large money-center banks | 54.3 | 56.3 | 27.1 | 49.8 | — | 630.0 |
| Thirteen other large banks | 17.9 | 14.8 | 12.7 | 23.1 | — | 284.0 |
| All other banks (excluding 22 banks above) | 18.0 | 14.1 | 26.4 | 51.4 | — | 679.0 |
| Total (All U.S. banks)[2] | 90.2 | 84.8 | 66.2 | 124.4 | — | 1,593.0 |

1. The 15 countries are: Argentina, Bolivia, Brazil, Chile, Colombia, Cote d'Ivoire, Ecuador, Mexico, Morocco, Nigeria, Peru, Philippines, Uruguay, Venezuela, and Yugoslavia. Amounts in billions of dollars as of June 30, 1982 and June 30, 1987.
2. The number of reporting banks was 167 in June 1982; 181 in June 1987.
NOTE: Totals may not agree due to rounding.
SOURCE: FFIEC Statistical Releases No. E. 16 (126), Country Exposure Lending Survey. Exposures are adjusted for guarantees and external borrowings.

condition of the nine large U.S. money-center banks with the greatest exposures to 15 heavily indebted countries is shown in table 2. Their exposure ($54.3 billion) in June 1982 was approximately twice their total capital ($27.1 billion). Also, that exposure constituted about 60 percent of the total claims of all U.S. banks on those 15 countries ($90.2 billion).

The concentrated exposure in the largest U.S. banks raised questions about the capacity of the entire U.S. banking system to withstand the shock of the default of a single large debtor or the coordinated defaults of a group of debtors.[11] Also, four large Latin American debtors (Mexico, Brazil, Argentina, and Venezuela) account for three-fourths of all U.S. banks' claims on the heavily indebted countries.

Such concerns prompted additional efforts to ensure the soundness of banking conditions. For some time prior to 1981, banks' capital adequacy had been a matter of increased supervisory concern. The International Lending Supervision Act (ILSA), enacted in November 1983, directed U.S. bank supervisory authorities to monitor the foreign lending activities of U.S. banks and to study the need for capital increases and new loan-loss reserves because of those activities. The U.S. bank supervisory authorities proposed increased minimum capital ratios in July 1984, requiring primary capital of 5.5 percent and total capital of 6.0 percent for member banks and bank holding companies.[12]

In fact, as table 2 shows, the capital positions of all banks have improved substantially since 1982—both absolutely and in relation to LDC debt. The large regional banks reduced their LDC debt exposures slightly and nearly doubled their total capital from 1982 until 1987. During 1986 and 1987, there were particularly large increases in both primary capital and total capital of the 34 largest bank holding companies (see table 3).

If rescheduling and new-money loans acted to increase debts for the debtors and the loans outstanding for many creditors, the net effect of those measures was, in many cases, to retard the progress of those creditors in adjusting their balance sheets in the direction of greater stability. Thus, the resulting LDC debt exposure of U.S. banks, on a scale that constitutes a potentially serious difficulty, remains concentrated increasingly in the money-center banks, together with one or two large regional banks.

After the initial round of reschedulings in 1982-84, a generally improved world economic outlook encouraged those who believed that the new-money-lending approach would work satisfactorily. In fact, much progress occurred. Even though domestic inflation never really was controlled in

11 For accounts of official statements on the "too big to let fail" problem, see Sprague, Irvine H., *Bailout* 259 (1986) (remarks attributed to a former Comptroller of the Currency and to a former director of the Federal Deposit Insurance Corporation). *Cf.* Lever and Huhne at 17-22.

12 See Federal Reserve System Board of Governors, *Annual Report 1984* at 177. The 1981 minimum capital ratios for large bank holding companies had been established at 5.0 percent (primary capital) and 5.5 percent (total capital). ILSA is Pub. L. No. 98-181, Title IX, Nov. 30, 1983; codified at 12 U.S.C.A. sections 3901-3912.

**TABLE 3**

**Large Bank Holding Companies' Capital Increases (Decreases) During 1986 and 1987**

| | Total Primary Capital | | Total Capital | |
|---|---|---|---|---|
| | **1986** | **1987** | **1986** | **1987** |
| Twelve Large Money-Center Banks (except California) | | | | |
| Bank of New York | $231 | $319 | $272 | $335 |
| Bankers Trust NY | 472 | 1,271 | 538 | 1,152 |
| Chase Manhattan | 571 | 987 | 706 | 1,441 |
| Chemical NY | 364 | 1,674 | 258 | 1,892 |
| Citicorp | 2,598 | 3,281 | 5,583 | 2,931 |
| Irving Bank Corp. | 50 | 253 | 133 | 302 |
| Manufacturers Hanover | 517 | 742 | 461 | 892 |
| J.P. Morgan & Co. | 824 | 929 | 1,333 | 1,078 |
| Marine Midland | 159 | 464 | 140 | 469 |
| Republic NY Corp. | 255 | 471 | 390 | 346 |
| Bank of Boston Corp. | 471 | 448 | 837 | 370 |
| First Chicago | 466 | 537 | 525 | 653 |
| Money Center Composite | 7,093 | 11,376 | 11,176 | 11,861 |
| Large California Banks | | | | |
| BankAmerica Corp. | 24 | 679 | 339 | 722 |
| First Interstate | 369 | 291 | 267 | 14 |
| Security Pacific | 616 | 1,631 | 1,210 | 2,080 |
| Wells Fargo | 1,133 | 495 | 1,760 | 275 |

