Fall

1987

Federal Reserve Bank of San Francisco

Economic Review

Number

4

The Federal Reserve Bank of San Francisco's Economic Review is published quarterly by the Bank's Research and Public Information Department under the supervision of Jack H. Beebe, Senior Vice President and Director of Research. The publication is edited by Gregory J. Tong, with the assistance of Karen Rusk (editorial) and William Rosenthal (graphics).

For free copies of this and other Federal Reserve publications, write or phone the Public Information Department, Federal Reserve Bank of San Francisco, P.O. Box 7702, San Francisco, California 94120. Phone (415) 974-2163.

Three Questions Concerning Nominal and Real Interest Rates

Carl E. Walsh*

Do increases in real interest rates tend to be followed by declines? Are market interest rate movements a reflection of variations in expected inflation or expected real rates of return? Are monetary and fiscal policy responsible for the behavior of real rates in the 1980s? These three questions, and their implications for monetary policy, are addressed in this paper.

The 1980s have witnessed unusually high levels of market interest rates relative to measured rates of inflation. The importance of this phenomenon depends critically on the extent to which these high *ex post* real rates have reflected high expected, or *ex ante*, real rates of interest, since it is the expected real return that should affect the savings, investment, and portfolio choices of the public. Because these aspects of economic behavior are related to expected real rates of interest, it is important to gain a fuller understanding of the relationship between market interest rates, expected real rates, and macroeconomic policies.

This paper examines three empirical questions related to the behavior of nominal and expected real interest rates:

Does the real rate of interest have a random walk component? If the real rate does not have such a component, it would tend to revert to a constant average value after any changes, that is, rate changes would be temporary in nature. Deviations of the real rate from its average therefore may provide information about the business cycle that would be useful for the conduct of monetary policy. One could interpret the average value of the real rate as its "equilibrium" value, and indeed several analysts have suggested that monetary policy act to stabilize the real rate around its equilibrium value.[1] If, however, the real rate does not tend to revert to any constant level, then there is no sense in which the real rate has a constant, long-run equilibrium value around which it might be stabilized.

To what extent are unpredicted movements in market interest rates due to movements in real rates as opposed to movements in expected inflation? Using U.S. data from the 1950s and 1960s, Fama (1975) concluded that nominal interest rate movements were consistent with a constant expected real rate of interest and that all market interest rate changes were attributable to changes in expected inflation. More recent U.S. experience suggests that the expected real rate has moved quite sharply, so that nominal rate changes may reflect a more equal balance of movements in the real rate and expected inflation.

Federal Reserve monetary policy has often been characterized as designed to smooth market interest

* Associate Professor, University of California at Santa Cruz, and Visiting Scholar, Federal Reserve Bank of San Francisco. This article was written while the author was a Senior Economist at the Federal Reserve Bank of San Francisco.

rates, and the appropriateness of such a policy depends, in part, on whether movements in market rates tend to be generated by changes in real rates or by inflationary expectations. An expansion in the money supply designed to offset a rise in market rates that originates from expectations of higher inflation may simply fuel an actual increase in inflation.

To what extent are monetary and fiscal policy disturbances responsible for the movements of the real rate, particularly over the last ten years? The initial apparent rise in real rates in the early 1980s has generally been attributed to restrictive monetary policy actions designed to reduce inflation; the continued high level of real rates is often blamed on large federal budget deficits. However, many economists argue that deficits have little impact on interest rates. Decomposing the real rate into components due to monetary policy shocks and fiscal policy shocks may shed light on this debate.

The paper is organized to discuss each question in order. The next section examines the stochastic processes followed by nominal interest rates and inflation to test for whether changes in these variables tend to persist or to be temporary. The results have implications for the existence of a constant average *ex ante* real rate around which the real rate fluctuates. They also are useful in determining the specification of the variables to use in the later empirical analysis.

Section II uses the results from a Vector Autoregression (VAR) to decompose innovations in the nominal rate into *ex ante* real rate innovations and expected inflation revisions. By comparing such decompositions over different sample periods, one can obtain a sense for the changing informational content of nominal rate innovations. Section III presents the decomposition of the real rate into components attributable to monetary and fiscal disturbances, respectively. Conclusions are summarized in Section IV.

I. Does the Real Rate Have a Random Walk Component?

Until relatively recently, economists generally assumed that most macroeconomic variables tended to fluctuate randomly around either a constant average value or around a trend line. When a variable rose above its trend, it was expected subsequently to fall back towards the trend line.

In the last few years, this standard view has been questioned. For example, Nelson and Plosser (1982) argue that most macroeconomic variables are better characterized as having a random walk component to their behavior.[2] A random walk has the property that changes are permanent, that is, if the variable goes up, there is no tendency for it to return to any average or trend value. Thus, shocks to a variable containing a random walk component will have permanent effects on the level of the variable.

A finding that the *ex ante* real rate has a random walk component would have important implications for suggestions that real rates be used to guide the conduct of monetary policy (Jenkins and Walsh 1987). Factors, such as changes in tax policy, that produce persistent shifts in the real rate may call for a different policy response than factors, such as fluctuations in the demand for money, that produce temporary changes in the real rate.

To be more specific, a rise in the demand for money, in the absence of a policy response, would temporarily raise the real rate and contract aggregate demand. Policy might respond by expanding the money supply to keep the real rate from rising. But if the initial rise in the real rate were due to a permanent shift in consumer preferences towards current consumption and away from saving, then no such monetary policy action would be called for. In other cases, it may be less important to respond to temporary movements in the real rate, since the costs of failing to act would presumably be smaller than a failure to respond to more persistent disturbances. At the time the change in the real rate is observed, however, it may be difficult to determine whether permanent or temporary factors are at work.

Testing for a Random Walk

Testing for random walk behavior in the *ex ante* real rate of interest is complex because the expected real rate cannot be observed. Nevertheless, it is possible to draw some conclusions about the real rate process by examining the behavior of the *ex post* real rate and its two components, the nominal interest rate and the rate of inflation.

To define some notation, let i_t denote the nominal interest rate from t to t+1. Let π_{t+1} be the rate of inflation from t to t+1, and let $E_t x_{t+j}$ be the expectation, formed at time t, of a variable x_{t+j}. Then, ignoring taxes, the ex ante real rate, r_t, and the ex post realized real rate, exr_t, are given by equations 1 and 2:

$$r_t = i_t - E_t\pi_{t+1} \quad (1)$$

$$exr_t = i_t - \pi_{t+1}. \quad (2)$$

Equations 1 and 2 imply that

$$r_t = exr_t + (\pi_{t+1} - E_t\pi_{t+1}) \quad (3)$$

so that the *ex ante* real rate and the *ex post* real rate differ by the error made in forecasting future inflation.

Chart 1 plots the nominal interest rate on 3-month Treasury bills and their *ex post* real return. The apparent upward drift in the nominal rate from 1960 to 1981 was primarily a reflection of rising expectations of inflation; the *ex post* real return, far from mirroring this upward trend, remained negative for most of the 1970s. The sharp rise in the *ex post* real rate from 1978 to 1982 was interrupted only during early 1980 by the Federal Reserve's imposition of credit controls.

The realized real rate differs from the expected real rate by the error made in forecasting the rate of inflation. Under any reasonable model of expectations formation, this inflation forecast error should be transitory, or stationary, in nature (that is, have no random walk component). Since the sum of a variable with a random walk component and a variable without one will contain a random walk component, equation 3 shows that r is stationary if and only if exr is stationary. If exr contains a random walk component, then so must r.

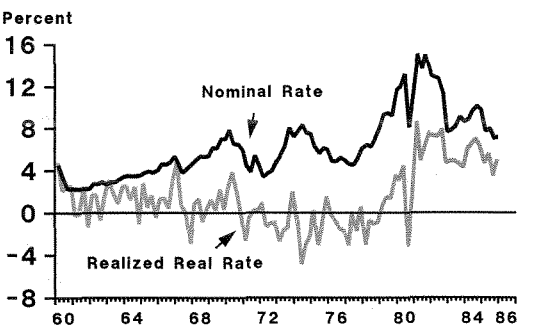
A common test for a random walk is based on the least squares regression of the first difference of a variable on its lagged level and lagged first differences. A constant and a time trend also may be included. The test statistic is simply the standard t-statistic for the coefficient on the lagged level. Under the null hypothesis that the variable has a random walk component, the coefficient on the lagged level should equal zero.[3] A large, negative t-statistic would indicate rejection of the null in favor of the hypothesis that the variable is stationary (perhaps with a trend).

Table 1 presents the results of the test described above. Quarterly data were used, and the nominal interest rate is the daily average of secondary market yield on 3-month Treasury bills for the first month of the quarter. Two price indices were used to calculate π: the GNP Price Deflator and the Consumer Price Index. Results for various sample periods are reported.

The test statistics consistently fail to reject the presence of a random walk term in the real rate. (In no case can the null hypothesis be rejected at the 5 percent level.) Rose (1987) reports similar findings for annual, quarterly, and monthly data for the U.S. He also finds evidence of a random walk component in the real rate for 17 other countries.

Chart 1

Nominal and Realized Real Rate on 3-Month Treasury Bills



The Effect of Taxes

One possible explanation for these results is that exr is the wrong way to combine the nominal rate and realized inflation to obtain a measure of the real rate. Many economists would argue that the relevant real interest rate should be an after-tax real rate. Letting τ denote the marginal tax rate, the *ex post* after-tax real rate is $(1 - \tau)\, i_t - \pi_{t+1}$. When both i and π contain independent random walk elements, the two variables will tend to drift apart over time since there are no forces acting to keep them close together. But if the after-tax real rate tends to fluctuate around a constant value, then i and π cannot drift too far apart. This implies that the random walk elements in i and π must be related.

If the after-tax nominal interest rate and the rate of inflation contain the same random walk component, then when one is subtracted from the other to obtain the after-tax real rate, the random walk components will cancel, leaving an after-tax real rate with no random walk element. If both i and π have random walk components, then exr can also have a random walk component, as indicated by Table 1, even if the after-tax real rate does not.

When two variables contain random walk components but some combination of the two does not, the variables are said to be cointegrated (see Engle and Granger, 1987 and 1986, and Hendry, 1986). The nominal interest rate and the rate of inflation will be cointegrated if they contain the same random walk

TABLE 1

Tests for a Random Walk Component in the Real Rate

A: Reported Test Statistic is the t-statistic on β_1 in the regression

$$x_t - x_{t-1} = \beta_0 + \beta_1 x_{t-1} + \Sigma\, \gamma_j (x_{t-j} - x_{t-1-j})^1$$

Inflation Measure	Sample Period	Test Statistic[2]
GNP Deflator	1961QI-1985QIII	−1.44
GNP Deflator	1961QI-1979QIII	−2.60
GNP Deflator	1970QI-1985QIII	−0.98
CPI	1961QI-1985QIII	−1.42
CPI	1961QI-1979QIII	−1.13
CPI	1970QI-1985QIII	−1.49

B: Results with trend included

Inflation Measure	Sample Period	Test Statistic[3]
GNP Deflator	1961QI-1985QIII	−1.94
GNP Deflator	1961QI-1979QIII	−3.25
GNP Deflator	1970QI-1985QIII	−2.02
CPI	1961QI-1985QIII	−2.03
CPI	1961QI-1979QIII	−2.81
CPI	1970QI-1985QIII	−2.00

* Significant at the 5% level.
1. A lag length of 4 was used.
2. Approximate 5% critical value is −2.9 (Fuller (1976, Table 8.5.2, P.373)).
3. Approximate 5% critical value is −3.47.

component. In this case, there will exist a constant α, called the cointegrating parameter, such that $\alpha i - \pi$ is stationary. If the after-tax expected real rate has no random walk component, then α will just be equal to one minus the marginal tax rate. Tests for cointegration and estimates of α are reported in Part A of the Appendix.

The results from the cointegration tests are mixed. Evidence of cointegration is found for the 1961QI - 1979QIII period, but cointegration is rejected when the sample is extended through 1985QIII. In addition, if the after-tax rate has no random walk component, the cointegrating parameter should equal one minus the marginal tax rate, that is, the estimated value of α should be around 0.6 to 0.7. Unfortunately, the actual estimates generally fail to fall in this range. Hence, the evidence seems to suggest that both the *ex ante* real rate and the after-tax rate contain random walk components.

If this finding were to hold for other real rates, particularly for longer term real interest rates, it would have important implications. For example, most modern macroeconomic theories imply that monetary forces have only temporary effects on real rates of interest. The presence of apparently permanent shifts in the real rate must then be due to nonmonetary phenomena.

However, the evidence of a random walk component in the real rate still leaves unanswered the question of the relative importance of permanent and temporary shocks to the real rate. A finding that the random walk component accounts for almost all the movement in the *ex ante* real rate would suggest monetary disturbances have not been important. Such evidence would support proponents of real business cycle theories, which de-emphasize the importance of money.[4]

Cochrane (1986) has recently proposed a method of measuring the relative importance of the random walk component of an economic time series.[5] Applied to the *ex post* real rate for the period 1961QI to 1985QIV, Cochrane's measure of persistence approaches approximately .12, implying that roughly 12 percent of the total unpredicted change, or innovation, to the *ex post* real rate represents a permanent innovation associated with the random walk component. Cochrane's measure suggests that innovations to the *ex post* real rate are predominantly temporary in nature. Since monetary disturbances have only temporary effects on the real rate, this finding is consistent with the view that monetary disturbances are an important source of real rate movements.

The evidence provided by Cochrane's measure of persistence must be qualified, however, by noting that it has a downward bias when used to measure the importance of the random walk component in the *ex ante* real rate.[6] Thus, the appropriate interpretation is that *at least* 12 percent of real rate shocks have permanent effects.

II. Movements in Real Rates or Expected Inflation?

Central banks have quite frequently relied on nominal interest rates as both instruments of monetary policy and as informational variables to be used as guides in the formulation of monetary policy. However, the use of nominal rates has inherent limitations because of the difficulty of determining whether nominal rate movements reflect movements in expected real rates or in expected inflation. In the 1970s, for example, the Federal Reserve was criticized for failing to allow nominal interest rates to rise sufficiently in the face of inflationary pressures. As a result, it was argued, monetary policy was insufficiently anti-inflationary. More recently, some economists have blamed the Federal Reserve for high real interest rates as nominal rates have, it is argued, fallen less than has expected inflation.[7]

Decomposition

It is possible to use historical data to decompose nominal interest rate movements into expected real rate and expected inflation changes. This allows an assessment to be made of the relative importance of these two components during different sample periods. Of particular interest is the decomposition of the unpredicted changes — or innovations — in the nominal rate. Such innovations are important as

they represent "new information" that may be useful for the conduct of monetary policy.

If $E_{t-1}i_t$ is the best linear forecast of the nominal rate i_t based on information available at $t-1$, then the nominal rate innovation, denoted $\hat{i}_t$, is just the forecast error:

$$\hat{i}_t \equiv i_t - E_{t-1} i_t. \tag{4}$$

Since $i_t = r_t + E_t\pi_{t+1}$ and $E_{t-1}i_t = E_{t-1}r_t + E_{t-1}\pi_{t+1}$,[8] the nominal rate innovation can be written as the sum of the innovation to the expected real rate and the revision, or innovation, to expected inflation:

$$\begin{aligned}\hat{i}_t &= (r_t - E_{t-1} r_t) + (E_t\pi_{t+1} - E_{t-1}\pi_{t+1}) \\ &= \hat{r}_t + E_t\hat{\pi}_{t+1}\,. \end{aligned} \tag{5}$$

Given any two of the three innovations — $\hat{i}_t$, $\hat{r}_t$ and $E_t\hat{\pi}_{t+1}$ — the third can be calculated from equation 5. Armed with estimates of the three innovations, the relative importance of the expected real rate and expected inflation for nominal interest rate innovations can be gauged.[9]

Estimates of both $\hat{i}_t$ and $E_t\hat{\pi}_{t+1}$ were obtained by estimating a six-variable VAR system. The variables included in the VAR were quarterly observations on the three-month Treasury bill rate, the logs of real GNP, the GNP price deflator, M1, the relative price of fuels, and the real value of federal defense purchases. All variables were entered into the VAR in first difference form with a lag length of four.[10] The estimation period was 1961QI to 1984QIV. Data from 1985 to 1986 were dropped because of the apparent shift in the relationship between M1 and other macroeconomic variables that occurred in 1985. Details of the construction of $\hat{i}_t$ and $E_t\hat{\pi}_{t+1}$ can be found in Part B of the Appendix.

The estimation results show expected inflation innovations to have been much more volatile than nominal rate innovations. For the 1961QI - 1984QIII period, the variance of $E_t\hat{\pi}_{t+1}$ was four times that of $\hat{i}_t$ (2.03 versus 0.51). Since the October 1979 change in Fed operating procedures, the variance of $\hat{i}_t$ has risen (to 1.05), while that of $E_t\hat{\pi}_{t+1}$ has fallen (to 1.52), putting the expected inflation innovation variance at less than twice that of $\hat{i}_t$.

The series on $\hat{i}_t$ and $E_t\hat{\pi}_{t+1}$ can be used to construct a series on $\hat{r}_t$, the innovation to the ex ante real rate.[11] The results of this decomposition for various subperiods are given in Table 2.

For the entire estimation period (1961QI - 1984QIII), a one percent innovation in the nominal rate reflected, on average, a .56 percent real rate innovation and a .44 percent expected inflation innovation.[12] This division, however, is far from

TABLE 2

Decomposition of Nominal Interest Rate Innovation*

	1961QI-1984QIII	1961QI 1979QIII	1970QI 1984QIII	1979QIV 1984QIII
Variance of Nominal Rate Innovation	.508	.362	.667	1.054
Fraction due to:				
Real Rate Innovations	55.7	36.9	51.1	79.9
Expected Inflation Innovations	44.3	63.1	48.9	20.1

*Based on a VAR estimated over 1961QI-1984QIV period. See text for details.

constant. During the period prior to the Fed's October 1979 change in operating procedures, nominal interest rate innovations appear to have predominately reflected expected inflation innovations. In contrast, nominal rate innovations since the fourth quarter of 1979 have primarily reflected innovations in the real rate. A one percent nominal rate innovation during the period 1979QIV - 1984QIII was equal, on average to a .8 percent real rate innovation and a .2 percent expected inflation innovation.