SOURCES: Salomon Brothers; and ***American Banker.***

either Mexico or Brazil, exports were stimulated, imports were reduced by more than one-half in Mexico, and enough new-money loans were provided to cover debt-service needs. By early 1985, Mexico and Brazil had accumulated modest or, in Brazil's case, significant surpluses in their trade balances (up to $10 billion per year).

At the IMF-World Bank annual meeting in Seoul, Korea, in October 1985, U.S. Treasury Secretary James A. Baker revealed what is now known as the Baker Plan for the LDC debt crisis. Moving beyond the initial, three-year IMF austerity regimes for debtors, Secretary Baker urged banks to continue providing enough new-money loans to stimulate real growth in LDC economies, in addition to merely lending enough to meet debt-service requirements. In return, eligible LDC debtors (the "15 heavily indebted" countries) were to strengthen the foundation for long-term growth and eventual debt service by adopting market-oriented reforms of domestic policies, including extensive privatization of state-owned enterprises, and elimination of some producer and consumer subsidies. About $20 billion of new-money loans, net of repayments, over a three-year period were called for.

A number of debtors, including Argentina and Brazil, agreed to the principal Baker Plan-style reforms, and renewed attempts to control their domestic inflation. In January and February 1986, Argentina and Brazil adopted the Austral and Cruzado plans, respectively, which included sweeping currency reforms, wage and price freezes, and initial reductions in domestic inflation. Mexico was pursuing a modified version of the 1982 IMF austerity regime and experienced modest net inflows of capital in 1986 and early 1987.

## III. Economic Conditions of LDC Countries

The initial successes of the chosen approach to the LDC debt crisis eventually were impaired by persistent and increasing domestic inflation and large domestic budget deficits, especially in the largest heavily indebted countries. Debt-export and debt-service-export ratios remained burdensome.

In 1982, real gross domestic product (GDP) growth in the 15 heavily indebted countries averaged about zero percent, inflation averaged nearly 60 percent, domestic budget deficits were more than five percent of GDP, the aggregate current-account deficit totaled about $50 billion, the debt-export ratio was close to 270 percent, and the debt-service export ratio was about 50 percent (table 4). As the data in table 4 indicate, economic conditions in the aggregate have improved in a number of respects since the 1982-1984 period. Real GDP growth, budget deficits and the current-account balance all improved by varying degrees.

Yet, it is clear from the data that inflation remains severe and debt burdens have increased, despite the fact that debt-service obligations (interest payments and principal amortizations expressed as percentages) have moderated somewhat from their 1982 peak values. And it is also clear that, despite some improvements since 1982, economic conditions in the heavily indebted countries are far from healthy today. Improvements in the aggregate trade balance, a key source of foreign-exchange earnings, slowed during the past two years. Though some economic improvements have occurred since the worst of the crisis, and though debtor countries and lenders have worked hard at improving the

**TABLE 4**

**Economic Indicators of 15 Heavily Indebted Countries**
**(Percent change at annual rate unless otherwise indicated)**

| Indicator | Average 1969-1978[a] | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 |
|---|---|---|---|---|---|---|---|---|---|---|
| Real GDP[b] | 6.1 | 6.1 | 5.0 | 0.5 | -0.4 | -3.4 | 2.2 | 3.1 | 3.5 | 3.2 |
| Consumer prices | 28.5 | 40.8 | 47.4 | 53.2 | 57.7 | 90.8 | 116.4 | 126.9 | 76.2 | 86.3 |
| Fiscal balance (percent GDP) | na | -0.8 | -0.8 | -3.7 | -5.4 | -5.2 | -3.1 | -2.7 | -4.5 | -3.6 |
| Trade balance ($-billions) | na | -1.9 | 4.4 | -7.5 | 3.2 | 28.3 | 43.2 | 40.8 | 22.9 | 18.8 |
| Export volume | 2.8 | 7.3 | 0.6 | -2.2 | -5.1 | 6.4 | 9.6 | 1.8 | -6.5 | -1.3 |
| Import volume | 8.4 | 7.2 | 7.9 | 4.3 | -16.7 | -21.2 | -2.4 | 1.1 | -8.5 | 0.5 |
| Current-account balance ($-billions) | na | -24.6 | -29.5 | -50.3 | -50.6 | -15.2 | -0.6 | -0.1 | -11.8 | -14.0 |
| Debt-export ratio (percent)[c] | na | 182.3 | 167.1 | 201.4 | 269.8 | 289.7 | 272.1 | 284.2 | 337.9 | 349.6 |
| Debt-service/exports (percent)[c] | na | 34.7 | 29.6 | 39.0 | 49.4 | 42.5 | 41.1 | 38.7 | 43.9 | 40.7 |

a. Compound annual rates of change unless otherwise noted.
b. Gross domestic product.
c. Ratio of debt or debt-service payments to exports of goods and services.
na — not available.
SOURCE: World Bank, *World Debt tables: 1987-1988* (*1988*).

situation, the debt burden remains enormous even five years after the crisis began.