The decompositions of the nominal rate innovations that are reported in Table 2 are based on a single VAR estimated over the entire 1961QI - 1984QIV period. This has the effect of implying individuals knew the behavior of inflation and nominal interest rates during the 1980s when forming expectations in, say, 1970. Such an implication is not implausible if the underlying structure generating inflation, interest rates, and the other macroeconomic variables had remained unchanged over the entire sample period. However, the increased importance of aggregate supply shocks, such as the oil price increase and oil embargos in the 1970s, the shift in monetary policy procedures in 1979, the rapid decline in inflation in the 1980s, and the historically unprecedented deficits of the Reagan Administration suggest that such an assumption of structural constancy may yield a poor approximation when used to characterize the recent macroeconomic experience of the U.S. Huizinga and Mishkin (1986), for example, present evidence to suggest a shift in the structure in the real rate process in October 1979.

To obtain a rough check on the robustness of the innovation decompositions, the VAR system was reestimated over two subsamples: 1961QI - 1979QIII and 1970QI - 1984QIV. While the results differed somewhat from those obtained using the entire sample, the basic message was the same. For example, estimates from 1961QI - 1979QIII imply that almost all nominal rate innovations (98 percent in fact) were the result of expected inflation innovations. This is consistent with Fama's assumption that for the post-war period prior to 1972, all nominal interest movements were due to changes in expected inflation (Fama, 1975). When the VAR is estimated over the 1970QI - 1984QIV period, expected inflation innovations are estimated to account for 75 percent of the nominal rate innovations during 1970QI - 1979QIII and only 33 percent during the 1979QIV - 1984QIII period.

Findings

The changing composition of the innovations to the nominal rate reflects the changing relative importance of expected inflation and real rate movements over the last twenty-five years. The late 1960s and most of the 1970s were periods of high and variable rates of inflation. Real rates were far from constant then, and *ex post* real rates were negative during the 1970s (see Wilcox, 1983), but the dramatic increases in inflation appear to have dominated nominal rate innovations. The 1980s have witnessed large movements in both inflation and real interest rates. In a reversal of the 1970s, a falling rate of inflation has been associated with very high ex post real rates. Nominal rates have been much more volatile, and, according to the VAR estimates, nominal rate innovations have predominately reflected innovations to the *ex ante* real rate of interest.

This evidence indicates that monetary policy cannot reliably respond in a simple way to movements in market interest rates. For example, increases in the nominal rate due to upward revisions of expected inflation would, in general, call for a more contractionary monetary policy. If nominal rate changes were always dominated by such expected inflation changes, a simple automatic policy response might be possible. But nominal rate changes are sometimes, as in the 1980s, dominated by real rate changes.

Real rate changes pose more difficult problems for monetary policy. If they were due to money demand shifts, then they should be offset. In contrast, real rate effects due to aggregate spending fluctuations should generally not be offset. The changing informational content of movements in market interest rates means that simple policy rules based on market rates are unlikely to produce a satisfactory monetary policy. Additional information is required to interpret the changing nature of nominal interest rate movements.

The innovation decompositions provide interesting evidence on the information contained in unanticipated movements in nominal rates. Such movements primarily revealed information on expected inflation in the 1970s and expected real rates in the 1980s, although they provide no explanation of the underlying causes of either inflation or expected real rate movements. In the next section, an attempt is made to assess the role of macroeconomic policy shocks in explaining the high real interest rate during the first half of the 1980s.

III. What Raised Real Rates in the 1980s?

A number of alternative explanations have been offered to account for the high real interest rates that the U.S. has experienced during the past eight years. Two of the most prominent attribute high real rates to macroeconomic policies. The first views the rise in the real rate beginning in 1979 (see Chart 1) as a result of a restrictive monetary policy aimed at reducing the rate of inflation. The second attributes the continued high level of real rates, particularly since the 1981-82 recession, to current and expected future federal budget deficits.

A measure of the contribution of monetary and fiscal policy actions to the behavior of the *ex post* real rate can be obtained from the same VAR system used in the previous section to decompose nominal interest rate innovations. The manner in which movements in the *ex post* real rate are attributed to the various disturbances is detailed in Part C of the Appendix. The observed value of the *ex post* real rate is expressed, for each period during the sample, as the sum of six independent terms, one for each of the six disturbances in the VAR system. Since the purpose of this section is to focus on the behavior of the measured real rate during the 1970s and 1980s, the sample period over which the VAR was estimated was shortened by dropping the decade of the 1960s and estimating the system over 1970QI - 1984QIV.

As described in the previous section, the VAR system used to decompose nominal rate movements used real federal defense expenditures as a measure of fiscal policy. It is more common to use either the federal deficit or total government purchases of goods and services as proxies for the impact of fiscal policy. Results will be reported for each of these proxies, but each is an imperfect measure. The deficit, or the deficit corrected for the business cycle (the high employment deficit), implicitly imposes the assumption that expenditures have the same impact on real interest rates as do tax revenues. Yet this is an assumption that macroeconomic theories imply is wrong.

Simple Keynesian models predict that tax changes are partially financed out of both consumption and savings so that the impact of taxes on aggregate demand is less than an equal dollar change in government purchases of goods and services. Other models predict that only government expenditures will affect real rates. According to these models, the impact of current taxes on private spending would be offset by the effect of the accompanying change in future expected taxes when government expenditures are held constant.[13]

Total government purchases of goods and services, however, will not provide a perfect measure of the impact of fiscal policy even when taxes do not matter. To the extent that some government programs (health, public transportation, etc.) substitute for private purchases, a rise in government purchases may produce an offsetting decline in private spending, leading to little net impact on aggregate demand. This possibility suggests that a category of government expenditures for which no close private substitute exists should be used in calculating the impact of government expenditures on real rates. Federal defense expenditures constitute one such category.

In light of these considerations, three fiscal proxies were used: the real federal budget deficit (National Income and Product Account basis), real government purchases of good and services, and real federal defense purchases. The VAR system was estimated using each of the three fiscal proxies in turn. Then, the predicted path of the *ex post* real

rate was generated under the assumption that either fiscal or monetary shocks were equal to zero. This assumption yields an estimate of the contribution of each type of shock over the sample period. Unfortunately, the estimated contributions of fiscal and monetary shocks to real rate movements are sensitive to the fiscal proxy used. Table 3 summarizes the results for the period since 1979QIV.

Impacts of Fiscal and Monetary Shocks

The deficit measure (rows 1 and 4 of Table 3) attributes relatively little of the rise in the real rate since 1979 to *either* monetary or fiscal shocks. There is some indication that monetary shocks have contributed less to the level of real rates since the end of the last recession in 1982QIV, whereas fiscal policy has contributed more. This result supports the view advanced by, among others, Cecchetti (1986).

Somewhat similar results were obtained by using defense expenditures, although the absolute contribution of both monetary and fiscal shocks in this case was much larger. Although the impact of monetary shocks falls slightly after the end of 1982, it is estimated to have added more than fiscal shocks to the real rate even in the 1983-1984 period. In marked contrast, the contribution of fiscal shocks is raised significantly when proxied by total real purchases of goods and services. With that proxy, fiscal shocks are estimated to have added roughly 450 basis points on average to the *ex post* real rate between 1979QIV and 1984QIII.

The time pattern of the impact of fiscal and monetary shocks implied by the estimates using either total purchases or defense purchases are fairly similar. Using the results obtained when defense purchases proxy for fiscal policy, Chart 2 illustrates the role played by M1 shocks on the path of the *ex*

Chart 2

Impact of Money Supply Shocks on the Real Rate

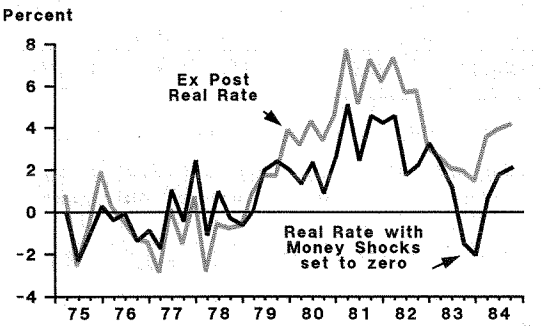


TABLE 3

Fiscal and Monetary Policy Effects on the Ex Post Real Rate

	Fraction of Predicted Real Rate Due to:			
	Monetary Shocks	Fiscal Shocks		
Period		Deficit[1]	Purchases[2]	Defense[3]
1.) 1979QIV-1982QIII	20% (1.09)[4]	*(−.61)		
2.) 1979QIV-1982QIII	29% (2.36)		55% (4.44)	
3.) 1979QIV-1982QIII	48% (2.6)			22% (1.2)
4.) 1982QIV-1984QIII	6% (0.23)	17% (0.63)		
5.) 1982QIV-1984QIII	30% (2.06)		66% (4.59)	
6.) 1982QIV-1987QIII	35% (1.91)			26% (1.4)

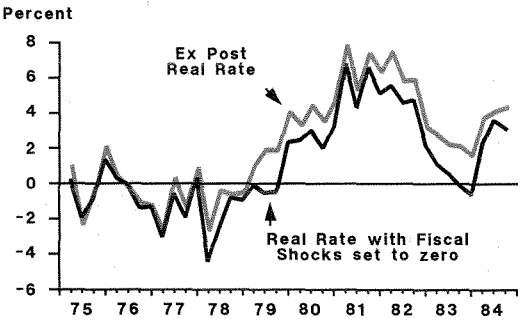
[1]Fiscal policy measured by real federal deficit.
[2]Fiscal policy measured by real federal purchases.
[3]Fiscal policy measured by real federal defense expenditures.
[4]Effect in percentage points is given in parentheses.
*Fiscal policy estimated to have reduced the real rate by an average of 61 basis points during this period.

post real rate. This chart plots the *ex post* real rate[14] and an alternative path, $e\hat{x}r_t$, in which the estimated effects of M1 shocks on exr_t are removed. Whenever exr_t exceeds $e\hat{x}r_t$, money disturbances are estimated to have raised the *ex post* real rate. When exr_t is less than $e\hat{x}r_t$, the net impact of M1 shocks was to lower the *ex post* real rate.

The evidence in Chart 2 appears to agree with other analyses of U.S. real interest rates in the early 1980s (for example, Blanchard and Summers, 1984, and Cecchetti, 1986). If money supply shocks are interpreted as reflecting the impact of monetary policy, the estimated decomposition of the *ex post* real rate suggests that monetary policy began to push up the real rate during the fourth quarter of 1979 and continued to contribute to the high level of exr through 1982. Apparently not until the fourth quarter of 1982 did the net contribution of monetary policy fall to zero. During the three-year period (1979QIV - 1982QIII), monetary policy actions added an estimated 2.6 percentage points to the real rate. To place this in perspective, exr, net of the estimated effects of credit controls, averaged 5.4 percent during this three-year period.

More surprising is the apparent effect of monetary policy in pushing exr above $e\hat{x}r$ during 1983 and 1984. For example, Cecchetti (1986) attributes high real rates in 1984 to fiscal policy (high expected future budget deficits) on the basis of evidence from the term structure of interest rates. From 1982QIV to 1984QIII, exr averaged 2.88 while $e\hat{x}r$ averaged only 0.97. Monetary policy is

Chart 3
Impact of Fiscal Shocks on the Real Rate



therefore estimated to have contributed almost 2 percentage points to exr during this period.

The estimated impact of fiscal policy is shown in Chart 3, where the path of the *ex post* real rate when the effects of defense spending shocks have been removed is shown. Fiscal policy is estimated to have raised exr throughout the 1979-1984 period. This rise reflects the increase in real defense expenditures that began in 1979 under President Carter and that continued under President Reagan. The average effect of fiscal policy during 1979QIV - 1982QIII was to raise exr 1.2 percentage points, roughly half the impact of monetary policy. Since the end of the 1981-82 recession, fiscal policy, as measured by defense spending shocks, has added 1.4 percentage points on average to exr.

V. Conclusions

This paper has attempted to address three empirical questions related to the behavior of nominal and real interest rates. The first asked whether a random walk component plays a role in the *ex ante* real rate of interest. Test results were consistent with the hypothesis that the real rate does contain a random walk component. However, they also indicated that the permanent effect of an unpredicted change in the real rate is probably relatively small, although the results showed that at least 12 percent of an unpredicted change would have a permanent effect on the real rate.

The second question concerned the respective importance of innovations to the expected rate of inflation and the expected real rate in accounting for innovations in the 3-month Treasury bill rate. Test results showed clearly that the division of nominal rate movements between real rate and expected inflation rate movements has changed quite dramatically during the last twenty-five years. In the 1970s, almost all unpredicted nominal rate changes were associated with variation in the expected rate of inflation. In contrast, unpredicted changes in the nominal rate during the first half of the 1980s

predominately reflected changes in the expected real rate of interest.

The third question addressed the role of fiscal and monetary shocks in explaining the high real rates of the 1980s. Decomposing the history of the *ex post* real rate into the independent contributions of various shocks provided a means of assessing the impact of monetary and fiscal effects. Using defense purchases by the federal government as a proxy for fiscal policy, the evidence suggests that monetary policy added just over 2 percentage points to the *ex post* real rate between 1979QIV and 1984QIII. Fiscal policy raised the *ex post* real rate on average just over 1 percentage point during this same period.

These results, however, were sensitive to the measure of fiscal policy employed. When total federal purchases of goods and services was used, fiscal policy was estimated to have added 450 basis points on average to the real rate between 1979QIV and 1984QIII. When the federal deficit was used, neither fiscal nor monetary policy was estimated to have contributed much to the behavior of the real rate over the same period.

Appendix

Part A

Table A.1 presents the outcomes of stationarity tests for the 3-month nominal Treasury Bill rate and the two measures of inflation. The test statistics indicate that the random walk hypothesis is not rejected for the nominal interest rate, with one exception: the nominal rate behavior during 1961QI - 1979QIII is consistent with that of a variable stationary around a constant trend. Since both i and π appear nontrend stationary for the sample period as a whole, the hypothesis of cointegration is tested; that is, does there exist some combination of i and π that is stationary? Can we find a constant α such that $\alpha i_t - \pi_{t+1}$ is stationary?

Engle and Granger (1987) propose several tests of cointegration based on the "co-integrating regression" of either i_t on π_{t+1} or π_{t+1} on i_t.[1] If the real after-tax rate of interest is stationary, then the coefficient on i_t in a regression of π_{t+1} on i_t should equal one minus the marginal tax rate. This coefficient should therefore be of the order of magnitude of 0.6 to 0.7. The reverse regression of i_t on π_{t+1}, should yield a consistent estimate of one over one minus the marginal tax rate, which should be in the approximate range 1.4 to 1.7.

Under the null hypothesis of no cointegration, the residuals from the cointegrating regression should be nonstationary. This implies that the Durbin-Watson statistic will approach zero. Thus, a "large" D-W indicates cointegration. In addition, the residuals can be subjected to standard tests for a random walk. Critical values from a Monte Carlo experiment are reported by Engle and Granger.

Results from the cointegrating regressions are reported in Table A.2. The column labeled CRDW gives the Durbin-Watson statistic, the D-F (for Dickey-Fuller) column gives the t-statistic from a regression of the first difference of the residuals on their lagged level, while the ADF column adds four lagged first differences to the residual regression.

The evidence for cointegration is mixed. For the 1961QI - 1979QIII period, none of the lagged first differences of the residuals is significant, so D-F provides the appropriate test, and both it and CRDW indicate rejection of no cointegration. When the post 1979QIII period is added to the sample, some of the lagged first differences are significant, suggesting the ADF statistic should be used. In all cases, this fails to reject no cointegration. The CRDW statistics rejects no cointegration when π_{t+1} is regressed on i_t but not when i_t is regressed on π_{t+1}. The estimates of the cointegration parameters (reported in the column labeled α) also yield mixed results. The estimated coefficient

1. Barsky [1987] discusses the effects of regressing i_t on lagged π_t's as proxies for $E_t\pi_{t+1}$ when inflation is stationary. However, the results in his Table 2 suggest that π is non-stationary for the 1960-1979 period.

in all odd numbered regressions should be around 0.7. Only equation 4 comes close.

Part B

The nominal interest rate innovation, $\hat{i}_t$, is simply the one-step ahead forecast error for the nominal bill rate as implied by the estimated VAR. The inflation forecast innovation, $E_t\hat{\pi}_{t+1}$, can also be obtained from the VAR in the following manner. Suppose z_t is the 6x1 vector of the variables in the VAR at time t. The VAR system can be written as

$$z_t = A(L)z_{t-1} + u_t \qquad (A.1)$$

where A(L) is a 6x6 matrix of polynomials in the lag operator L (that is, $A(L) = A_0 + A_1L + A_2L^2 + \ldots$ and $L^i x_t = x_{t-i}$), and u_t is the vector of one-step ahead forecast errors. Let s_π be a selection vector such that $s_\pi z_t = \pi_t$ (that is, s_π just picks out π from the list of variables in z). The equation for π_t is given by

$$\pi_t = s_\pi z_t = s_\pi A(L)\, z_{t-1} + s_\pi u_t. \qquad (A.2)$$

Equation A-2 can be used to evaluate $E_t\,\hat{\pi}_{t+1}$.

By definition, $E_t\hat{\pi}_{t+1} = E_t\pi_{t+1} - E_{t-1}\pi_{t+1}$. Updating A.2 by one, $\pi_{t+1} = s_\pi A(L)z_t + s_\pi u_{t+1}$ so that $E_t\pi_{t+1} = s_\pi A(L)z_t$. Similarly, $E_{t-1}\pi_{t+1}$ is equal to $s_\pi A_0 E_{t-1}z_t + s_\pi A_1 z_{t-1} + s_\pi A_2 z_{t-2} \ldots$ It follows that

Table A.1

Tests for a Random Walk Component in the Nominal Interest Rate and the Rate of Inflation[1]

A: Trend excluded

Variable	Sample Period	Test Statistic
3-month Treasury Rate	1961QI-1985QIII	−1.94
	1961QI-1979QIII	−1.95
	1970QI-1985QIII	−1.73
GNP Deflator	1961QI-1985QIII	−1.92
	1961QI-1979QIII	−1.34
	1970QI-1985QIII	−1.49
CPI	1961QI-1985QIII	−2.05
	1961QI-1979QIII	−0.85
	1970QI-1985QIII	−2.06

B: Trend included

Variable	Sample Period	Test Statistic
3-month Treasury Rate	1961QI-1985QIII	−2.64
	1961QI-1979QIII	−3.84*
	1970QI-1985QIII	−2.15
GNP Deflator	1961QI-1985QIII	−1.26
	1961QI-1979QIII	−2.95
	1970QI-1985QIII	−1.57
CPI	1961QI-1985QIII	−2.05
	1961QI-1979QIII	−3.26
	1970QI-1985QIII	−2.00

* Significant at the 5% level.

1. See notes to Table 1. The rate of inflation is measured as the first difference of the log of the price index.

$$E_t\pi_{t+1} - E_{t-1}\pi_{t+1} = s_\pi A_0 (z_t - E_{t-1}z_t) = s_\pi A_0 u_t \quad (A.3)$$

Thus, the revision to the inflation forecast is equal to a linear combination of the errors made in forecasting all the elements of z_t. Because $E_t\hat{\pi}_{t+1}$ depends on the one-step ahead forecast errors (u_t) and coefficients from the VAR (A_0), it is easily calculated from the estimated system.

Part C

The decomposition of the *ex post* real rate into components attributable to the various underlying shocks is based on the moving average representation of the VAR system given in equation A.1:

$$z_t = (I - A(L)L)^{-1}u_t = B(L)v_t \quad (A.3)$$

where $v_t = Gu_t$ is the orthogonalized vector of disturbances obtained from the VAR residual vector u_t, and $B(L) = (I - A(L)L)^{-1}G^{-1}$. Using the selection vector s_π to pick out the equation for π and s_i to pick out the equation for the nominal rate, the *ex post* real rate can be expressed as

$$\begin{aligned} exr_t &= s_i z_t - s_\pi z_{t+1} \quad (A.4)\\ &= s_i B(L)v_t - s_\pi B(L)v_{t+1}\\ &= \sum_q \sum_j b^{(i)}_{qj} v_{jt-q} - \sum_g \sum_j b^{(\pi)}_{qj} v_{jt+1-q} \end{aligned}$$

where $b^{(x)}_{ij}$ is the coefficient on the i^{th} lag of the j^{th} shock in $s_x B(L)$, $x = i, \pi$. The contribution of the j^{th} shock to exr_t is equal to

$$\sum_q (b^{(i)}_{qj} - b^{(\pi)}_{qj})\, v_{jt-q} - b^{(\pi)}_{0j}\, v_{jt+1}$$

The orthogonalized shocks were obtained using a

TABLE A.2

Tests of Long-Run Relationship Between the Nominal Rate and Inflation

Cointegrating Regression: $y_t = \alpha + \beta x_t$

Sample Period	y_t[1]	x_t	Test Statistics: α	CRDW[2]	D-F[3]	ADF[4]
1961Q1-1985QIII	i_t	π^1_{t+1}	0.54	0.33	−3.03	−1.75
	π^1_{t+1}	i_t	0.44	0.68*	−4.28*	−1.79
	i_t	π^2_{t+1}	0.42	0.40	−3.37*	−1.83
	π^2_{t+1}	i_t	0.60	0.72*	−4.56	−1.87
1961Q1-1979QIII	i_t	π^1_{t+1}	0.49	0.84*	−4.37*	−2.95
	π^1_{t+1}	i_t	1.19	1.23*	−5.57*	−2.97
	i_t	π^2_{t+1}	0.44	1.79*	−5.81*	−2.96
	π^2_{t+1}	i_t	1.64	1.36*	−6.03*	−2.45
1970Q1-1985QIII	i_t	π^1_{t+1}	0.19	0.23	−1.93	−1.56
	π^1_{t+1}	i_t	0.13	0.59*	−3.03	−1.40
	i_t	π^2_{t+1}	0.17	0.29	−2.13	−1.60
	π^2_{t+1}	i_t	0.26	0.68*	−3.54*	−1.76

1. Variables are the 3-month Treasury bill rate (i_t), the first difference of the log of the GNP Price Deflector (π^1_t), and the first difference of the log of the CPI (π^2_t)
2. 5 percent critical value given by Engle and Granger (1987) is 0.39.
3. 5 percent critical value given by Engle and Granger (1987) is 3.37.
4. 5 percent critical value given by Engle and Granger (1987) is 3.17.

Choleski decomposition based on the following ordering of the variables in the VAR: government purchases and defense expenditures were ordered first in their respective VARs, followed by real GNP, M1, the nominal interest rate, the relative price of fuel, and the rate of inflation. When the deficit was used, the ordering was real GNP, M1, the nominal interest rate, the relative price of fuel, the deficit and the rate of inflation.

For each ordering, the hypothesis that a given variable Granger-caused a variable ordered before it could be rejected. Note that when the monetary or fiscal shock is set equal to zero, the predicted path of the money supply or the fiscal variable will still vary endogenously in response to movements in the other variables in the system.

FOOTNOTES

1. See the discussion of real rate targeting in Walsh (1983).

2. By a random walk component I mean that a variable x_t can be written as $y_t + z_t$ where y_t is a stationary random variable and $z_t = z_{t-1} + \varepsilon_t$ when ε_t is a stationary process. Realizations of ε_t have permanent effects on z_t and x_t.

3. The test statistic does not have a standard t-distribution, but the appropriate critical values are given in Fuller (1976).

4. For nontechnical introductions to real business cycle theories, see Walsh (1986, 1987).

5. If all changes in a variable x_t are permanent, then the variance of $x_{t+k} - x_t$ is equal to k times the variance of $x_{t+1} - x_t$. If all changes in x_t are temporary, then the variance of $x_{t+k} - x_t$ should tend to zero for large k. Thus the ratio

$$\sigma_k = \frac{1}{k} \cdot \frac{\text{var}\,(x_{t+k} - x_t)}{\text{var}\,(x_{t+1} - x_t)}$$

is a measure of the relative importance of the random walk component. The ratio σ_k equals 1 for a pure random walk and zero if all changes are transitory. Cochran's method is evaluated in Campbell and Mankiw (1987).

6. Because the *ex post* real rate used to construct the measure of persistence is equal to the *ex ante* real rate plus a serially uncorrelated inflation forecast error, Cochrane's measure will yield a value of σ_k less than one for the *ex post* rate even if the *ex ante* rate is a pure random walk.

7. For discussions of the use of the nominal interest rate in the conduct of monetary policy, see Sargent and Wallace (1975), McCallum (1986), and Goodfriend (1987).

8. From the properties of conditional expectations,

$$E_{t-1}(E_t\pi_{t+1}) = E_{t-1}\,\pi_{t+1}.$$

9. See Litterman and Weiss (1985).

10. Dummy variables for 1980QII and 1980QIII were also included to capture the effects of the credit controls in effect at that time. The use of defense expenditures as a proxy for fiscal policy is discussed in Section III; the general conclusions in this section were not affected when other proxies were used.

11. From equation 5, $\hat{r}_t$ is just equal to $\hat{i}_t - E_t\hat{\pi}_{t+1}$. This also implies that var $(\hat{i}_t)$ = cov $(\hat{i}_t, \hat{r}_t)$ + cov $(\hat{i}_t, E_t\hat{\pi}_{t+1})$. The fraction of nominal rate innovation variance associated with real rate innovations can then be estimated by cov $(\hat{i}_t, \hat{r}_t)$ / var $(\hat{r}_t)$. The fraction of var $(\hat{i}_t)$ associated with revisions in expected inflation is thus 1 − cov $(\hat{i}_t, \hat{r}_t)$ / var $(\hat{i}_t)$ = cov $(\hat{r}_t, E_t\hat{\pi}_{t+1})$ / var $(\hat{i}_t)$. Since var $(\hat{i}_t)$ = var $(\hat{r}_t)$ + var $(E_t\hat{\pi}_{t+1})$ + 2 cov $(\hat{r}_t, E_t\hat{\pi}_{t+1})$, the measure used to estimate the fraction of var $(\hat{i}_t)$ associated with $\hat{r}_t$ is not equal to var $(\hat{r}_t)$ / var $(\hat{i}_t)$ unless cov $(\hat{r}_t, E_t\hat{\pi}_{t+1}) = 0$. In fact, cov $(\hat{i}_t, \hat{r}_t)$ = var $(\hat{r}_t)$ + cov $(\hat{r}_t, E_t\hat{\pi}_{t+1})$, so the measure used here is equal to var $(\hat{r}_t)$ / var $(\hat{i}_t)$ + cov $(\hat{r}_t, E_t\hat{\pi}_{t+1})$ / var $(\hat{i}_t)$.

12 Based on a VAR estimated using quarterly data from 1949QII to 1983QII, Litterman and Weiss (1985) report that a 1-percent innovation to the nominal rate was, on average, associated with a .56 percent real rate innovation and a .44 percent expected inflation innovation, exactly the same division reported in Table 2 for the 1961Q1-1984QIII period. Note that, while the actual estimation period runs to 1984QIV, one observation is lost in calculating the realized future rate of inflation needed to form the *ex post* real rate.

13. For a discussion of this view, see Barro (1984, Chapter 15). Some empirical evidence is presented in Motley (1987).

14. The estimated effects of the 1980 credit controls have been subtracted out of the real rate series plotted in both Chart 2 and Chart 3.

REFERENCES

Antoncic, Madelyn. "High and Volatile Real Interest Rates: Where Does the Fed Fit In?," *Journal of Money, Banking and Credit*, Vol. 18, No. 1 (February 1986).

Barro, Robert J. *Macroeconomics*. New York: John Wiley and Sons, 1984.

Barsky, Robert B. "The Fisher Hypothesis and the Forecastability and Persistence of Inflation," *Journal of Monetary Economics*, Vol. 19, No. 1 (January 1987).

Blanchard, Olivier and Lawrence Summers. "Perspectives on High World Real Interest Rates," *Brookings Papers on Economic Activity*, 1984:2.

Campbell, John Y. and N. Gregory Mankiw. "Permanent and Transitory Components in Macroeconomic Fluctuations," *American Economic Review*, Vol. 77, No. 2 (May 1987).

Cecchetti, Stephen G. "High Real Interest Rates: Can They be Explained?," *Economic Review*, Federal Reserve Bank of Kansas City, September/October 1986.

Cochrane, John H. "How Big is the Random Walk in GNP?", mimeo, February 1986.

Dickey, David A. and Wayne A. Fuller. "Likelihood Ratio Statistics for Autoregressive Time Series with a Unit Root," *Econometrica*, Vol. 49, No. 4 (July 1981).

Engle, Robert F. and C.W.J. Granger. "Co-Integration and Error Correction: Representation, Estimation and Testing," *Econometrica*, Vol. 55, No. 2 (March 1987).

Fama, Eugene. "Short-Term Interest Rates as Predictors of Inflation," *American Economic Review*, Vol. 65 (1975).

Fuller, Wayne A. *Introduction to Statistical Time Series*. New York: John Wiley and Sons, 1976.

Goodfriend, Marvin. "Interest Rate Smoothing and Price Level Trend Stationarity," *Journal of Monetary Economics*, Vol. 19, No. 3 (May 1987).

Granger, C.W.J. "Developments in the Study of Cointegrated Economic Variables," *Oxford Bulletin of Economics and Statistics*, Vol. 48, No. 3 (August 1986).

Hendry, David F. "Econometric Modelling with Cointegrated Variables: An Overview," *Oxford Bulletin of Economics and Statistics*, Vol. 48, No. 3 (April 1986).

Huizinga, John and Frederic S. Mishkin. "Monetary Policy Regime Shifts and the Unusual Behavior of Real Interest Rates," in Carnegie-Rochester Conference Series on Public Policy, 24 (Spring 1986).

Jenkins, Paul and Carl E. Walsh. "Real Interest Rates, Credit Markets, and Economic Stabilization," *Journal of Macroeconomics*, Vol. 9, No. 1 (Winter 1987).

Litterman, Robert B. and Laurence Weiss. "Money, Real Interest Rates, and Output: A Reinterpretation of Postwar U.S. Data," *Econometrica*, Vol. 53, No. 1 (January 1985).

McCallum, Bennett T. "Some Issues Concerning Interest Rate Pegging, Price Level Determinacy, and the Real Bills Doctrine," *Journal of Monetary Economics*, Vol. 17, No. 1, January 1986.

Motley, Brian. "Ricardo on Keynes: Does Government Debt Affect Consumption?", *Economic Review*, Federal Reserve Bank of San Francisco, Winter 1987.

Nelson, Charles R. and Charles I. Plosser. "Trends and Random Walks in Macroeconomic Time Series: Some Evidence and Implications," *Journal of Monetary Economics*, Vol. 10, No. 2 (September 1982).

Rose, Andrew K. "Is the Real Rate Stable?" mimeo, April 1987.

Walsh, Carl E. "Should the Federal Reserve Establish a Real Interest Rate Target?", *Economic Review*, Federal Reserve Bank of Kansas City, June 1983.

Walsh, Carl E. "New Views of the Business Cycle: Has the Past Emphasis on Money Been Misplaced?", *Business Review*, Federal Reserve Bank of Philadelphia, January/February 1986.

Walsh, Carl E. "Real Business Cycles," *Weekly Letter*, Federal Reserve Bank of San Francisco, January 30, 1987.

Wilcox, James A. "Why Real Interest Rates Were So Low in the 1970s," *American Economic Review*, Vol. 73, No. 1 (March 1983).

Off-Balance Sheet Banking

Christopher James*

Commercial loan sales and the issuance of Standby Letters of Credit (SLCs) involve the separation of many of the services associated with lending, such as credit risk evaluation and underwriting, from the funding of a loan. These activities are shown to provide banks a way of issuing collateralized debt claims. This ability can induce banks to undertake profitable loan opportunities they would not undertake if restricted to deposit financing. Moreover, the incentives to issue collateralized claims increase when capital requirements are raised. Empirical evidence suggests that loan sales and SLCs are not important determinants of bank risk.

Over the past decade, there has been a dramatic increase in what is called "off-balance sheet" banking. Examples include the issuance of Standby Letters of Credit (SLCs) and commercial loan sales. These activities have the common feature of separating many of the services associated with lending, such as credit risk evaluation and underwriting, from the funding of a loan. By separating the funding of a loan from these other activities, a bank earns fee income without putting an asset or corresponding liability on its balance sheet.

This paper examines two questions pertaining to commercial loan sales and the issuance of SLCs. The first concerns the regulatory and other economic factors that induce a bank to separate the funding of a loan from the other services associated with lending. The most frequently cited explanation for the growth of these activities is that they provide banks a way of avoiding reserve requirements and bank capital adequacy requirements.

While these regulations may provide incentives to go "off-balance sheet," nonregulatory factors are also important. In particular, as Benveniste and Berger (1986) show, SLC-backed loans and commercial loan sales have payoff characteristics that are similar to secured or collateralized debt. This observation suggests that the incentive banks have to sell loans or to issue SLCs may be similar to the incentives other financial as well as nonfinancial firms have to issue secured debt. How bank regulation affects the incentives to issue collateralized debt and the linkage between capital requirements and off-balance activities are also explored.

A second and related question concerns the effect of loan sales and SLC issues on the default risk of deposits (borne by uninsured depositors and/or the FDIC). The effects of off-balance sheet activities on the risk of deposits depends on the reasons banks undertake those activities. For example, one explanation for the growth of off-balance sheet banking is that it is a manifestation of a moral hazard problem that is endemic to a system of fixed rate deposit insurance pricing. Because SLCs and certain loan sales are not subject to capital requirements, these contingent liabilities provide a way for a bank to increase leverage. By increasing leverage, a bank can generate or enhance subsidies arising from deposit insurance. This argument implies that off-balance sheet activities increase the risk of deposits.

An alternative explanation, examined in this paper, is that loan sales and SLC issues permit banks to engage in lending that they would find unprofitable to undertake if they were restricted to funding loans through deposit financing. This argument implies that off-balance sheet activities may enhance bank profitability and reduce bank risk.

The effect of loan sales and SLC issues on bank risk therefore is an empirical issue. To address this

* Visiting scholar Federal Reserve Bank of San Francisco. Thanks to Bill Robertson for research assistance.

issue, the relation between the interest rate paid on bank large CDs (greater than $100,000) and bank asset risk, financial leverage, the volume of SLCs, and loan sales is examined. The results reveal that the risk premium of large CDs increases with asset risk and financial leverage. However, no significant relation is found between the rate paid on CDs and either the volume of SLCs issued or loans sold. This suggests that SLCs and loan sales are not an important determinant of bank risk as perceived and priced by large depositors.

The paper is organized as follows. In Section I, I describe the market for SLCs and commercial loan sales. In Section II, the reasons for the use and growth of SLCs and loan sales are discussed. In Section III, the effects of loan sales and SLCs on bank risk are examined empirically. Section IV provides a summary.

I. The Market for Commercial Loan Sales and SLCs

Commercial loan sales involve the sale of newly originated commercial loans. Most commercial loan sales are structured contractually as participations so that the selling bank maintains a creditor-debtor relationship with the borrower.[1] This means that the selling bank continues to be responsible for servicing the loan, enforcing covenants, monitoring the financial condition of the borrower, and handling workouts and other problems that might arise in the event of default. In exchange for performing these services, the selling bank is compensated through a "spread." The spread represents the difference between the rate paid by the borrower to the bank and the return promised the purchaser of the loan. An average spread of 15 basis points was reported on commercial loan sales in the June 1, 1987 Senior Loan Officer Lending Practices Survey (LPS).