## IV. Implications for U.S. Banking Conditions

Since 1974, stock-market values of U.S. money-center banks' shares have usually been priced well below book values. Since 1982, money-center banks' shares have been priced even more substantially below book values, apparently because investors in financial markets evaluated LDC loans at less than their nominal value.

By year-end 1986, oil prices in Mexico fell as low as $9 per barrel, Mexican foreign-exchange reserves were at negligible levels, and the difficulties surrounding Argentina's Austral and Brazil's Cruzado plans were overwhelming. The stabilization programs that the debtors pursued relied heavily on nonmarket-oriented wage and price controls. Brazil suspended foreign-exchange interest payments to conserve foreign currency reserves in February 1987, and Argentina undertook negotiations for a new-money loan and rescheduling later in the year to compensate for shortfalls in the Austral plan.

In March 1987, apparently in response to concerns regarding Brazilian and certain other LDC debts, the nation's largest commercial bank holding company announced that it had put $3.9 billion of LDC loans on a "cash" accrual basis. Then, in May 1987, it announced the creation of up to $3 billion of loan-loss reserves for LDC debt, about 25 percent of its current LDC exposure. Within a week, its common equity share value increased $5 per share, about 9 percent of prior share value. Other bank holding companies followed suit in May and June 1987, including, in all, 43 of the 50 largest bank holding companies in the United States, as of June 30, 1987.

The amount of loan-loss reserves, which usually had been between 1 and 2 percent of total loans at the largest banks before 1986, became comparatively large, in the range of 3 to 5 percent. Table 5 shows loan-loss reserves as a per-

## TABLE 5

### Loan-Loss Reserves to Total Loans (Percent)

| Name of Bank Holding Company | 1982 | 1983 | 1984 | 1985 | 1986 | 6-30-87 | 12-31-87 |
|---|---|---|---|---|---|---|---|
| Ten Largest Bankers Trust New York Corp. | 1.11 | 1.17 | 1.55 | 1.70 | 2.02 | 5.10 | 4.96 |
| BankAmerica Corp. | 0.88 | 1.25 | 1.18 | 1.88 | 2.94 | 4.91 | 5.06 |
| Chase Manhattan Corp. | 1.00 | 1.01 | 1.23 | 1.47 | 1.61 | 4.00 | 4.00 |
| Chemical New York Corp. | 1.00 | 1.10 | 1.22 | 1.45 | 1.70 | 4.15 | 4.15 |
| Citicorp | 0.76 | 0.83 | 0.88 | 1.06 | 1.29 | 3.68 | 3.34 |
| First Interstate Bancorp. | 1.20 | 1.35 | 1.34 | 1.38 | 1.55 | 3.65 | 3.72 |
| Manufacturers Hanover Corp. | 0.74 | 0.90 | 1.08 | 1.41 | 1.80 | 4.88 | 4.77 |
| Morgan (J.P) & Co. | 1.15 | 1.48 | 1.63 | 2.14 | 2.62 | 5.35 | 5.58 |
| Security Pacific Corp. | 1.07 | 1.11 | 1.57 | 1.40 | 1.61 | 2.77 | 3.27 |
| Wells Fargo & Co. | 0.93 | 0.96 | 1.14 | 1.70 | 2.00 | 3.51 | 3.69 |
| Ten largest Average | 0.93 | 1.08 | 1.20 | 1.50 | 1.85 | 4.11 | 4.25 |

Weighted averages (except for 12-31-87).
SOURCE: Call Reports and Salomon Brothers.

centage of total loans, from 1982 to 1987. The new loan-loss reserve ratios are significantly larger than historical ratios in the last 15 years.

The round of special LDC loan provisioning initiated in early 1987, however, did not play itself out by midyear. More LDC loan-loss provisioning occurred at year-end 1987, including a general move toward 50 percent provisioning at most U.S. regional banks and three of the 10 largest banks. Ongoing payments arrears in Brazil, Ecuador, and Peru, together with particular uncertainties in other heavily indebted countries, generally were cited as the reason for the increased provisioning. In December 1987, one large U.S. regional bank took the first actual charge-offs of a portion of its LDC loans to a major debtor country, and at least two large regional banks with prior LDC debt exposure became 100 percent reserved for it in January 1988. The remaining seven largest U.S. banks have reserved thus far against approximately 25 percent of their LDC debt exposure.