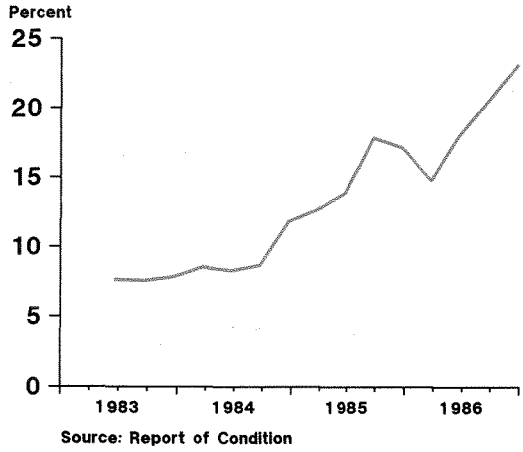
Current bank regulations require that loans sold with recourse (that is, with an issuing bank's guarantee against default) be treated as assets when calculating capital requirements. Moreover, the proceeds of loans sold with recourse are subject to reserve requirements. As a result of these regulations, commercial loans are rarely sold with recourse.[3]

While loans sold without recourse avoid reserve requirements and capital requirements, they raise concerns with the purchaser regarding both the quality of loans sold (an adverse selection problem) and the diligence with which the selling bank will monitor the borrower after a sale (a moral hazard problem). One technique used to provide the purchaser a credible assurance of quality is for the selling bank to maintain or fund a portion of the loan sold. A second technique involves selling short-term "strips" of longer term loans. While the buyer of the strip is exposed to default risk in the short-run, before the maturity date of the strip, the originating bank retains exposure to default in the longer run if it is committed to re-financing the loan. Finally, because most commercial loans sold are short-term and selling banks return repeatedly to the market, "reputational" capital (that is, the value of future earnings, which depend on honest dealing) may provide a mechanism for assuring quality (Gorton and Haubrich, 1987, make this argument).

Information on the volume of commercial loans sold indicates a dramatic increase in sales over the past few years. Information on the volume of loan sales comes primarily from two sources: Schedule L of the Call Report and periodic Senior Loan Officer Opinion Surveys on bank lending practices (LPS) conducted by the Federal Reserve System. Information from the Call Report indicates total loans sold increased from $23 billion in 1983 to $111 billion in 1986; an increase of 326 percent. A similar pattern of growth is observable in the LPS survey data. In November 1984, LPS respondents reported less than $5 billion in sales. By March 1987, sales of 37.5 billion were reported. Chart 1 shows the growth in loan sales (as reported in the Call Report) relative to commercial and industrial (C&I) loans outstanding over the 1984 through 1986 period. Loan sales have grown from about 7 percent of C&I loan volume to almost 25 percent of C&I loan volume over this period.

Chart 1

Commercial Loan Sales Have Grown as a Percent of Total C & I Loans



Source: Report of Condition

The SLC Market

SLCs are similar to loan sales in that they also involve a separation of many of the services associated with a commercial loan from the funding of the loan. An SLC is a guarantee by a bank to pay one party (called the beneficiary) if the bank's customer (called the account party) fails to repay a loan or perform some other contractual obligation (for a description of the SLC market see Bennett, 1986, or Koppenhaver, 1987). Because the bank's obligation is contingent on the default or nonperformance of the account party, most SLCs expire unused. For example, a special survey conducted by the staff of the Federal Reserve Board found that defaults by account parties constituted only 2.03 percent of SLCs outstanding in 1978. (Bank losses were much smaller because 98 percent of payments made were recovered from account parties.)

The majority of SLC issues are used to back financial contracts such as commercial paper, municipal bonds and direct loans. Because the issuing bank assumes the credit risk associated with an SLC-backed loan, the bank has the same incentive to evaluate and monitor the credit risk of the borrower as if it had funded the loan. SLCs therefore provide a bank the opportunity to realize its comparative advantage in obtaining and processing credit information without funding the loan.

As discussed in the next section, the payoff or cash flow characteristics of an SLC-backed loan are identical to a loan sale with full recourse. However, unlike loan sales, SLCs are not, under current capital regulation, considered when calculating capital requirements. Under risk-based capital standards recently proposed by the Federal Reserve Board however, SLCs would be treated the same as loans sold with recourse when calculating capital adequacy requirements.[4]

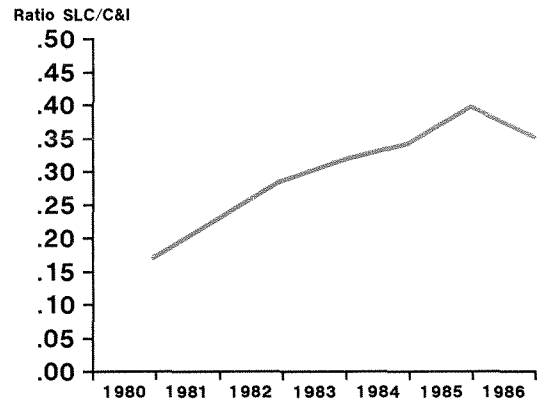
Like the commercial loan sales market, the volume of SLCs has grown rapidly in recent years. For example, since 1980, SLCs outstanding have grown at an annual rate of 20 percent, from $47 billion to $169 billion in 1986. Chart 2 shows the growth of SLCs relative to C&I loans over the 1980 through 1986 period. As Chart 2 reveals, SLCs have grown faster than C&I loans during the 1980s.

Payoff Characteristics

It is useful when analyzing the reasons for loan sales and SLC issues to begin by evaluating the payoff or cash flow characteristics of these activities because they determine when a bank will undertake those activities. Specifically, the focus is on factors that affect the cash flows received by the purchaser of a loan or the beneficiary (lender) in an SLC-

Chart 2

SLCs Have Grown Faster Than C & I Loans



Source: Report of Condition

backed loan. The promised rate the purchaser or beneficiary will require depends on the expected cash flows, and determines the profitability of a loan sale or SLC issue for the bank.

The payoff characteristics of SLC loans and loan sales with recourse, as Benveniste and Berger (1986) have shown, are similar to the cash flow characteristics of secured or collateralized debt.[5] Consider first a loan sale made with recourse. (The effect of removing the recourse provision on the cash flows will be discussed later.) The loan sold is the primary source of cash flows to the purchaser. In the event of a default on the loan, the purchaser still receives the contracted payment as long as the selling bank does not fail. SLC-backed loans operate in a similar fashion. The primary source of cash flows is the loan funded. The lender receives less than the contracted rate on the loan only when the borrower defaults *and* the bank fails. If the bank could issue uninsured deposits secured by a specific loan, precisely the same factors would determine cash flows to secured depositors. Specifically, the secured depositor would receive less than the contracted payment only when the bank failed and the cash flows on the loan serving as collateral were less than the contracted payment due on the debt.

Loans sales with recourse and SLC-backed loans are therefore functionally equivalent to secured debt and should have the same expected rate of return in a competitive market. The payoff characteristics of loan sales without recourse depend solely on the cash flows of the underlying loan because the selling bank issues no guarantee in the event of default. Because banks are generally prohibited from issuing collateralized deposits or debt, loan sales and SLCs provide effective substitutes.[6]

II. Reasons for SLCs and Loan Sales

The reasons for the growth and use of loan sales and SLCs can be divided into two groups: regulatory and non-regulatory explanations (although the explanations are not mutually exclusive). Regulatory explanations focus primarily on the incentives capital adequacy requirements, reserve requirements, and deposit insurances provide for issuing SLCs or selling loans. The nonregulatory explanations focus on why these activities might take place even in the absence of bank regulation and deposit insurance. Both sets of explanations explain why banks have begun increasingly to unbundle funding from other lending activities.

Regulatory Motives

Two hypotheses have been made concerning how regulation affects off-balance sheet banking: the *regulatory tax hypothesis* and the *moral hazard hypothesis*.

The *regulatory tax hypothesis* (see Pennacchi, 1987, and Pavel and Phillis, 1987), argues that loan sales and SLCs are responses to burdensome regulatory taxes. In particular, it says that the cost of holding noninterest-earning reserves, the need to meet capital requirements, and the level of deposit insurance premiums raise the cost of funds for a bank above what nonbank institutions must pay. Therefore, while a bank may have a comparative advantage in originating and servicing loans, regulatory taxes prevent it from profitably funding certain types of loans.

This argument implies that the cost of bank regulation exceeds the benefits banks receive from access to deposit guarantees and the Federal Reserve's discount window, that is, that deposit insurance is overpriced when regulatory taxes are considered.

While reserve requirements unambiguously increase the cost of bank funds, the effect of capital requirements is not well understood. In a world without taxes and transaction and agency costs (the costs of controlling potential conflicts between bondholders and stockholders as well as between managers and outside investors), the cost of financing a loan would be independent of a bank's capital structure (the mixture of debt and equity used). This is the famous Modigliani and Miller (1958) proposition concerning corporate capital structure. Introducing agency costs, personal and corporate taxes have been shown to yield an optimal capital structure (see, for example, Miller, 1977, and Barnea, Haugen and Senbet, 1981).

Given these costs, if the maximum debt to equity ratio set by the regulators is below what banks would hold in the absence of regulation (and deposit insurance), then capital requirements might serve to raise the cost of bank financing above that of nonbank institutions. However, because the debt to equity ratio for banks generally exceeds that of other financial institutions (and nonfinancial firms), it is unclear in what way capital requirements impose a tax on banks.

An alternative hypothesis concerning how regulation and deposit insurance influence off-balance sheet activities is the *moral hazard hypothesis*. This hypothesis focuses on the incentives a bank has to increase asset risk and financial leverage when deposit insurance is provided at a fixed price. By increasing leverage or the risk of its assets, a bank can generate or enhance the subsidies associated with fixed rate deposit guarantees. Under existing regulation SLCs are excluded from capital requirements. Therefore, by issuing SLCs, a bank can increase its financial leverage and enhance whatever subsidies it receives from the deposit insurer.

As Pyle (1985) and others have argued, fixed rate deposit insurance together with capital requirements provide incentives to undertake "off-balance sheet" activities that increase financial leverage. Moreover, by selling relatively low risk loans and maintaining riskier loans in its portfolio, a bank can increase risk and therefore raise the subsidy deposit insurance provides. The moral hazard hypothesis predicts that off-balance sheet activities will increase bank risk.

While regulation may enhance incentives for a bank to engage in off-balance sheet activities, it is unlikely that bank regulation is solely responsible. Several institutional facts support this conjecture. First, nonbank financial institutions, which are not subject to the same regulatory taxes and do not issue insured deposits, are active participants in the loan sales and financial guarantee markets. For example, General Motors Acceptance Corporation (GMAC) sold over $7 billion in loans during 1986.[8] In addition, insurance companies issue financial guarantees that compete directly with bank-issued SLCs. The volume of these guarantees, according to Hirtle (1987), has grown at approximately the same rate as bank-issued SLCs (that is, 20 percent per year since 1980).

Moreover, according to recent LPS surveys, a significant portion of loans sold are purchased by other commercial banks. For example, in 1985, approximately half of the loans sold were purchased by other domestic commercial banks (and 36.5 percent were purchased by banks with assets of over $1 billion). The 1987 Survey indicates that 35 percent of commercial loans sold were purchased by other domestic banks. Because most banks (and all banks over $1 billion in assets) are subject to the same marginal reserve requirement on deposits and money center banks (the primary sellers of loans) generally hold less capital than do other banks, it is unclear why the regulatory tax burden should be higher for financing the *same* loan for money center banks than for regionals.[9]

Nonregulatory Motives

Nonregulatory motives may also provide incentives for separating funding from other lending activities. SLC issues and loan sales facilitate interest rate risk management and loan portfolio diversification (see, for example, Pavel and Phillis, 1987, and Koppenhaver, 1987). SLCs permit banks to separate the interest rate risk from the credit risk associated with a loan. With an SLC issue, a bank can underwrite the credit risk while the beneficiary or purchaser bears the risk of any change in the value of the loan caused by unanticipated changes in interest rates. Loan sales also permit banks to invest in and diversify across a different set of loans than they originate and service.

A problem with this set of explanations is that it is unclear why bank stockholders would reward bank management for these activities when presumably they can diversify their own portfolios or hedge interest rate risk themselves.[10]

Collateralization as a Motive

A second set of nonregulatory explanations for loan sales and SLC issues is that such activities permit banks to issue a collateralized claim. As shown in Section II, loan sales and SLC-backed loans have payoff characteristics similar to secured debt. Therefore, banks may sell loans and issue

SLCs for the same reasons nonfinancial as well as nonbank financial corporations issue collateralized claims. Moreover, as discussed later, fixed price deposit insurance and capital requirements can increase the incentives for banks to issue collateralized claims.

Stulz and Johnson (1985) have analyzed the economic rationale for secured debt issues by nonfinancial firms. One hypothesis they studied argues that firms can effect a wealth transfer from unsecured debtholders to the firms' shareholders by increasing the default risk of unsecured debt. This shift occurs when a firm unexpectedly issues secured debt using existing assets as collateral. By providing secured debtholders a higher priority claim to the cash flows from some of the firm's *existing* assets, the remaining unsecured claimants are worse off. (This is similar to the moral hazard hypothesis discussed earlier.) As Stulz and Johnson point out, if this were the primary reason secured debt is used, unsecured debt would contain convenants prohibiting secured debt issues.[11]

An alternative hypothesis, referred to by Stulz and Johnson as the *underinvestment hypothesis*, is that the ability to issue secured debt can affect a firm's investment policy and therefore the size of the firm's cash flows as well as how cash flows are distributed among claimants. In particular, the ability to issue collateralized debt may enable a firm to undertake profitable *new* investment opportunities that it would pass up if constrained to issue unsecured debt. This can occur when the firm has risky debt outstanding that pays a contractually fixed rate of interest. The promised payment on *new* unsecured debt will reflect the uncertainty concerning the cash flows associated with the firm's existing assets as well as the newly acquired asset. However, if secured debt were used to finance a new project, the contracted rate would primarily reflect the uncertainty concerning the cash flows associated with the *new* investment opportunity. If the new investment were relatively low risk, the cost of secured debt would also be lower than the cost of unsecured debt. Therefore, the firm may undertake a project using secured debt that it would pass up if constrained to issue unsecured claims.

A similar argument can be made for the use of off-balance sheet activities by commercial banks. To determine when a bank will find it advantageous to engage in off-balance sheet activities requires knowledge of when the cost of financing a new loan will be less using a loan sale or an SLC than using deposits. In addition, to determine how off-balance sheet activities affect the risk of bank deposits requires examining how these activities affect the types of loans a bank will make.

To abstract from the effects of bank regulation and deposit insurance, these questions are examined first in the context of a deregulated environment without deposit insurance; examination of the effects of insurance and regulation follows.

Cost of Financing

The effects of collateralization on the cost of financing is analyzed in the context of a two-period model. A bank makes a new loan at time $t=0$ and realizes cash flows at time $t=1$. The new loan has payoffs denoted as $a_2(s)$, that is, cash flows are contingent on the state of the world, "s", at time $t=1$. For simplicity, the new loan is assumed to have a face value of $1. The bank is also assumed to have "booked" loans with payoffs at time $t=1$ of $a_1(s)$. Booked loans have been financed with a mixture of deposits and equity.

If the new loan were financed by issuing deposits promising a payment of r_d at time $t=1$, then the realized payment to new depositors in any state would be

$$\min \{r_d, \frac{r_d}{L_d} [a_1(s) + a_2(s)]\} \quad (1)$$

where L_d equals the sum of contracted payments to depositors. New depositors will receive the contracted payment, r_d, if the bank does not default; in the event of default, they receive a proportion of the cash flows from the bank's assets.

Suppose that instead of deposit financing, the new loan is sold with recourse. The contracted or promised payment to the purchaser of the loan is r_{sr} (this represents 1 plus the contracted interest rate). This contracted payment will generally be less than the rate the bank charges on the loan sold — the difference representing the bank's "spread." The realized payments to the purchaser of the loan will

depend on the promised rate or r_{sr} and the payments the purchaser receives in the event of default on the loan sold and the selling bank's failure. Denoting the cash flows associated with the underlying loan sold as $a_2(s)$, the realized payoff to the loan purchaser for a given state is

$$\min \left[r_{sr}, a_2(s) + a_1(s) \frac{r_{sr}}{L_{sr}}\right] \quad (2)$$

where L_{sr} equals the sum of the contracted payments to the loan purchaser and depositors. In words, when no default occurs, the loan purchaser receives the contracted payment r_{sr}. In the event of the bank's failure, the purchaser receives r_{sr} when the cash flows from the loan are sufficient to meet the contracted payment. When not, the purchaser receives the cash flows from the loan sold, $a_2(s)$, plus a proportion of the cash flows from the bank's other assets. As discussed in Section II, expression 2 also describes the cash flows to the lender in the case of an SLC-backed loan and the cash flow characteristics of a secured deposit claim.

The expression for the realized cash flows for a loan sold with partial recourse is more complex. Let α represent the proportion of the loss guaranteed. The realized cash flow to the purchaser is

$$\min \left[r_{sr}, a_2(s) + \min \left\{\alpha[r_{sr} - a_2(s)], \alpha \frac{r_{sr} - a_2(s)}{L_{sr}} a_1(s)\right\}\right] \quad (3)$$

In words, the purchaser receives either the contracted payment r_{sr} or, in the event of default, the cash flows from the loan plus either reimbursement for losses or a proportional claim on the bank's other assets. When no recourse is provided, α equals zero and the realized cash flows become simply

$$\min [r_{sr}, a_2(s)] \quad (4)$$

In this case, the rate paid by the purchaser depends solely on the characteristics of the new loan sold.

By comparing the payoff characteristics of new deposits (expression 1) to the payoff characteristics of a loan sale or SLC-backed loan (expressions 2 or 3), one can determine when the rate paid on collateralized debt will be less than the rate on deposits. Specifically, when investors are risk neutral, r_{sr} will be less than r_d if and only if (1) there is some positive probability of bank failure with deposit financing (that is, deposits are risky) and (2) in the event of default, the cash flows collateralized debtholders receive are larger than the cash flow new depositors would receive in the event of bankruptcy. That is,

$$\min \left[r_{sr}, a_2(s) + a_1(s) \frac{r_{sr}}{L_{sr}}\right] > \frac{r_d}{L_d} [a_1(s) + a_2(s)] \quad (5)$$

or, for a nonrecourse loan sale:[12]

$$\min [r_{sr}, a_2(s)] > \frac{r_d}{L_d} [a_1(s) + a_2(s)] \quad (6)$$

The left hand side of expression 5 is what secured depositors receive, and the right hand side is what uninsured depositors would receive in the event of default. Intuitively, if investors were risk-neutral, the *expected return* on deposits and secured debt must be equal. For the contracted rate on collateralized debt (that is, the promised payments investors receive when default does not occur) to be less than the rate paid on deposits, collateralized debtholders (or loan purchasers) must expect higher payments in the event the bank fails. This condition is expressed in 5 or 6.

Note that the above discussion suggests that the difference between r_{sr} and r_d will be greater the higher the probability of bank failure (that is, the riskier a bank's deposits) and the lower the risk of the collateral (that is, the default risk of the new loan). This suggests that collateralization provides the greatest benefit for high-risk banks investing in low-risk loans (that is, investment grade credits).

Types of Loans

How does issuing SLCs or selling loans affect a bank's investment policy, that is, the types of loans it will make? The effect can be illustrated by the following example. Suppose a bank has a portfolio of risky loans and has risky deposits outstanding (deposits with a positive probability of default). Ignore deposit insurance for the moment. The con-

tracted rate the bank must pay on deposits will reflect the risk of default.

Assume that the bank has an opportunity to invest in a new loan that has a positive net present value and yields a safe or certain return. If the new loan were financed by issuing additional deposits, investing in the loan would reduce the risk of existing deposits (since they receive a proportional claim in the cash flows of the new loan). If the existing deposits pay a contractually fixed interest rate, the market value of the deposits would increase because the new loan lowers the likelihood of bankruptcy and increases the level of the bank's cash flows. This outcome implies that old or existing depositors gain. Moreover, these depositors' gain lowers the return bank shareholders receive from making the new loan. The lower return to shareholders reduces their incentives to make new relatively low risk loans. This transfer is illustrated numerically in the box (Case 1).

Selling loans or issuing SLCs provides a bank an incentive to undertake low risk loans by reducing this transfer. Recall that the promised rate on collateralized debt, r_{sr} (or loan sales and SLC-backed loans), will be lower than the rate paid on new deposits when the payoffs to secured debtholders are larger in the event of bank failure (that is, expression 5 or 6 holds). However, this implies that, in the event of failure, existing depositors would receive less than if new deposit claims were issued. Therefore, if the contracted rate on secured debt is less than the rate on deposits (that is, expression 5 holds), the gain existing depositors realize is less, and the return to shareholders is larger when secured debt is

Box 1

Numerical Example of the Underinvestment Problem and the Effect of Collateralization

A bank with risky deposits outstanding may pass up profitable new investment opportunities in what has been termed an *underinvestment problem*. The following example is intended to show how secured debt, loan sales or SLC issues can alleviate this problem. In the example, deposit insurance and bank regulation are ignored. In addition, all investors are assumed to be risk-neutral, and the risk-free rate is assumed to be 10 percent.

A bank currently (at time $t=0$) has "booked" loans that pay off in one period (time $t=1$). The loans are risky in that their cash flows depend upon the state of the world at time $t=1$. The cash flow characteristics of the "booked loan" are provided below:

Cash Flow of "Booked Loan"

State	Payoff
1	$ 0
2	$ 0
3	$10

Only three states are possible and each is assumed to be equally likely to occur. If the promised payment to depositors in each state is $9.00, then the market value of deposits is $2.73 at $t=0$ ($9.00 × .333 ÷ 1.1), and the market value of equity is $.30.

Now suppose the bank has an opportunity to invest a new loan at time $t=0$ *after* it invested in the "booked" loan and issued deposits. Assume that the new loan has the following cash flow characteristics;

Cash Flow of New Loan

State	Payoff
1	$10
2	$10
3	$10

The market value of the new loan is $9.09. Suppose because of luck, an established customer relationship, or some other fortuitous circumstance, the loan can be acquired for only $8.00. In other words, the loan is a positive net present value investment.

Case 1: New Deposits Are Issued

If new deposits were issued to finance the loan, they must yield an *expected* return of 10 percent. If $8.00 of new deposits were issued to finance the loan, the bank must *promise* payments (in the absence of deposit insurance) of $17.47 to new depositors for the *expected* return on deposits to be 10 percent*. The realized payoffs to "new" depositors and existing or "old" depositors and the market value of the payments are provided below.

Notice that the value of existing deposits increases when the new loan is undertaken (from $2.70 to $4.12) but that *all* cash flows now are divided among depositors. As a result, the value of equity drops to zero. The bank therefore will not finance this loan with deposits even though it has a positive net present value.

Realized Payoffs — New Deposits

State	Total Cash Flow	Payoff "New" Depositors	Payoff "Old" Depositors
1	$10.00	$ 6.60	$3.40
2	$10.00	$ 6.60	$3.40
3	$20.00	$13.20	$6.80
Market Value at t=0	$12.12	$ 8.00	$4.12

Case 2: Collateralized Debt Is Issued

A bank could also finance the new loan by issuing debt secured by the cash flows from the new loan. Because the cash flows associated with the new loan are riskless, the promised payment to secured debtholders will be $8.80 (to yield an expected return of 10 percent). The payoffs to the various bank claimants are given below:

Notice that by issuing secured debt to finance the loan, the value of equity increases. The bank would therefore make the loan. In addition, notice that the value of existing deposits also increases. In this example, issuing secured debt makes both depositors and shareholders better off.**

Realized Payoffs — Collateralized Debt

State	Total Cash Flows	Payoff Secured Debt Holders	Payoff Depositors	Payoff Stockholders
1	$10.00	$8.80	$1.20	0
2	$10.00	$8.80	$1.20	0
3	$20.00	$8.80	$9.00	$2.20
Market Value at time t=0	$12.12	$8.00	$3.45	$ .67

* The contracted payment of $17.47 is computed by using Expression (1) in the text.

** When deposits are insured or partially insured, a portion of the benefits accrue to the FDIC. In this example, as long as the bank must pay a contracted rate that exceeds the risk-free rate, it will prefer issuing secured debt or selling loans to new deposits as the means of financing new loans.

issued. Case 2 in the Box provides a numerical illustration.

An alternative and perhaps more intuitive explanation for how issuing collateralized claims affects investment policy is that the rate on an SLC-backed loan or loan sale will reflect primarily the risk of the new loan (in the case of a nonrecourse loan sale, the rate reflects only the risk of the new loan). The rate paid on uninsured deposits will reflect the average risk of the bank's loan portfolio. Therefore, the cost of financing a relatively low risk loan will be less with loan sales or SLCs than with deposit claims.

Deposit Insurance

The above discussion is intended to show why a bank might issue SLCs and sell loans even in the absence of regulation and deposit insurance. Introducing deposit insurance does not affect the basic conclusions as long as the rate paid on deposits, including insurance premiums and regulatory taxes, exceeds the risk-free rate. With fixed rate deposit insurance, the rate on existing deposits will not adjust fully to reflect the marginal contribution of the new loan to the overall risk of the bank. Indeed, with complete, that is, 100 percent, insurance, the cost of deposits does not adjust at all to changes in asset risk. Therefore, a bank with risky deposits outstanding will tend to *underinvest* in relatively low risk loans and *overinvest* in high risk loans. This phenomena is referred to as the underinvestment problem (see Myers, 1977).

It is important to point out that capital requirements can exacerbate the underinvestment problem and enhance incentives to go "off balance sheet." By increasing the amount of equity required to finance new loans, the gain both existing uninsured depositors and the FDIC receive from a bank that undertakes a new low risk loan increases (because increased capital requirements lowers the risk of new loans to depositors). Therefore, as capital requirements are raised (as they were in 1981) loan sales and SLC issues would be expected to increase.

Implications

The collateralization argument points out an important aspect of off-balance sheet activities and restrictions on bank financial policy generally: The financing techniques available to a bank affect its investment policy and therefore its overall profitability. This implication is similar to an implication of the regulatory tax hypothesis in that both imply that off-balance sheet activities may permit banks to engage in investment opportunities that they might pass up if constrained to use deposit financing.

Moreover, unlike the moral hazard hypothesis which predicts off-balance sheet activities increase bank risk, the collateralization hypothesis implies that the risk of deposits does *not* necessarily increase with off-balance sheet activities because even though leverage may increase, profitable loan opportunities of lower risk are undertaken[13]. In addition, while the collateralization hypothesis is consistent with the regulatory tax hypothesis discussed earlier, it suggests that even if regulatory taxes were eliminated (or extended to off-balance sheet activities), banks would still have an incentive (albeit reduced) to engage in loan sales or to issue SLCs.

The collateralization hypothesis yields important implications concerning the types of loans sold or backed by SLCs and the effect of off-balance sheet activities on the default risk of bank deposits. First, the collateralized debt argument suggests that relatively low-risk loans will be sold or backed by an SLC. LPS surveys on loan sales indicate that currently loan sales are concentrated primarily in loans to investment-grade credits. For example, the 1986 LPS survey indicated that two-thirds of the loans sold by respondents were obligations of investment-grade borrowing. Second, the riskier a bank's existing deposits (and therefore the higher the rate the bank must pay on new uninsured deposits), the more likely it will be to engage in off-balance sheet activities. Finally, the collateralization hypothesis indicates that SLC and loan sales may not adversely affect the risk of deposits (the same reasoning explains why unsecured creditors of nonfinancial firms permit secured debt issues).

III. Empirical Evidence

The various explanations for why banks issue SLCs and sell loans have different implications for the effect of these activities on bank risk. The moral hazard hypothesis predicts loan sales and SLCs increase bank risk, while the regulatory tax and collateralization hypotheses predict that these activities do not necessarily increase bank risk.

Ideally, to determine the effect of these activities on the risk of deposits one would examine the relation between the risk exposure of the FDIC and uninsured depositors and a bank's use of SLCs and loan sales. While the FDIC's risk exposure is not directly observable, one can obtain a measure of the risk premium on a bank's uninsured (or partially insured) deposits. Assuming uninsured depositors behave as if they are not implicitly fully insured, as recent evidence by Hannan and Hanweck (1987) suggests, the moral hazard hypothesis predicts a positive relation between the risk premium on uninsured CDs and the volume of SLCs and loan sales. However, if one motive for loan sales or SLC is to avoid an underinvestment problem or regulatory taxes, existing depositors as well as bank stockholders may be better off given SLCs and loan sales. Therefore, finding no significant relation (or a negative relation) between the risk premium on bank CDs and the volume of SLCs and/or loan sales is consistent with the collateralization hypothesis and inconsistent with the moral hazard hypothesis.

To examine the effect of SLCs and loan sales on bank risk the relation between the interest cost on large CDs (deposits in excess of $100,000), the volume of SLCs and loan sales, and a set of variables designed to act as proxy for other factors affecting bank risk is examined.

The interest cost of large CDs is estimated from information contained in the Consolidated Report of Condition and Income. The average rate paid on CDs is estimated by dividing the total interest paid on large domestic CDs during a quarter by the average dollar value of domestic CDs outstanding during the quarter. A problem with this measure, noted by previous researchers (see Baer and Brewer, 1986) is that it fails to account for differences in the maturities of CDs outstanding.[14] However, the large bank supplement to the Report of Condition contains information on the maturity structure of CDs outstanding. From this information, a weighted average maturity of a bank's CDs can be computed.[15]

The interest cost on large CDs in a quarter is assumed to be a function of several factors: (1) the average maturity of the CDs outstanding, (2) the general level of interest rates as measured by average yield on ninety day Treasury bills over the quarter, (3) the leverage of the bank, (4) the default or credit risk of the bank's loan portfolio, and (5) the interest rate risk of the bank.

Month-end quotes for the yield on 90-day Treasury bills in the secondary markets are used to calculate the average yield on Treasury bills during each quarter. Financial leverage is estimated as the ratio of total assets of the bank (or bank holding company) to the market value of total bank capital. The total market value of capital is estimated as the sum of the book value of subordinated debt and preferred stock of the bank or bank holding company and the market value of common stock of the bank or bank holding company. The market value of common stock outstanding is calculated by multiplying the number of shares outstanding at the beginning of the quarter by the price of the bank's stock at the beginning of the quarter.

Two variables are used to measure the risk of a bank's asset portfolio. The first measure is the provision for loan and lease losses in each quarter divided by the end of the quarter total of loans and leases outstanding. A second measure is the variance of the bank's or bank holding company's monthly common stock returns for the twelve months prior to the end of each quarter. The variance in stock returns is multiplied by the square of the ratio of the asset to market value of equity. This adjusted variance measure provides an estimate of the variance of the bank's asset returns.[16]

The interest rate risk of the bank is measured by the maturity mismatch between the bank's assets and liabilities. A measure of maturity mismatch, identical to the one used in Flannery and James (1984), is constructed from the Call Report. This

measure, denoted as "Short" represents the absolute value of the difference between dollar value of assets subject to repricing within one year and the dollar value of liabilities subject to repricing within the same period, divided by the book value of equity.[17]

Data

The empirical analysis is based on a sample of fifty-eight banks. Banks were included in the sample if they met the following criterion: (1) information for the bank or bank holding company was contained in the Compustat Quarterly Bank File during the period 1984 through 1986, and (2) a lead bank was identifiable in the case of a multibank holding company.

Only banks contained in the Compustat Quarterly Bank File were included because Compustat is used to obtain monthly stock prices and balance sheet information for the bank holding companies. Only bank holding companies with an identifiable lead bank were included in the sample so balance sheet items obtained from the lead bank's Call Report will adequately reflect the holding company's balance sheet. (Only bank holding companies with the lead bank constituting 75 percent or more of the holding companies' assets in 1986 were included in the sample. For the holding companies in the sample, the assets of the lead bank averaged 90 percent of the holding company assets.)

Quarterly data over the period 1984 through 1986 were used to test the model. This period was chosen because the first full year loan sales were reported in the Call Report is 1984.

Empirical Results

Table 1 provides descriptive statistics for the banks in the sample. It is interesting to note that SLCs and loan sales constitute a sizable proportion of the total capital of the bank holding company. Total SLCs, (the sum of SLCs issued from foreign and domestic offices) average 95 percent of total capital, with a maximum value of 12 times total capital. The average ratio of loan sales to total capital is 24 percent.

Because the empirical analysis is based on an assumption that the rate paid on CDs reflects a

TABLE 1

Summary Statistics for Fifty-Eight Commercial Banks

(1984-1986, quarterly data)

Characteristics	Mean	Maximum	Minimum
Assets of Holding Company (millions)	$18,292	$196,124	$1,196
Assets of Lead Bank (millions)	$16,288	$153,293	$551
Market Value of Total Capital/Assets*	.072	.220	.012
Book Value of Total Capital/Assets**	.061	.114	.036
Loan Loss/Total Loans	.0022	.0487	−.0004
Absolute Value of Ratio Net Short-Term Assets to Book Value of Equity	4.69	11.99	.006
Average Maturity of CDs (months)	8.03	39.33	1.04
Interest Cost of CDs	.087	.195	.024
SLCs/Market Value Total Capital	.948	12.54	.000
Loan Sales/Market Value Total Capital	.239	4.07	.000

* Market value of total capital equals the market value of common stock plus the book value of preferred stock and subordinated debt for the holding company. Assets refer to assets of holding company.

** Book value of total capital equals the book value of common stock plus the book value of preferred stock and subordinated debt for the lead bank. Assets refer to the assets of the lead bank.

default risk premium, the first step was to investigate the relation between average CD rates and the measures of bank leverage and asset risk described in the previous section. Two models were estimated. One model relates the average rate paid on CDs to balance sheet measures of credit risk, interest rate risk, and financial leverage. The second model relates CD rates to the adjusted variance in the bank's stock returns over the preceeding 12 months (which should reflect both interest rate risk and credit risk) as well as financial leverage.

The results of this analysis are reported in Table 2. The first column of Table 2 contains the results of an OLS regression relating the rate paid on CDs to Treasury bill rates, the average maturity of the bank's CDs and balance sheet measures of risk. The second column presents the results of an OLS regression in which the adjusted variance in the monthly return on the bank's common stock is used as proxy for asset risk.

The results in Table 2 are generally consistent with the hypothesis that CD rates reflect a default risk premium. With both models, a positive and statistically significant relation is found between the interest cost on CDs and the ratio of assets to total capital of the holding company. Moreover, the coefficients on the loan loss variable and on Short (which measures interest rate risk) are positive and statistically significant. This result is consistent with the view that CD rates reflect both the credit risk and interest rate risk of the issuing bank. In the second column, the coefficient on the adjusted variance in monthly stock returns is positive and statistically significant.[18]

To investigate whether "off-balance sheet" activities affect the risk premium on large CDs, the

TABLE 2

Pooled Cross-Section Time Series Regression Relating Interest Cost of Large CDs to the Risk of the Issuing Bank*

(t-statistics in parentheses)

	Dependent Variable = Interest Cost on Large CDs	
Independent Variables	**(1)**	**(2)**
Intercept	.0147 (5.238)	.0189 (7.803)
T-Bill Rate	.8402 (28.67)	.8224 (28.17)
Average Maturity CDs	.0004 (6.049)	.0005 (7.803)
Assets/Market Value Total Capital**	6.220×10^{-5} (5.494)	6.427×10^{-5} (5.625)
Adjusted Variance in Monthly Stock Returns		1.633×10^{-5} (2.812)
Loan Loss Provision/Total Loans	.7252 (4.646)	
Short	.0004 (1.706)	
R^2	.58	.57
Number of Observations	679	679

* Analysis based on quarterly data for 58 bank holding companies over the period 1984 through 1986.

** Market value of total capital equals the sum of the market value of the holding companies common stock, the book value of preferred stock and subordinated debt.

regressions reported in Table 2 were re-estimated with two additional independent variables: (1) the ratio of SLCs outstanding to total market value of capital and (2) the ratio of loan sales to total market value of capital. If the volume of SLCs outstanding or loans sales relative to total capital were to increase the risk borne by uninsured depositors (and the FDIC), a positive relation would be expected between CD rates and SLCs outstanding as well as loan sales. No significant relation would be expected under the underinvestment or regulatory tax hypothesis.

The results of this analysis are reported in Table 3. No statistically significant relation is found between the rate paid on CDs and either SLCs outstanding or loan sales during the quarter. Moreover, using an F-test, one cannot reject at the .10 level the hypothesis that the coefficients on SLCs and loan sales are jointly equal to zero in either model. The results presented in Table 3 are therefore inconsistent with the moral hazard hypothesis that SLCs and loan sales increase bank risk.

Summary and Conclusion

The growth of loan sales and SLCs in recent years has raised concerns over the effect of these off-balance sheet activities on bank risk. How these activities affect bank risk depends on the reasons banks undertake them.