Banks have added to capital and increased reserves. Generally, apart from the largest New York City banks and one large California bank, reserves are more or less in line with market evaluations of the debts of the 15 heavily indebted countries. The 1987 rounds of special provisions for LDC debt were taken almost entirely from the equity accounts (paid-in, common-share capital, perpetual preferred shares, plus retained earnings or surplus) of the bank holding companies. Because 100 percent of the LDC loan-loss provisions still count as primary supervisory capital, the primary capital ratios of the bank holding companies have not been weakened, but the equity capital ratios are as low as they have been since the early 1980s, typically between 2 and 4 percent of total assets at the largest companies where the bulk of the remaining LDC exposure is concentrated.

The future exclusion of the new loan-loss reserves from primary (Tier 1) capital for supervisory capital adequacy purposes, however, seems likely to cause banks to attempt to rebuild equity capital.[13] Under the proposed international guidelines, 4 percent would be the eventual norm for equity capital, by 1992.

**13** See, for example, Bennett, Robert A., "Hard Times for Three Big Banks." New York Times, April 10, 1988, section 3, at 1, col. 2 (national edition). Future treatment of loan-loss reserves as a part of bank capital is discussed in a 17-nation agreement released December 10, 1987. Bank for International Settlements, Basle Committee on Banking Regulation and Supervisory Practices, "Proposals for Intemalional Convergence of Capital Measurement and Capital Slandards," Dec. 10, 1987. The Federal Reserve System's Board of Governors approved publication for comment on capital adequacy standards generally conforming with Ihe December 10, 1987 document on January 25, 1988. The joint, federal bank supervisory aulhorities' capital adequacy proposal was published in 53 Federal Register 8550-8587 (March 15, 1988).

## TABLE 6

### Dividend Payout Ratio and Dividends on Common Stock Per Share, 1982-1987

| | 1982 | | 1983 | | 1984 | | 1985 | | 1986 | | 1987 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bank of New York | 32.2% | 1.09 | 30.5% | 1.16 | 29.5% | 1.26 | 32.9% | 1.40 | 31.4% | 1.56 | nr | nr |
| Bankers Trust NY | 27.1 | 1.05 | 27.4 | 1.15 | 26.5 | 1.26 | 25.6 | 1.38 | 25.5 | 1.53 | nm | 1.71 |
| Chase Manhattan | 44.0 | 1.70 | 31.9 | 1.75 | 40.5 | 1.83 | 29.7 | 1.90 | 30.9 | 2.05 | -18.7 | 2.16 |
| Chemical NY | 34.2 | 1.92 | 34.1 | 2.16 | 36.4 | 2.36 | 33.8 | 2.48 | 34.3 | 2.60 | -16.3 | 2.72 |
| Citicorp | 30.7 | 1.72 | 29.0 | 1.88 | 31.9 | 2.06 | 31.7 | 2.26 | 34.5 | 2.45 | -31.7 | 2.70 |
| Irving Bank Corp. | 36.8 | 1.68 | 36.2 | 1.76 | 36.0 | 1.84 | 31.9 | 1.96 | 30.5 | 2.08 | nm | nr |
| Manufacturers Hanover | 37.9 | 2.95 | 36.7 | 3.07 | 44.5 | 3.17 | 38.3 | 3.21 | 36.9 | 3.25 | -12.1 | 3.28 |
| J.P. Morgan & Co. | 36.6 | 0.87 | 35.9 | 0.95 | 33.8 | 1.03 | 28.9 | 1.13 | 26.6 | 1.26 | nm | 1.40 |
| Marine Midland | 28.4 | 1.29 | 28.9 | 1.40 | 38.4 | 1.60 | 28.9 | 1.75 | 27.5 | 1.98 | nr | nr |
| Republic NY Corp. | 26.5 | 0.93 | 27.7 | 1.01 | 29.2 | 1.07 | 27.4 | 1.09 | 22.8 | 1.12 | nm | 1.16 |
| Bank of Boston Corp. | 29.6 | 0.66 | 29.3 | 0.72 | 28.1 | 0.78 | 29.1 | 0.82 | 24.7 | 0.91 | nm | 1.02 |
| First Chicago | 36.0 | 1.20 | 32.1 | 1.26 | 110.9 | 1.32 | 46.5 | 1.32 | 28.1 | 1.32 | 14.0 | 1.50 |
| Money-Center Median | 33.2% | | 31.2% | | 34.9% | | 30.7% | | 29.3% | | -12.1% | |
| BankAmerica Corp. | 58.5 | 1.52 | 69.7 | 1.52 | 85.9 | 1.52 | nm | 1.16 | nm | 0 | nm | 0 |
| First Interstate | 39.6 | 2.12 | 38.5 | 2.22 | 37.7 | 2.32 | 36.0 | 2.46 | 36.4 | 2.62 | -23.1 | 2.77 |
| Security Pacific | 30.0 | 0.98 | 30.2 | 1.09 | 30.3 | 1.20 | 30.1 | 1.31 | 29.7 | 1.45 | nm | 1.72 |
| Wells Fargo & Co. | 33.1 | 0.96 | 32.9 | 0.99 | 31.6 | 1.08 | 29.9 | 1.24 | 28.0 | 1.41 | nm | 1.67 |
| Regional-Bank Median (includes 22 banks) | 37.0% | | 35.6% | | 34.8% | | 30.4% | | 31.7% | | 36.4% | |
| 35-Bank Median[b] | 35.1% | | 33.4% | | 34.9% | | 30.6% | | 30.5% | | 12.1% | |