TABLE 3

Pooled Cross-Section Time Series Regression Relating Interest Cost of CDs to the Risk of the Issuing Bank and the Volume of SCLs and Loan Sales*

(t-statistics in parentheses)

	Dependent Variable = Interest Cost on Large CDs	
Independent Variables	**(1)**	**(2)**
Intercept	.0142	.0180
	(4.954)	(7.783)
T-Bill Rate	.8396	.8207
	(28.35)	(27.73)
Average Maturity CDs	.0004	.0005
	(5.890)	(6.208)
Assets/Market Value Total Capital**	6.145×10^{-5}	6.386×10^{-5}
	(5.387)	(5.555)
Adjusted Variance in Monthly Stock Returns		1.588×10^{-5}
		(2.670)
Loan Loss Provision/Total Loans	.7055	
	(4.401)	
Short	.0004	
	(1.861)	
SLC/Total Market Value Capital	−.0002	−.0001
	(−.4921)	(−.3733)
Loans Sales/Total Market Value Capital	−.0004	−.0001
	(−.3892)	(−.1048)
R^2	.57	.57
Number of Observations	679	679

* Analysis based on quarterly data for 58 bank holding companies over the period 1984 through 1986.

** Market value of total capital equals the sum of the market value of the holding companies common stock, the book value of preferred stock and subordinated debt.

In this paper, I show that one motive for selling loans and issuing SLCs is that they permit banks to make relatively low-risk loans that would be unprofitable to finance with deposits. This suggests that off-balance sheet activities are not motivated solely by the incentives created by deposit insurance to increase leverage or asset risk through "off balance" sheet activities.

The empirical evidence from the CD market is consistent with this conclusion. Specifically, loan sales and SLCs do not appear to be important determinants of bank risk as perceived and priced by large uninsured depositors.

FOOTNOTES

1. Loan sales structured as participations differ from what has traditionally been referred to as a participation in the banking literature. The older form of participation is better described as a syndication or assignment, and involves a lead bank negotiating for each bank in the syndicate. However, each of the banks in the syndicate make a separate loan to the borrowing firm. Recent loan sales, structured as participations, involve the creation of a new contract between the bank and the purchaser of the loan. The purchaser's contract is with the originating bank and not with the bank's loan customer. See Gorton and Haubrick (1987) for a discussion of the contractual aspects of loan participations.

2. See Melvin (1986) for a description of the regulatory treatment of loan sales. If a depository institution sells a loan and agrees to be responsible for 75 percent or less of the losses from the loan, then under present regulations, the proceeds from the sale are not reservable.

3. Information on loan sales with recourse is difficult to obtain. Available evidence suggests that loans sold with full recourse are rare. The 1985 LPS Survey indicated 13 percent of loans sold had a put option, allowing the purchaser to sell back the loan. In addition, loans sold with full recourse were reported to be only $11 million while nonrecourse loan sales totaled $26 billion.

4. Under the Federal Reserve Board's guidelines, released for comment February 12, 1986, capital requirements for SLCs would vary depending on the account party and use of the SLC. For SLCs backing commercial paper or loans to nongovernment entities, the capital requirements proposed are identical to those that apply to "booked" loans and loans sold with recourse.

5. The payoff characteristics of collateralized debt as well as the effect of collateralized debt issues on a bank's investment policy are derived formally in James (1987).

6. Under Federal law and regulation (12 USC 90 and 12 CRF 7.7410) national banks may pledge assets against public deposits. However, in 1934, the U.S. Supreme Court ruled that national banks may not pledge assets against private deposits. (Texas and Pacific Ry Co. vs. Portorff, 291, U.S. 245, 1934).

7. The regulatory tax hypothesis is based on the proposition that deposit insurance is overpriced (when regulatory taxes are included). The results of empirical studies on the under- or overpricing of deposit guarantees are mixed. For example, Marcus and Shaked (1984) find that for large banks, guarantees are overpriced. Ronn and Verma (1986) show that this result is quite sensitive to the assumptions concerning forebearance (that is, closure rules) of the FDIC.

8. See Leonard Sloane, "New Securities Tied to Assets", *New York Times*, July 20, 1985, and Lowell Bryan, "The Selling of American Loans", *Wall Street Journal*, October 20, 1986.

9. Money center banks hold less capital relative to assets than most regional or smaller banks. Therefore, it is unclear why the cost of financing the same loan should be *lower* for regional and small banks who are the primary purchasers of loans. An explanation for this pattern is provided below when the motives for collateralization are discussed.

10. Another explanation for the use of SLCs and loan sales with recourse is provided by Benveniste and Berger (1986). They show that the ability to issue securitized claims can improve the allocation of risk-sharing among a bank's debtholders and depositors. In particular, securitization provides some bank claimants a senior claim to certain assets. If investors were to vary in their degree of risk-aversion, securitization may result in a lower cost of funds by providing richer risk-sharing opportunities. Benveniste and Berger's model is based on an assumption that investors' risk-sharing opportunities outside the bank are limited. Their model does, however, yield implications similar to the model developed in this paper.

11. A similar argument can be made for banks with uninsured deposits and subordinated debt outstanding. Moreover, the largest issuers of SLCs and sellers of loans are money center and large regional banks with the largest proportion of uninsured (or partially insured) deposits.

12. See James (1987) for a formal proof of this proposition.

13. Selling loans or issuing collateralized debt can of course increase the risk of deposits. This will occur when *existing* assets are sold or collateralized (that is, when cash flows to depositors are reduced) or when new loans are sold when the activity would have been profitable with deposit-financing.

14. Another problem with using the average interest cost of large CDs calculated from the Call Report data as a proxy for the rate paid on newly issued CDs is that the average interest cost reflects rates paid on CDs issued in previous quarters as well as newly issued CDs. To determine whether the average interest cost of CDs is a reasonable proxy for the rate offered on CDs in a given quarter, I obtained the Innerline survey of rates paid on newly issued

CDs by 300 banks for the first quarter of 1985. Thirty-nine of the banks in my sample reported rates to Innerline. The average rate reported by these banks in the Innerline survey was 9.28 percent. The average interest cost of CDs from the Call Report is 9.12 percent for that quarter. The difference in rates is not significantly different from zero. Moreover, the correlation between the two series is .60.

15. The dollar volume of time deposits of $100,000 or more is reported for six maturity categories: one day, 3 months or less, over 3 months to 6 months, over 6 months to 12 months, over 1 year to 5 years, and over 5 years. The weighted average maturity is calculated in months, with deposits with a maturity of 3 months or less assigned a maturity of one month. For the remaining categories, the maturity of CDs is assumed to be the longest maturity in that category. For deposits over 5 years, a maturity of 60 months was assigned.

16. This calculation is based on a simplifying assumption that the variance of the return on debt is zero.

17. A larger value of Short implies a greater maturity mismatch between bank assets and liabilities. The absolute value of the difference between short term assets and liabilities is used to account for the fact that earnings variability induced from interest rate changes can arise through either short-term assets exceeding short-term liabilities or the converse. Reporting requirements necessitated using a one-year dividing line between Short and long-term assets. See Flannery and James (1984) for a description of how Short is constructed.

18. The coefficient on the T-bill rate variable of less than one may appear puzzling. However, note that for this sample of banks the average maturity of CDs outstanding exceeds 90 days (see Table 1). The results in Table 2 may reflect the fact that short-term rates (that is, 90 T-bill rates) are less volatile than long-term rates.

REFERENCES

Baer, Herbert and Elijan Brewer. "Uninsured Deposits as a Source of Market Discipline: Some New Evidence," *Federal Reserve Bank of Chicago Economic Perspectives*, 1986, 10, 23-31.

Barnea, Amir, Robert Haugen and Lemma Senbet. "An Equilibrium Analysis of Debt Financing Under Costly Tax Arbitrage and Agency Problems," *Journal of Finance*, 1981, 36.

Bennett, Barbara. "Off Balance Sheet Risk in Banking: The Case of Standby Letters of Credit," *Economic Review*, Federal Reserve Bank of San Francisco, No. 1.

Benveniste, Lawrence and Allen N. Berger. "Standby Letters of Credit: Benefits of Financing Loans Off a Bank's Balance Sheet," *Research Papers in Banking and Financial Economics*, Board of Governors of the Federal Reserve System, 1986.

Flannery, Mark and Christopher James. "The Effect of Interest Rate Changes on the Common Stock Returns of Financial Institutions," *Journal of Finance*, 1984, 39.

Goldberg, Michael and Peter Lloyd-Davis. "Standby Letters of Credit: Are Banks Over Extending Themselves?" *Journal of Bank Research*, 1985, 16.

Gorton, Gary and Joseph G. Haubrich. "The Loan Sales, Recourse and Reputation: An Analysis of Secondary Loan Participations," Working Paper, University of Pennsylvania, 1987.

Gurel, Eitan and David Pyle. "Bank Income Taxes and Interest Rate Risk Management: A Note," *Journal of Finance*, 1984, 39.

Hannan, Timothy and Gerald Hanweck. "Bank Insolvency Risk and the Market for Large Certificates of Deposit," *Journal of Money Credit and Banking*, forthcoming.

Hirtle, Beverly. "The Growth of the Financial Guarantee Market," *Quarterly Review*, Federal Reserve Bank of New York, 1987, 12.

James, Christopher. "An Analysis of the Use of Loan Sales and Standby Letters of Credit by Commercial Banks," mimeo, 1987.

Koppenhaver, Gary. "Standby Letters of Credit," *Economic Perspectives*, Federal Reserve Bank of Chicago, 1987, 11.

Marcus, Alex and Israel Shaked. "The Valuation of FDIC Deposit Insurance Using Option Pricing Estimates," *Journal of Money Credit and Banking*, 1984, 16.

Melvin, Donald. "A Primer for RMA Staff on Legal and Regulatory Concepts and Standards in the Securitization of Loans." Robert Morris Associates: Philadelphia, PA, 1986.

Meyers, Stewart. "Determinants of Corporate Borrowing," *Journal of Financial Economies*, 1987, 5.

Miller, Merton. "Debt and Taxes," *Journal of Finance*, 1977, 32.

Modigliani, Franco and Merion Miller. "The Cost of Capital, Corporation Finance and the Theory of Investment," *American Economic Review*," 1958, 48.

Pavel, Christine. "Securitization," *Economic Perspectives*, Federal Reserve Bank of Chicago, 1986, 10.

Pavel, Christine and David Phillis. "Why Commercial Banks Sell Loans; An Empirical Analysis," *Economic Perspectives*, Federal Reserve Bank of Chicago, 1987, 11.

Pennacchi, George. "Loan Sales and the Cost of Bank Capital," mimeo, 1987.

Ronn, Ehud and Avinash Verma. "Pricing Risk-Adjusted Deposit Insurance: An Option-Based Model," *Journal of Finance*, 1986, 41.

Pyle, David. "Discussion of Off Balance Sheet Banking" in *The Search for Financial Stability: The Past Fifty Years*, Federal Reserve Bank of San Francisco, 1985.

Salem, George. "Selling Commercial Loans: A Significant New Activity for Money Center Banks," *Journal of Commercial Bank Lending*, 1986.

_____. "Loan Selling: A Growing Revolution That Can Affect Your Bank," *Journal of Commercial Bank Lending*, 1987.

Stulz, Rene and Herb Johnson. "An Analysis of Secured Debt," *Journal of Financial Economics*, 1985, 14.

Tax Policy and Corporate Capital Structure

Randall Johnston Pozdena*

In the past decade or so, corporations have been using debt increasingly to finance their activities. This is manifested both in a generally rising trend in corporate leverage and in the growing use of low-grade ("junk") bond financing. This article discusses the theory of the choice of corporate financial structure and the role that tax policy plays in that choice. The findings suggest that tax policy has contributed importantly to the observed trends and that recent changes in federal tax policy make it likely that the preference for debt financing will continue.

Corporations in the United States appear to be financing their activities increasingly through the use of debt (bonds, loans and other liabilities) rather than equity (corporate stock). Indeed, available data suggest that the ratio of corporate debt to equity outstanding has increased by two-and-one-half times since the 1960s.[1] In addition, the issuance of low-grade debt obligations by corporations ("junk" debt) has increased significantly in recent years. The quarterly issuance of corporate bonds with below investment-grade ratings has climbed from less than $1 billion in 1982 to over $32 billion in 1986.[2]

The growing use of debt financing by corporations may have a number of important implications. First, everything else being equal, highly leveraged finance makes the profitability and solvency of individual corporations more susceptible to fluctuations in income. Some observers have expressed concern for the welfare of investors in corporate bonds should the corporations involved suffer unexpectedly low earnings. Second, a widespread decline in corporate earnings might also be a destabilizing force for the financial system as a whole. The argument, made most cogently by Bernanke[3], is that when widespread defaults on indebtedness occur, certain conventional avenues of finance operate inefficiently "closing off" access to financial capital and depressing economic activity. This argument has been employed, in fact, to argue that the Great Depression was a phenomenon of a credit rather than monetary system failure.[4]

The purpose of this article is to explore the reasons behind the rise in the use of debt by U.S. nonfinancial corporations. In particular, theory suggests that personal and corporate income tax policy influence the corporate use of debt. Using historical data on corporate leverage, debt and equity issuance activity, and federal tax policy, we find that changes in tax policy are indeed related to the changes observed in corporate financial policy over the last century in a manner generally consistent with theory. Moreover, a review of the major features of the 1986 Tax Act reveals that it is an unusually strong potential source of stimulus to the corporate use of debt.

The remainder of the paper is structured as follows. First, the theory of corporate financial structure is reviewed briefly. Then, in Section II, a study designed to detect the influence of tax policy on financial structure is presented. In Section III, the data employed to test these notions is introduced and the empirical findings summarized. The paper concludes with a summary of the findings and a discussion of policy implications, focussing on recent Federal tax reforms.

* Assistant Vice President, Federal Reserve Bank of San Francisco. The author wishes to thank William Robertson for his valuable and diligent research assistance during the course of this study.

I. Determinants of Corporate Financial Structure

Corporations finance their activities in two basic ways. First, they issue debt in the form of bonds, notes, and other primary securities, and take on liabilities in the form of loans from individuals and financial institutions. Bonds and other primary securities of the corporation may be sold into active, organized markets or placed directly with the ultimate investor. The second way they obtain funds is through the sale of shares in the equity of the corporation and the retention of earnings.

The theory of corporate financial structure — that is, the mixture of debt and equity finance — has been a subject of interest to finance economists for many years. Conventional theory of the firm assumes that the goal of management is to maximize the present value of the profits of the corporation, which is tantamount to maximization of the value of the firm's shareholder equity. It is assumed that this same goal motivates the selection of corporate financial structure.

The Notion of Irrelevance

In 1958, Franco Modigliani and Merton Miller first put forth the notion that, in fact, the value of the firm may be independent of its financial structure — at least in simple financial environments. This notion, known as the Modigliani-Miller (MM) or "irrelevance" theorem, can be motivated in a number of ways. The simplest is the argument that the value of the firm is determined fundamentally by the firm's assets and the cash flow generated by those assets. Partitioning those cash flows into payments to equityholders versus payments to debtholders does not have any obvious influence on the present value of the cash flows and, hence, does not change the value of the firm.[5] Put differently, the value of the firm is independent of its financial structure, and there is no optimal debt-equity ratio for an individual firm.

This fundamental point also can be demonstrated formally using the capital-asset pricing model (CAPM).[6] The key assumptions, however, are that the value of the partitioned cash flow is the same to each type of investor (investors in debt or investors in equity) and that the costs of borrowing (and hence the discount rate applied in computing the present value of the flows) are the same and constant for investors and the firm.

Effects of Taxes

Although there may not be an optimal debt-equity ratio for an individual firm in a perfect market, such may not be the case in a world in which taxes, transactions costs, and other "imperfections" exist. Moreover, financial structure for the corporate sector in the aggregate may be influenced by these imperfections even if individual firm conduct is not. Tax policy is a particularly likely source of influence on financial structure since there are important differences in the treatment of debt and equity securities in the U.S. tax structure.

Corporate Tax Treatment of Interest and Dividends

Let us turn first to the treatment of debt and equity under the corporate income tax system. Corporations have been subject to an income tax in the United States since 1908. The tax is paid on income net of deductible expenses. The interest paid by a corporation on its debt is one such deductible expense; the dividends it pays to equityholders are not deductible. Thus, everything else being equal, the income of a firm financed by debt is partly "shielded" from taxation whereas that of an all-equity firm is not.

The present value of the tax-saving represented by this shield is a potential source of additional value to the firm. The tax-saving varies in direct proportion to the corporate tax rate and the size of the debt shield. For perpetual debt, the value of the shield is t_cD where t_c is the corporate tax rate and D is the amount of debt outstanding.[7] Thus, the value of the shield rises with the tax rate and increased use of debt. Other influences aside, therefore, corporate tax policy biases financial structure toward an all-debt configuration.

Personal Taxation of Debt and Equity Income

Corporations make financing decisions not on their own behalf, but on behalf of investors. Seen

from this perspective, the objective of corporate finance decisions is to maximize the present value of the income of its investors after all taxes. If these investors face a personal income tax, the earlier conclusion that corporate taxes bias financial structure in favor of debt may not be unambiguous.

Personal income in fact has been taxed in the United States since 1913. In addition, for most of that time, income from equity has been taxed differently from so-called "ordinary income", including interest income. Income from equity is in the form of dividend payments and capital gains that accrue to equityholders as the result of earnings retention. Although dividends historically have been taxed at the same rate as ordinary income, the accrual of earnings in the form of capital gains is treated favorably. In particular, the gains typically are not taxed until they are realized (that is, until the appreciated equity is sold), and realized capital gains typically have been taxed at a favorable rate. The fact that the firm can elect to retain, rather than distribute, its net earnings, and that the tax obligation on the resultant capital gains is delayed, is one source of the preferential treatment afforded equity income. In addition, even *realized* capital gains have been taxed at a rate lower than ordinary income.[8]

If the tax rate applied to interest income is t_b and the perceived effective tax rate on equity income is t_e, the combined effects of corporate and personal income taxation policy can be described succinctly. A dollar of corporate income paid out as interest expense avoids corporate income taxation but is taxed at the personal level, yielding an after-tax income of $(1 - t_b)$ dollars for the investor. If paid out as equity income, in contrast, a dollar of corporate income implicitly must bear both the corporate and personal tax burdens, yielding $(1 - t_c)(1 - t_e)$ dollars to the investor.

Debt finance will be preferred, therefore, when it offers after-tax income to the investor that exceeds that offered by equity income, that is, if

$$(1 - t_b) > (1 - t_c)(1 - t_e).$$

Equity finance will be preferred when the opposite is true. Investors will be indifferent between the two modes of finance when their after-tax income is the same in both cases. Note that preference for debt financing increases with (a) lower tax rates on normal income, (b) higher tax rates on corporate income, and (c) higher tax rates on equity income. Note also that if the personal tax rate faced by debt and equity income were the same (that is, t_b equaled t_e), debt finance unambiguously would be preferred.