a. Common dividends declared per share, divided by net income per share on a primary basis.
b. Average of subgroup medians.
c. Stock split during year is dividend = $1.35/share, $2.70 on prior basis.
nm = not meaningful.
nr = not reported.
SOURCE: Salomon Brothers.

### Alternative Solutions That Have Been Pursued

- Three large bank holding companies announced new common equity issues during 1987, and other large bank holding companies are said to be considering such issues to raise equity accounts. Only two of the 15-largest bank holding companies had new common equity issues in 1986, which were the first significant new common equity issues by the largest bank holding companies since 1982.
- Banks also may have to reexamine dividend policies if they wish to rebuild equity accounts through retained earnings. The dividends per share declared by eight of the 10-largest bank holding companies increased each year from 1982 through 1986. Prior to year-end 1987, every major New York City bank holding company increased its declared dividend each year since August 1982. The dividend payout ratio (dividends as a proportion of net income per share) essentially was unchanged at most of the largest bank holding companies over the 1982-1986 period (see table 6).
- Generally, New York City banks increased their declared dividends as reported earnings rose during that period. Low equity capital ratios of most large bank holding companies, caused by the LDC loan-loss reserves created in 1987, are likely to prompt the largest bank holding companies to reconsider their policies on declared dividends, or at least to consider reducing their dividend payout ratios, in order to build up the equity capital ratios through retained earnings.
- Debt-for-equity swaps are frequently mentioned for improving banks' capacity to manage the payments arrears problem on LDC debt. Debt-for-equity swaps are exchanges of LDC debt, usually at discounts from par value, for equal value (in

dollars) of shares or other equity investments in enterprises operating within the debtor country. Regulations allowing U.S. banks and Edge or Agreement corporations to own equities in foreign, nonbanking businesses have been liberalized twice in the last year.

- Debt-for-equity swaps may be useful vehicles in particular circumstances but have only limited capability to resolve the overall LDC debt problem because of the limited availability of enterprises suitable for debt-for-equity conversion in many LDCs. Some analysts have noted that, in the past, debt-for-equity swaps have substituted for capital flows (direct investments) that might have occurred anyhow, without the inducement of discounted exchanges for local equity. Such exchanges might reduce the debtor's net external resources below the expected level that would have been available otherwise. Domestic inflation also may be increased to the extent that new domestic credit is created to accommodate the exchange of local currency for external debt in connection with the swap.
- Securitization, another frequently mentioned LDC debt option, generally is understood to mean the packaging of debt, usually with a payment guarantee provided by the issuer (seller) of fractional shares of the packaged debt. Securitization appears to offer only limited value as a long-term solution to the LDC debt crisis because the debt being offered is considered by many analysts to be of speculative value and could not satisfy institutional investors' "prudent man" fiduciary standards without sellers' or third parties' payment guarantees. Most analysts believe that debt-for-equity swaps and securitization have a useful, but limited, role to play in the LDC debt-adjustment process.

A secondary market for LDC debt developed in London shortly after the 1982 crisis began. It began initially as a device for repositioning LDC debt exposures among institutional creditors. That market has increased in depth and volume and has expanded to New York. Although this market still is incapable of dealing with more than modest amounts of LDC debt in an orderly fashion, the estimated volume of trading in 1987 reached $12 billion per year (par value). Estimated volume in this market is about 50 percent above 1987 levels thus far in 1988. Representative bid prices for LDC debt in April 1988 were as follows: Brazil (49.5 percent), Argentina (28 percent), Mexico (51 percent), and Venezuela (54.25 percent).

Thus, as with the alternatives mentioned above, outright sales of LDC debt in the secondary market offer limited opportunity at present for easing the strains of the LDC debt crisis. The market is so small that any offer of a large quantity of a country's debt depresses bid prices dramatically, and the sale of debt at market prices clearly would require sellers to recognize extensive losses on the debts thus sold under current accounting standards. Also, from the debtors' perspectives, the secondary market often does not ease the strains because the discount from par value may not be captured by the debtors—they often remain obligated to repay at par value, even after the sale is completed.

Another important development occurred in late December 1987, when J.P. Morgan & Company, the U.S. Treasury, and the Mexican government separately made statements announcing a proposed auction arrangement under which Mexican debt held by banks would be exchanged for Mexican government 20-year bonds.[14] Bids in the auction were expected by many to enable Mexico to exchange $1 of bonds for a greater amount of debt, perhaps as many as $2.

The repayment of principal (after 20 years) was to be assured by Mexico's purchase of a new issue of U.S. Treasury, zero-coupon, 20-year securities for between $2 billion and $2.5 billion. The principal value of the U.S. bonds at maturity was to be between $10 billion and $11 billion at current interest rates and was to enable Mexico to extinguish up to $20 billion of bank debt.

The actual results of the auction were not as encouraging as many had expected. Although active participation in the auction was expected from regional and foreign banks, it was not expected from most money-center banks. The participation of

■ **14** See Bennett, Robert A., "Big Bank Proposes a Plan for Easing Third-World Debt." *New York Times*, December 30, 1987, at A1, col. 6 (late city edition). Farnsworth, Clyde H., "New Debt Relief Policy." *New York Times*, December 31, 1987, at A1, col. 1 (late city edition). Bennett, Robert A., "Billions in Plan in Mexico Bond Sale," *New York Times*, February 26, 1988, at 39, col. 4. The Treasury's role in this arrangement is not entirely clear—it took steps to facilitate the transaction, but it does not appear that the Treasury's initial role was more than that of a facilitator. Cf. Bennett, Robert A., "Lesson on Mexican Debt," *New York Times*, March 5, 1988, at 15, col. 1. Citations to the *New York Times* are to the national edition unless otherwise indicated.

the money-center banks may have been hindered by accounting rulings that apparently required banks to charge off or reserve against all Mexican debt tendered at the auction at the rate of discount tendered, regardless of whether the tender was accepted. In fact, at the debt auction held early in March 1988, only $3.7 billion of debt was accepted, at an average price of 69.77 cents per dollar, for $2.6 billion of bonds, reducing Mexico's debt by only $1.1 billion.

The applicability of the Mexican bond approach to the immediate debt-service problems of other countries is not yet clear. For one thing, it requires foreign currency reserves to purchase the U.S. Treasury or other similiar securities that would support any new bond issue, and most LDC debtors besides Mexico lack comparable amounts of foreign exchange.

Also, a Mexican-style bonds-for-debt auction probably would require creditors to accept bonds for significantly less than the face value of the debt and to recognize the loss. Nevertheless, the Mexican proposal is another encouraging example of the search for solutions that is under way.

Solutions obviously will vary from debtor to debtor and from lender to lender. In April 1988, Brazil conducted a debt-for-equity swap variation of the Mexican bonds-for-debt auction, exchanging $150 million of equity in designated Brazilian enterprises for $186 million of foreign debt at discounts ranging from 10 to 27 per cent below par value.

## VI. Conclusion

The LDC debt crisis is not significantly closer to a permanent, global solution today than in 1982. By creditor-country measures, such as LDC debt as a percentage of total banks' capital, the problem of the U.S. banking system is only half as severe as in 1982, but the remaining problem is still highly concentrated in seven of the nine largest money-center banks. For most U.S. regional banks, the LDC debt crisis now is a problem no more severe, proportionately, than domestic credit problems.

For the debtor countries, the problem remains as severe as ever. For example, real wages in Mexico declined 34 percent below 1982 levels by 1985 and have continued to decline since then.[15] Domestic inflation (more than 150 percent per annum) and currency depreciation (more than 100 percent per annum) were increasing rapidly in three of the four large debtor countries at year-end 1987, and debt-service indicators deteriorated in most LDCs throughout the 1982-1987 period. Because of the new-money loans, the external debt now exceeds 50 percent of gross national product in all but four of the 15 heavily indebted countries. From the debtors' standpoints, great sacrifices have been made, but there is as yet very little to show for them.

Effective remedies may not, in the end, depend crucially on large-scale, government-directed plans. The market valuation of banking firms will reflect expectations of the banks' future earnings, regardless of the banks' actual loan-loss provisions or LDC debt charge-offs. To a large extent, financial markets have already discounted the value of LDC loans on the books of banks.

Market recognition of the substantial risks that could impede eventual debt service probably will continue to prompt banks to reserve further (in accordance with the perceived market value of LDC debts), to raise capital, and perhaps also to reexamine dividend policies. And debtors and creditors alike seem likely to continue to explore cooperative solutions that recognize the necessity of compromises in the terms, maturities, and principal amounts of the debts.

■ **15** Real wage changes were computed by dividing the local currency wage index and consumer price index for 1985:IQ by the same indices for 1982 (annual averages). International Monetary Fund. International Financial Statistics 350 (June 1987).

# Comparing Inflation Expectations of Households and Economists

by James M. Hvidding

While the Economic Review primarily contains articles by economists associated with the Bank or the Board of Governors, occasionally we receive comments from readers that are appropriate for the Review. Prof. Hvidding's comment on an earlier Review article by Michael Bryan and William Gavin is one such case.