In essence, the effect of taxes is to make the value of the firm dependent upon how the cash flow from the firm is partitioned. That is, the conventional theory's assumption that the values of these flows are the same regardless of the way in which they are partitioned proves not to be false when tax policy is considered.

The Determinacy of Aggregate Leverage

This simplified view of corporate capital structure does not address important practical issues about corporate debt policy. Perhaps most important of these issues is the model's implication of an "either-or" nature to the corporate debt decision. That is, depending upon the tax structure, the model implies that investors are likely to prefer either an all-debt or all-equity structure. In reality, a mixture of debt and equity is observed both in the aggregate and among individual firms in our economy.

A number of explanations have been offered for the observation of a determinate amount of debt and equity in the aggregate. Two are particularly relevant to the analysis pursued in this paper. The first is the notion offered by Miller that debt and equity "clienteles" exist because of differences in the tax rates faced by individuals in the economy. That is, investors facing low personal marginal tax rates will tend to prefer debt, and those with sufficiently high tax rates will prefer equity. The relative wealth of these different "clienteles" thus makes the aggregate balance of debt and equity observed in the economy determinate. *Individual firms*, however, remain indifferent on the margin between the two avenues of finance because the equilibrium prices of debt and equity must satisfy all of these clienteles or the clienteles would continue to shift.[9]

A second explanation recognizes that a progressive income tax structure creates incentives to exchange corporate securities to achieve maximal after-tax income for investors. Individuals in high

tax brackets, for example, will tend to be willing to trade debt holdings for equity holdings to obtain the preferred tax treatment afforded income from the latter. This process of trading corporate securities affects both the equilibrium prices of debt and equity, and the equilibrium effective marginal tax rate. Indeed, it can be shown that in equilibrium, *effective* marginal tax rates will be equilibrated across households.[10] In such an instance there are no *clienteles* as such and firms are indifferent between debt and equity financing, but the aggregate amount of debt and equity in the economy remains determinate.

The Determinancy of Individual Firm Leverage

The observed variation in debt and equity held by individual firms also has a number of explanations. Miller has argued that since individual firms' financial structure is irrelevant, it is not costly for firms to pursue what they feel is a value-maximizing financial structure. This argument implies that the observed variation is serendipitous.

A second explanation recognizes the fact that firms enjoy shields against income taxation generated by sources other than debt. These "non-debt shields" include such things as depreciation and depletion allowances and the investment tax credit. If these shields were large enough relative to the income of the firm, the interest deduction could be completely redundant as a tax shield, and, in effect, make the marginal corporate tax rate (t_c) zero, reducing the incentive to prefer debt-financing. Even if the non-debt shields were not a complete offset to income, however, there is some probability that a debt shield will be redundant in a stochastic income environment.

Thus, the existence of non-debt shields reduces the expected shield benefit of additional debt. That is, the contribution to the value of the firm of an additional unit of debt is not constant, but declines with expanded debt usage because it increases the probability that the debt shield will be redundant for any given amount of non-debt shielding.

DeAngelo and Masulis have argued that, in the presence of these non-debt-related shields, individual firms can lose their indifference to financial structure.[11] The loss of indifference would make both the leverage of the individual firm and firms in the aggregate determinate.

The treatment of non-debt related shields in the U.S. Tax Code also can influence leverage. In particular, depletion and depreciation allowances are long-lived deductions whose value as a deduction for tax purposes is fixed at the time of the relevant investment. If the corporation subsequently is exposed to general price inflation (including inflation in the price of its own product) and its nominal income rises, the effectiveness of the depletion or depreciation shield implicitly declines. Thus, by inference, inflation can have the effect of increasing the attractiveness of additional *debt* shields, everything else being equal, and thereby increase the degree of leverage observed in the corporate sector.

Finally, restrictions on the ability of households to borrow also may influence observed levels of corporate leverage. This point relates to the notion that exchange of corporate securities is a strategy to achieve maximal after-tax income for households holding such securities. The strategy may require, however, that certain households borrow (issue personal debt) to acquire corporate equity.

If there were limits on short-selling and deductibility of interest expenses, or other limitations on borrowing by households, then the use of a corporation as a "tax intermediary" would become more important and may make corporate financial policy relevant. Say, for example, that interest expenses are deductible by corporations but not by households. If households were able to purchase shares in a highly leveraged corporation, they could possibly sidestep such restrictions on personal leverage and provide an incentive for an increased corporate use of debt. (In effect, the corporate securities would be used to arbitrage the differences in personal and corporate tax treatment of debt.) Models of the use of corporate securities in such "tax minimization" strategies show that household borrowing restrictions can influence corporate leverage.[12] This finding is relevant because, as we shall see in Section IV, recent tax reform limits personal borrowing.

In the long literature on optimal corporate financial structure, many other factors have been discussed as possible influences on the observed finan-

cial structure of corporations. Factors such as bankruptcy costs[13], differences between the preferences of managers ("inside equity holders") and other equity holders[14], and the influence of intangible assets, all have received some attention in the literature as sources of determinacy in the amount of leverage observed in the corporate sector.

While it may be likely that these and other non-tax considerations play some role in determining corporate financial structure, their influence is difficult to study empirically as these aspects of the economic environment are difficult to quantify.[15] The empirical work presented in this paper focuses, therefore, on the influence of tax policy on corporate financial structure. As we shall see, a significant fraction of the variation in observed corporate leverage over time appears to be associated with changes in tax policy.

Taxes, Leverage and Debt Quality

We turn now to the association between tax policy and the *quality* of corporate debt. Specifically, if a change in tax policy stimulates an increase in a corporation's leverage, it likely will result in the deterioration of the quality of its debt on the margin. One direct reason for this effect is that increased leverage simply reduces the capital buffer against default and thereby reduces the risk of a corporation's default on its debt. Debt-rating agencies and the marketplace in general would respond to increased default risk by downgrading the quality assessment of new (and perhaps existing) debt.

Tax policy also may directly influence the preference for debt of low quality, however. A bond that is risky will contain a compensatory premium in its yield. The higher interest payments associated with risky debt implicitly provide a larger tax shield (for a given amount of debt) than less risky, lower yield debt. The higher default probability of the risky debt, of course, means that its tax shield effects have a higher probability of going unused. Zechner and Swoboda have argued, however, that because of peculiarities in the way in which tax law treats the obligations of corporations in a bankrupt state, the present value of the implied tax shield effects can nonetheless be greater for riskier debt.[16]

Another, possibly offsetting influence of tax policy on risky debt is the probability of a high-risk bond becoming a low-risk bond (as the corporation that issued the obligations evolves into a corporation with strong earnings and a growing net worth). Such an event would, in effect, confer a capital gain on the holders of the (formerly) risky debt that is treated favorably for tax purposes. Everything else being equal, had the corporation issued high-quality debt to begin with, there would be no prospect for such gains. (In essence, low-grade debt has some "equity-like" characteristics.) This suggests that, unlike debt in general, the issuance of high risk debt may be retarded by increases in the capital gains rate.[17]

II. Corporate Financial Structure and Tax Policy: Measurement Issues

In this study, we examine empirically the influence of tax policy on the financial structure of corporations. We use aggregate data on the tax treatment of corporations and corporations' financing behavior over time. This longitudinal approach has a number of advantages over a study design that relies on examining the behavior of firms in the cross-section. For example, the considerable variation in tax policy and corporate financing behavior over time permits forging a statistical association between the two. There is less variation in the tax treatment *across* firms at a given point in time, and much of that variation may be inherently endogenous.[18] In addition, using tests on aggregate time series data to determine the influence of taxes on leverage offers the opportunity to discover that influence whether it operates at the firm level or only at the level of the corporate economy overall.

Measuring Corporate Financial Structure

A major empirical issue in our analysis concerns the measurement of corporate financial structure. The theory discussed earlier suggests that the relative stocks of debt and equity outstanding in the

economy as a whole (and, perhaps, for individual firms) may be influenced by features of the tax system and other variables. Accurate measurement of these stocks (to create a leverage measurement or some other summary statistic) requires estimates of the market values of the debt and equity of all firms.

Unfortunately, a long time-series of such data is not available for the corporate sector as a whole and is difficult to construct from generalized indices. For equities, value-weighted indices of share prices such as the Standard and Poor's 400 and 500 exist, but their coverage is limited and has changed over time, and the indices themselves have been "rebased" at various times.[19] Also, these indices cover only companies with traded equity which, arguably, may behave differently from other corporations. An even more serious problem exists for measurement of the market value of corporate debt in the aggregate, since no single value-weighted index exists. The result is that market value debt and equity estimates constructed from some indices are of questionable value to empirical work.

Book-value measures of total corporate assets and total corporate liabilities, in contrast, are available in a reasonably consistent form.[20] They have been reported to the Internal Revenue Service (for firms with and without tax liability) for about 50 of the 80 years that corporate income has been subject to tax in the United States. While not the ideal measures, they may nevertheless approximate market measures reasonably closely in the aggregate if corporate asset and liability portfolios turn over sufficiently rapidly.

The market values of net *issuance* of corporate debt and equity also are observable. Net issuance is the market value of new gross securities issued minus the value of retired securities. While net issuance activity is not ideal data for examining the leverage process directly, it can offer some assistance. Specifically, if a change in tax policy were likely to induce additional corporate leverage, relatively more debt than equity should be observed to be issued. For example, suppose that the ratio of debt (D) to equity (E) initially is

$$L = D/E$$

and that the reaction to a change in tax policy is to increase the desired degree of leverage to

$$L' = (D + dD)/(E + dE) > L,$$

where dD and dE are, respectively, the net issuance of debt and the net issuance of equity. If L' exceeds L,

$$(dD/D) > (dE/E).$$

That is, the percentage change in outstanding debt must exceed the percentage change in outstanding equity. Computing the percentage change accurately would require accurate measures of the stocks of debt and equity. However, as long as D is less than or equal to E (as it is for the aggregate of all U.S. nonfinancial corporations), net issuance of debt in excess of net issuance of equity will be associated with an increase in leverage.

In the empirical work in this paper, leverage measures and issuance activity are both employed to test the relationship between tax policy and corporate financial structure.

Measuring Tax Policy

Measurement of the tax policy environment also raises conceptual and practical issues. Miller's notion of debt and equity "clienteles" implicitly suggests that the degree of leverage observed in the economy as a whole will depend upon the wealth of groups in various tax brackets. This, in turn, suggests that wealth-weighted relationships between personal and corporate taxes might be an appropriate measure of ambient tax policy. The view of corporate securities as devices to arbitrage such tax differences, however, argues that such clienteles do not exist in equilibrium.

In either case, the outcome will be driven by the clientele with the highest individual wealth who, in turn, might be assumed to face the highest *ex ante* marginal tax rates on ordinary personal income. It is this rate that is used in our study, and it ranges from 7 percent (in 1913, the first year that personal income was subject to taxation) to a peak of 94 percent in 1944 and 1945.

The measurement of the tax rates applicable to income from equity also poses conceptual and empirical problems. Income from equity takes the form of dividends and capital gains. Given the

nondeductibility of dividend payments from gross income at the corporate level, it is something of a conundrum to financial economists that corporations pay dividends at all; it would appear preferable in all cases for firms to retain earnings and convert current income to capital gains for its security holders.[21] In addition, since the timing of the realization of capital gains can be controlled by the investor in most cases, the argument has been made that investor behavior will result in effective avoidance of the tax and thus that the effective capital gains rate is zero.[22]

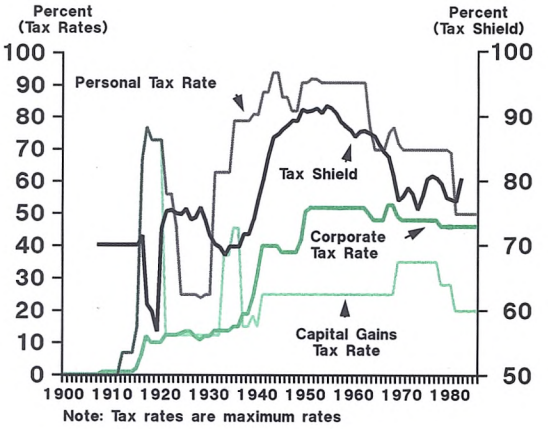
This debate will not be resolved here, but it seems reasonable to assume that *some* differential treatment of income from holding corporate equity occurs and certainly that the *ex ante* rate of taxation of capital gains (which is what will influence security holding behavior) is nonzero and differs from the rate applied to ordinary income. Once again, we will measure changes in the taxation of capital gains using the *highest* statutory rate. Since no distinction was made between equity income and ordinary income until 1922, these two statutory rates correspond for the first 9 years of taxation of personal income.

Fewer problems exist in defining and measuring the corporate tax rate. Over most of its history, the corporate income tax in the United States has been a simple proportional tax. That is, a single tax rate, with exceptions to that rate only for very small corporations, has been employed. In the analyses that follow, therefore, the corporate tax rate has been measured as the primary (maximum) statutory rate on corporate income. The taxation of corporate income began in 1908 and the primary rate has ranged from 1 percent in that year to a peak of 52.8 percent in 1960.

The other feature of tax policy examined in this research is the influence of nondebt-related tax shields. Depletion and depreciation allowances and the investment tax credit are the major nondebt sources of shields to net income. Unfortunately, it is not possible to measure these features of tax policy using a single parameter, making them difficult to characterize *ex ante* in a consistent empirical manner. In the analyses that follow, a measure of the actual use of these shields is used in lieu of a policy parameter. Specifically, the ratio of nondebt-related deductions to total deductions actually claimed by nonfinancial corporations is employed. This ratio can be interpreted as a measure of the likelihood that interest deductions would be redundant. In contrast to the other tax parameters examined, therefore, the nondebt-related tax shield is measured using realized (or *ex post*) data.[23]

Chart 1 presents the tax rate and shield values employed in this study and displays the considerable variation exhibited by these policy parameters over the last century.

Chart 1
Tax Rates and Shield



Note: Tax rates are maximum rates

III. Data Description and Econometric Evidence

This section contains simple econometric evidence of the relationship between tax policy and (1) aggregate corporate leverage, (2) the aggregate net issuance of corporate debt and equity in the economy, and (3) the gross issuance of low quality debt. The study employs data, where possible, from 1900 to the present so that the maximum variation in tax policy parameters and its association with corporate financial behavior can be studied. Financial corporations are excluded from the study on the grounds that special regulatory factors likely influence their behavior and would confound the effects of tax policy.

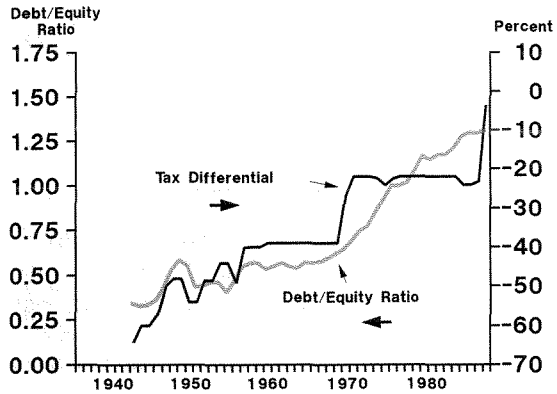
Tax Policy and Aggregate Corporate Leverage

The theoretical discussion above suggested that leverage may be positively associated with higher corporate tax rates, higher tax rates on equity income relative to ordinary income, lower personal tax rates, lower non-debt related shields, except in the instance that tax rates on ordinary and equity income were identical, in which case a pure preference for debt would be exhibited regardless of the level of tax rates.[24]

Chart 2 presents a measure of leverage derived from the book value of total liabilities and total assets reported to the Internal Revenue Service and its predecessor agencies. Only data for manufacturing corporations is represented to extend the data series back in time as far as possible while keeping consistent measures. A simple tax differential (the corporate tax rate minus the personal tax rate) also is presented in Chart 2. From the discussion above, leverage should be positively associated with this differential. From Chart 2, it is apparent that the association is, indeed, seemingly positive, and linear.

We examined the statistical association between leverage and the tax differential and other representations of the tax parameters using ordinary least squares regression techniques to create a linear representation of the relationship between contemporaneous measures of leverage and the tax parameters, measured in level terms. Two formulations were made with the first employing the individual tax parameters entered directly. The second uses the relative size of certain tax rates to others rather than the tax rates themselves. This procedure represents a simple attempt to recognize the notion that the relation of the corporate tax rate to the personal tax rate and the relation of the capital gains tax rate to the personal tax rate may be more relevant to leveraging decisions than the individual levels of tax rates.

Chart 2
Corporate Leverage and Tax Policy



Source: IRS data; manufacturing corporations only

In both formulations, a variety of other specifications involving both complete and incomplete sets of the tax variables and the use of lagged — as well as contemporaneous — measures of the independent variables also were employed.[25] The results of these complex variants are not reported here because the coefficients on the tax rate variables (the corporate, personal, and capital gains tax rates) appear quite insensitive to the model specification.

The parameters of the two basic regression formulations are presented in Table 1. In both cases, the signs on the tax parameters are those expected from the earlier theoretical discussion. Leverage appears to be positively associated with the corporate tax rate, the capital gains tax rate, and increases in the inflation rate; it is negatively related to the personal tax rate and the prevalence of use of nondebt-related tax shields. Consequently, as is indicated in the second regression, leverage is positively associated with increases in the difference between the corporate tax rate and the personal tax rate (the "tax differential") and with the difference between the maximum capital gains tax rate and the tax rate on ordinary personal income.

The Durbin-Watson statistics for both regressions suggest a moderate degree of correlation among the residuals of the regression and, hence, the possibility of imprecision in the estimates of the standard errors of the coefficient. Correcting this problem with simple techniques yields essentially similar results.[26] The consistency of the signs with that suggested by theory and the relative robustness of the finding with respect to specification of the regression is encouraging. The few tax variables (and the inflation rate variable) alone explain up to

85 percent of the observed variation in aggregate leverage in the manufacturing sector over the last 50 years.