This comment extends Bryan and Gavin's earlier Economic Review article (1986 Quarter 3) on measuring inflation expectations. Using a different frequency of observations, Prof. Hvidding's results support Bryan and Gavin's findings that the Michigan Survey dominates the Livingston Survey as a forecast of inflation. Using quarterly observations, he finds, however, that the Michigan survey forecasts inflation slightly better than the time series method, while Bryan and Gavin find the opposite using semiannual data.

— Editor

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In a recent issue of this Review, Bryan and Gavin (1986a) hereinafter referred to as GB, compared the forecast accuracy of three alternative series of inflation forecasts: the Livingston survey of Economists' CPI forecasts, the Michigan survey of household inflation expectations, and a generated series of out-of-sample time-series forecasts of the inflation rate. They concluded that the household survey is a more accurate forecast of inflation than the Livingston survey of economists' forecasts but that "the relatively simple time-series model...performed about as well as the Michigan survey." This note addresses the second part of this conclusion.

The BG study was designed primarily to compare the Livingston and Michigan surveys. Since these two surveys measure different expectations, some compromises had to be made. First, in fairness to the semiannual Livingston survey, half the observations from the quarterly Michigan survey had to be ignored. Second, a choice had to be made whether to treat the forecasts as June to June (Livingston) or May to May (Michigan).[1] Given the outcome of the study, BG made the correct choice in picking June to June. Handicapping the Michigan survey in this way strengthens their primary conclusion that the Michigan survey is superior to the Livingston survey. But using only half of the available observations and measuring forecast accuracy on the wrong forecast horizon is not appropriate if the objective is to compare the Michigan survey with a generated alternative forecast.

To provide a more appropriate comparison of the Michigan survey and the generated forecast, I generated out-of-sample time-series forecasts for both the June to June and May to May forecast periods using a seasonally adjusted CPI series supplied to me by BG. Using semiannual observations on the June to June series, I was able to replicate their results almost exactly. These results are reported in tables 1(a) and 2(a).[2] I then repeated the forecast comparison using

■ 1 The Livingston survey is conducted semiannually in June and December and asks its respondents to forecast the level of the Consumer Price Index for the following June or December. The forecasts are therefore "June to June" (or December to December). The Michigan survey is taken quarterly in February, May, August, and November. Here the respondents are asked to predict what will happen to the prices of the things they buy "over the next twelve months." The forecasts are from February to February, May to May, and so on.

■ 2 BG did not present figures for the "naive" forecast (the inflation rate for the year preceding the forecast date). It is included here to facilitate comparison between the semiannual data used by BG and the quarterly data presented here.

TABLE 1

Forecast Accuracy

(a) Semiannual Observations: June 1966 -June 1987

| Forecast | MAE | RMSE | U | $U^M$ | $U^R$ | $U^D$ |
|---|---|---|---|---|---|---|
| Naive | 2.205 | 2.744 | 1.000 | 0.000 | 0.197 | 0.802 |
| Livingston | 2.303 | 3.006 | 1.096 | 0.203 | 0.015 | 0.782 |
| Michigan | 1.871 | 2.362 | 0.861 | 0.037 | 0.000 | 0.963 |
| Time-Series | 1.870 | 2.335 | 0.851 | 0.018 | 0.107 | 0.876 |

**(b)** Quarterly Observations: June 1966 -June 1988

| Forecast | MAE | RMSE | U | $U^M$ | $U^R$ | $U^D$ |
|---|---|---|---|---|---|---|
| Naive | 2.164 | 2.663 | 1.000 | 0.000 | 0.188 | 0.812 |
| Michigan | 1.612 | 2.030 | 0.762 | 0.026 | 0.020 | 0.954 |
| Time-Series | 1.823 | 2.301 | 0.864 | 0.000 | 0.179 | 0.821 |

KEY:
MAE — Mean absolute error.
RMSE — Root mean squared error.
U — Ratio of forecast RMSE to naive forecast FMSE.
$U^M$ — Fraction of forecast error due to bias.
$U^R$ — Fraction of forecast error due to difference of regression coefficient from unity.
$U^D$ — Fraction of forecast error due to residual variance.
SOURCE: Author.

quarterly observations on the May to May series.[3] These results are reported in tables 1(b) and 2(b). Table 1(b) reports measures of forecast accuracy for quarterly observations on the Michigan survey and the May to May time-series forecast over the period covered in BG. Here the Michigan survey is shown to be noticeably more accurate that the time-series forecast.

In addition to the standard measures of forecast accuracy, BG presented the results of a conditional efficiency test employing the regression equation:

$$(1) \quad \pi_t = \beta_0 + \beta_1 x^*_{1t} + \beta_2 x^*_{2t} + \dots \beta_n x^*_{nt} + U_t$$

*where* $\pi_t$ is the inflation rate and the $*_{it}$ are $n$ linearly independent forecasts of w, . Forecast i is "conditionally efficient" relative to the other forecast if $\beta_i = 1$ and $\beta_j = 0$ for all $j$ $i$. Table 2(a) shows that the hypothesis that the Livingston survey is conditionally efficient relative to the Michigan survey and the time-series forecast can be rejected at the one percent significance level for the June observations (equation [1]) and at the five percent level of significance for the December observations (equation [2]). The conditional efficiency hypothesis is not rejected in either equation for the Michigan survey or the time-series forecast. These findings lead BG to conclude that the household survey and the time-series forecasts are statistically comparable.

In conducting their conditional efficiency test, BG divided the sample of semiannual observations into two series of annual observations and ran two separate regressions. This treatment is used in order to avoid the serially correlated error term that inevitably arises when the sampling interval is less than the forecast horizon. Hansen and Hodrick (1980) have demonstrated

■ 3 The generated time-series forecast used by BG (and reported in tables 1 (a) and 2(a)) is actually a forecast of the change in the log of the CPI, which, as BG explicitly note, is only an approximation of the annual percentage change in the CPI. It just happens that this approximation makes the time-series forecast appear to be more accurate than it really is. When the delta-log forecasts are converted to percentage change forecasts, the RMSE for the semiannual time-series forecast is 2.407, as opposed to the 2.335 reported in table 1(a). The time-series forecasts used in generating the results reported in table 1(b) and 2(b) have been converted to annual percent change forecasts.

## TABLE 2

### Conditional Efficiency Tests

| | (a) Annual | | (b) Quarterly[b] | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Time Period | June 66 - June 85 | Dec 66- Dec 84 | 66:2-85:2 | 66:2-85:2 |
| Constant | 0.161 | 3.070 | 0.139 | -0.195 |
| | (0.09) | (1.58) | (0.18) | (0.25) |
| Naive | | | (-0.347) | |
| | | | (0.67) | |
| Test Statistic[a] | | | 32.48 | |
| | | | (.000) | |
| Livingston | -0.291 | 0.022 | | |
| | (0.69) | (0.04) | | |
| Test Statistic[a] | 5.67 | 3.28 | | |
| | (.005) | (.040) | | |
| Michigan | 0.784 | -0.591 | 0.715 | 0.757 |
| | (1.73) | (0.73) | (1.29) | (1.24) |
| Test Statistic[a] | 0.83 | 1.50 | 6.25 | 2.62 |
| | (.526) | (.252) | (.181) | (.454) |
| Time-Series | 0.495 | 1.124 | 0.631 | 0.297 |
| | (1.27) | (2.33) | (1.13) | (0.72) |
| Test Statistic[a] | 1.43 | 0.67 | 14.24 | 11.56 |
| | (.269) | (.622) | (.007) | (.009) |
| No. of Obs. | 20 | 19 | 77 | 77 |
| $R^2$ | .674 | .507 | .641 | .627 |
| Durbin-Watson | 1.560 | 1.239 | 0.838 | 0.621 |

NOTE: t-statistics for coefficients and significance levels for test statistics are in parentheses.
a. For the joint hypothesis that the coefficient is one and all other coefficients in the regression are zero. For equations using annual data this is an F-statistic. For equations using quarterly data it is Chi-square as suggested by Hansen and Hodrick (1980).
b. The t-statistics for the equations using quarterly data are derived from the adjusted standard errors as suggested by Hansen and Hodrick (1980).
SOURCE: Author

an alternative approach that is asymptotically more efficient. Their treatment includes all observations in the OLS regression and employs an estimate of the implied autocovariances of the residuals to calculate a Chi-square statistic for hypotheses concerning restrictions on the regression coefficients.[4] Table 2(b) reports the results of conditional efficiency tests employing all quarterly observations on the forecast series.

The naive forecast (last year's inflation rate) is included in equation (3) to replace the Livingston series so that the three-way test employed by BG is preserved. Here the hypotheses that the naive and time-series forecasts are conditionally efficient relative to the Michigan survey are strongly rejected while the hypothesis that the Michigan survey is conditionally efficient cannot be rejected. Equation (4) shows that the same conclusion holds for a two-way conditional efficiency test.

These results demonstrate that the Michigan survey measure of the inflation expectations of households dominates a single ARIMA time-

4 For a description of this testing procedure and an illustration of its use in this context see Brown and Maital (1981) or Bryan and Gavin (1986b).

series forecast. This finding implies that such forecasts are not appropriate proxies for household inflation expectations in quarterly econometric models. Another interesting implication follows from the observation that the generated forecast used here makes use of the CPI data for the survey month, that is, first-quarter forecasts use the current February value of the CPI, second-quarter forecasts the May value, and so on. The fact that this information is not officially published until more than a month after the Michigan survey is taken, together with the finding that the Michigan survey is conditionally efficient relative to this forecast implies that households are not dependent on published indexes for information on prices and inflation.

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