Tax Policy and the Issuance of Debt and Equity

The disadvantages of direct study of leverage are apparent from Chart 2. Conceptual problems of measurement aside, data are available consistently only from the 1930s. We are therefore unable to test the effects of the greater variation in tax policy that characterized the first part of this century. For the reasons stated earlier, however, the trend in the excess of debt over equity issuance also may provide information about leverage trends. In contrast to the leverage measure, data on net debt and equity issuance are available in market value terms from the first decade of the century to the present.

Chart 3 presents one measure of the excess of debt issuance over equity issuance along with the simple tax differential variable. Although there is considerable volatility in the measure of debt minus equity issuance, the pattern of corporate security issuance seems to be positively and quite consistently related to the tax parameters. In Table 2, regression results that relate the issuance measure to the complete set of tax parameters are presented. As might be expected given the much greater volatility of the issuance measure than the direct leverage measure (and the theoretically less straightforward link between issuance and tax policy), the empirical findings are less consistent than those using the leverage measure directly.

In particular, while the coefficients on the corporate and personal tax rates and the capital gains tax rate have the anticipated signs, the sign on the

TABLE 1

Leverage in Manufacturing Corporations, 1935-1982

Dependent Variable	Ratio of Liabilities to Equity for Manufacturing Corporations	
Regressions	**1**	**2**
Corporate Tax Rate	2.4*	
	(10.5)	
Personal Tax Rate	-1.2*	
	(4.8)	
Capital Gains Tax Rate Tax	0.3	
	(1.3)	
Nondebt Shield	-2.4*	-1.4*
	(4.8)	(3.1)
Inflation Rate	1.4*	1.3*
	(3.0)	(2.6)
Corporate minus Personal Tax Rate		1.9*
		(9.9)
Capital Gains minus Personal Tax Rate		0.2
		(0.8)
N	48	48
R^2	.87	.85
D.W.	1.67	1.78

Note: The regressions are based on annual data using contemporaneous observations on the dependent and independent variables. No attempt to correct for serial correlation in the error terms was made. All tax rate computations employ the highest tax rate in force during the year.

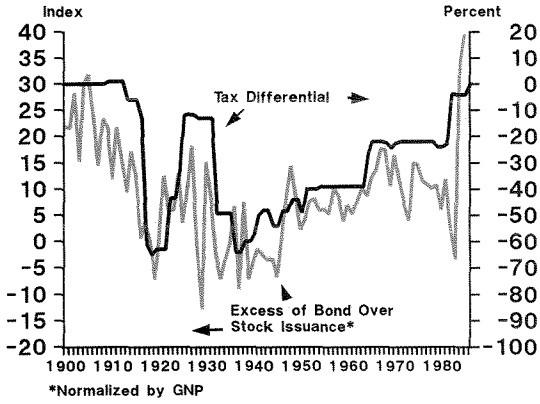
* Indicates that the estimated coefficient differs from zero at the 90 percent level of confidence or better.

"nondebt shield" variable is the opposite of what was expected. In addition, the sign on the inflation variable in the second regression is inconsistent with expectations, although both sets of coefficients are not statistically different from zero. The essential relationships between the issuance activity and the tax policy variables, however, have the signs predicted by the simple model of the leverage decision presented earlier.

Tax Policy and the Issuance of Low-Grade Debt

We turn now to an examination of the influence of tax policy on a particular type of debt: below-investment grade or "junk" debt. In recent years, the issuance of debt below investment-grade debt has increased sharply. This phenomenon usually has

Chart 3
Debt vs. Equity Issuance and Tax Policy



*Normalized by GNP

Table 2

Net Issuance of Corporate Securities, 1908-1985

Dependent Variable	Net Debt Issuance minus Net Equity Issuance / Current GNP	
Regressions	**1**	**2**
Corporate Tax Rate	-29.3*	
	(3.7)	
Personal Tax Rate	-32.9*	
	(6.5)	
Capital Gains Tax Rate Tax	16.1*	
	(2.3)	
Nondebt Shield	25.5	37.1*
	(1.4)	(2.2)
Inflation Rate	18.8	-9.6
	(1.4)	(0.8)
Corporate minus Personal Tax Rate		18.9*
		(3.7)
Capital Gains minus Personal Tax Rate		10.9*
		(2.7)
N	75	48
R^2	.40	.85
D.W.	1.68	1.78

Note: The regressions are based on annual data using contemporaneous observations on the dependent and independent variables. No attempt to correct for serial correlation in the error terms was made. All tax rate computations employ the highest tax rate in force during the year.

* Indicates that the estimated coefficient differs from zero at the 90 percent level of confidence or better.

been ascribed to a variety of nontax factors. One explanation, for example, is that recent declines in interest rates have made investors generally more reluctant to seek high-risk investments to obtain the high yields to which they have become accustomed. Related to this explanation is the claim that investment bankers and brokers only recently have discovered untapped investor interest in high-yield, high-risk instruments. A second conventional explanation is that improvements in information technology now make it economical to evaluate investments in smaller and high-risk firms, whose debt typically would be of lower grade.

Combined with the growth of investment portfolios of sufficient scale to permit diversified holdings of low-rated debt, the factors cited are seen as making the issuance of junk bonds more feasible. Indeed, the factors may be contributing to the recent growth in the use of low grade debt by U.S. corporations, except that the first argument is *ad hoc* and difficult to verify empirically. The second explanation, emphasizing technological change, is at variance with the history of the use of low-grade debt. As we shall see, low-grade debt was used extensively early in this century. Indeed, the highest volumes of junk debt were issued in the "low-tech" decades of the century.

In this context, it is interesting to examine the influence of tax factors alone on junk debt activity. Unfortunately, a single continuous body of data on the outstanding volume of junk debt does not exist. All that is available is the data on the gross flow of new issues of debt that are below investment grade.[27] This is a biased estimate, of course, of *net* issuance of this type of debt, since neither retirements of outstanding low-grade debt nor the effects

TABLE 3

Issuance of Junk Bonds, 1908-1985

	Gross Par Value of Junk Bonds Issued			
Dependent Variable	Current GNP			
Regressions	**1**	**2**	**3**	**4**
Corporate Tax Rate	24.1*	16.1*		
	(1.8)	(2.2)		
Personal Tax Rate	-15.5*	-1.6		
	(4.5)	(0.4)		
Capital Gains Tax Rate Tax	-8.4*	-4.7		
	(1.8)	(-1.4)		
Nondebt Shield	-23.1	11.2	-23.6*	7.9
	(1.5)	(1.0)	(1.9)	(0.7)
Inflation Rate	8.2	2.2	9.7	0.6
	(0.9)	(0.4)	(1.0)	(0.1)
Corporate minus Personal Tax Rate			13.8*	4.1*
			(3.5)	(2.1)
Capital Gains minus Personal Tax Rate			4.4	-3.0
			(0.9)	(0.9)
N	71	71	71	71
R^2	.69	.87	.47	.85
D.W.	.80	2.45	.45	2.57
Rho	-	0.74	-	0.84

Note: The regressions are based on annual data using contemporaneous observations on the dependent and independent variables. All tax rate computations employ the highest tax rate in force during the year.

* Indicates that the estimated coefficient differs from zero at the 90 percent level of confidence or better.

of changes in the rating of outstanding debt issues are incorporated in this data. Finally, there is a potential problem in the consistency of even the available data over time since there has been no single source for the data over the long time period of interest.

Although the various authors that have produced estimates of debt issuance have attempted to employ consistent standards and sources, there easily may be "drift" in effective debt rating criteria over time. Additionally, the rating of directly placed debt is usually not available, and analysts have had to apply proxies (such as the rating of publicly issued debt of a corporation) in making inferences about the quality of private placements.[28]

Despite these serious difficulties, the statistical relationship between tax policy and junk debt issuance activity displays rough correspondence with that suggested by the theories of issuance of high-risk debt. We used the same regression models employed in the analysis of aggregate debt issuance with a time series on junk debt issuance assembled from the available sources. As with the aggregate debt series, the issuance volume is expressed relative to current gross national product as a simple means of expressing the dimension of the activity relative to the aggregate "size" of the economy.[29]

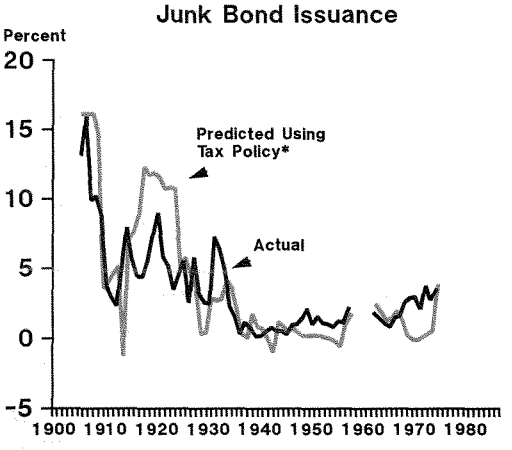
The results of the regression analysis are presented in Table 3. Most of the signs on the tax parameters are the same as those found earlier in the analysis of aggregate corporate leverage relationships and the aggregate issuance of debt and equity.

There are some statistical problems with the estimates, however. In particular, the low Durbin-Watson statistics suggest that there is a strong serial correlation among the residuals. This problem likely follows from the exclusion of important explanatory variables and thus is not likely to be redressed by simple statistical treatment of the correlated residual problem. Nonetheless, in equations 2 and 4, the results of regressions employing a Cochran-Orcutt specification are reported for the two basic specifications of the model. Qualitatively, the effects of the corporate tax rate and the personal tax rate on ordinary income are unaffected by the specification and confirm the notion that junk bond issuance is positively related to the corporate tax rate and negatively related to the personal tax rate. However, the possibility remains that the equations are misspecified in an important way.

From the results of regressions 1 and 2, the effect of the capital gains tax — which is potentially theoretically ambiguous for reasons cited earlier — appears to be such that an increase in this tax rate decreases junk bond issuance. However, this finding is not confirmed by the alternative specifications represented by regressions 3 and 4. Similarly, the sign on the nondebt-related shield variables in equations 1 and 3 is consistent with the theoretical expectation that increases in such shields decrease the use of debt generally and low-grade debt specifically; when the Cochran-Orcutt specification is employed, however, the coefficient is indistinguishable from zero, although it has a positive sign.

Despite these difficulties, the general concordance of these results with those found earlier provides at least weak confirmation of the notion that factors that increase leverage generally also tend to increase the use of "junk" debt. In Chart 4, the predicted and actual junk debt issuance volume is displayed. Changes in tax variables alone appear clearly to be associated not only with the high volumes of junk debt issuance early in the century, but also the recent resurgence in low-grade debt use.

Chart 4
Junk Bond Issuance



Note: issuance is par amount of offerings relative to GNP

*From Table 3, equation 1.

IV. Summary and Policy Implications

The theory of corporate financial structure was altered three decades ago by the notion that the mixture of debt and equity used by a firm to finance its assets was irrelevant to the value of the firm. The "irrelevance theorem", first advanced by Modigliani and Miller, stimulated a large literature that tries to explain the apparently contradictory *empirical* evidence of capital structure to firms. Several strands of this literature emphasize the role of the tax treatment of corporations and households as the mechanism by which the total amount of debt and equity in the economy — if not that of individual firms as well — becomes determinate. This paper has attempted to test for the influence of tax policy using long time series on various indicators of corporate financial structure.

Specifically, trends in the aggregate leverage displayed by U.S. manufacturing corporations, the relative volume of net debt and equity issuance, and the volume of low-grade debt issuance were studied. They were examined for evidence of a relationship to four important tax parameters: the marginal corporate tax rate, the marginal personal tax rate, the personal tax rate applied to capital gains, and the relative importance of nondebt related shields at the corporate level. Although such a study faces a number of theoretical and measurement problems, simple regression analyses reveal essential consistency between the relationships posited by a simple theoretical model of tax influence on corporate structure and actual behavior of these various measures.

Everything else being equal, an increase in the corporate marginal tax rate or the tax on capital gains increases the use of debt generally and low-grade (risky or "junk") debt specifically. In contrast, increases in the personal marginal tax rate, or the availability of nondebt related shields (such as depreciation and depletion allowances and the investment tax credit) appear to reduce debt use by corporations.

Implications of the 1986 Tax Act

With these findings, the changes in federal tax law made with the passage of the 1986 Tax Act take on special importance. Among other provisions, that tax reform legislation altered significantly the relationship between personal and corporate tax rates, the tax treatment of capital gains, and the availability of nondebt related tax shields for the corporation. The corporate tax rate, for example, will be 34 percent while the marginal personal tax rate paid by the highest income households will be only 28 percent.[30] The result is that, for the first time in almost 80 years, the corporate tax rate will exceed the personal marginal tax rate.

In addition, the tax preference afforded long-term capital gains is to be eliminated. In terms of the discussion above, the elimination is tantamount to an increase in the rate at which income from capital is taxed relative to ordinary income. The Tax Act alters the availability of nondebt-related shields in a significant way as well. The allowed period over which various assets may be depreciated is shortened significantly and the investment tax credit — that had been in existence in some form for most of the post-war period — is eliminated.[31] Finally, some restrictions have been imposed on household borrowing through the limitation of deductibility of consumer debt.

If the discussion and results of this paper were correct, all of these changes bias the balance between debt and equity toward increased use of debt. Using the estimated coefficients from the regression models presented earlier and the tax parameters implied by the 1986 tax reform, significant increases in the use of debt generally and junk debt in particular can be projected. For leverage in manufacturing corporations, for example, this projection implies an increase in the debt-equity ratio from the 1.3 observed in the last year for which data are available (1982) to a ratio of 1.9. Similarly, the excess of debt over equity issuance is projected to increase by 200 percent over its 1982 level, and junk bond issuance by 150 percent over its 1985 level.[32]

Policy Implications

From a broader policy viewpoint, these developments may have undesirable implications. Higher levels of corporate leverage make the corporate sector more susceptible to adverse changes in their income. Thus, an unanticipated economic downturn

would have a more deleterious effect on U.S. corporations.

This result is troublesome in and of itself to investors (including the banking sector) that hold debt and equity shares in American corporations. But even more serious is the prospect raised by Bernanke that widespread loss of confidence in the liabilities of U.S. corporations could have a depressing systemic on economic activity that exceeds the aggregate of the individual losses that might confront firms. Others have pointed out that precarious financial circumstances in the corporate sector make it more difficult for a nation's central bank to pursue a tight money policy, if that should be desired, for fear of precipitating a recession.

The tax treatment of corporations — specifically, the relatively high tax rates to which U.S. corporations are now exposed — long has been guided by a concern that corporations "pay their fair share" of federal government revenue requirements. If the links between tax policy and corporate leverage discussed in this paper were realistic, and the link between corporate leverage and economic fragility is as important as some have suggested, then requiring corporations to pay relatively high tax rates could prove to be a very costly political stance.

FOOTNOTES

1. The ratio of debt to equity in manufacturing firms was .55 in 1960 and 1:25 in 1982. The source of this data is the Internal Revenue Service, *Statistics of Income: Corporation Income Tax Returns*, annually, and its predecessor publications.

2. Data Source/IDD Information Services, Inc.

3. Ben S. Bernanke, "Nonmonetary Effects of the Financial Crisis in the Propagation of the Great Depression," *American Economic Review*, June 1983, pp. 257-276.

4. Bernanke, *ibid*, and Hyman Minsky, "A Theory of Systemic Fragility," in Altman and Sarnetz, eds, *Financial Crises: Institutions and Markets in a Fragile Environment*," New York: Wiley-International, 1977.

5. Another variant of the same argument is that any advantages of leverage achieved at the corporate level can be undone by investors. For leverage to cause corporate share values to be higher, investors must find it more costly to achieve leverage privately (that is, by issuing their own debt). If, in contrast, firms and households face the same borrowing and lending opportunities, such "homemade" leverage will be able to undo any effects of corporate leverage. Once again, therefore, leverage at the corporate level will be irrelevant, although the aggregate of corporate plus household debt and equity outstanding could be determinate. See, F. Modigliani and M. Miller, "The Cost of Capital, Corporation Finance and the Theory of Investment," *American Economic Review*, June 1958, pp. 261-297.

6. See, R. Bresley and S. Myers, *Principles of Corporate Finance*, McGraw-Hill, 1984, appendix to Chapter 17.

7. This follows from the fact that the periodic shield is the corporate tax rate times the debt coupon, or $t_c Dr$, where r is the coupon interest rate on the perpetual debt. The present value of such a perpetual stream of shields is $(t_c Dr)/r = t_c D$.

8. Income from equity consists of appreciation of capital shares and payment of dividends. Appreciation of capital shares is treated favorably because the tax liability can be postponed until the gains are realized and because these gains typically have been taxed at a lower rate than ordinary income. Dividend income, although nominally taxed at the same rate as ordinary income, can be converted easily into capital gains outside the firm if an investor borrows optimally to finance share ownership. See M. Miller and M. Scholes, "Dividends and Taxes," *Journal of Financial Economics*, December 1978, pp. 333-364. Indeed, if this were not the case, it is unclear why firms would ever pay dividends given the preferential treatment afforded capital gains.

9. See, M. Miller, "Debt and Taxes," *Journal of Finance*, May 1977, pp. 261-275.

10. A simple graphical presentation of this point is available in V. Aivazian and J. Callen, "Miller's Irrelevance Theorem: A Note," *Journal of Finance*, March 1987, pp. 169-179.

11. H. DeAngelo and R. Masulis, "Optimal Capital Structure under Corporate and Personal Taxation, "*Journal of Financial Economics*," March 1980, pp. 3-29.

12. Aivazian and Callen, *op cit.*

13. See, for example, N. Baxter, "Leverage, Risk of Ruin, and the Cost of Capital," *Journal of Finance*, March 1967, pp. 395-403.

14. M. Jensen and W. Meckling, "Theory of the Firm: Managerial Behavior, Agency Costs, and Ownership Structure," *Journal of Financial Economics*, October 1976, pp. 305-360.

15. The difficulties involved are typified by the study of bankruptcy cost by Warner. See, J. Warner, "Bankruptcy Costs: Some Evidence," *Journal of Finance*, May 1977, pp. 337-348.

16. Zechner and Swoboda, "The Critical Tax Rate and Capital Structure," *Journal of Banking and Finance*, (10) 1986, pp. 327-341.

17. I am indebted to Chris James for suggesting this effect.

18. Specifically, firms may have selected their industrial activities or their form of organization to obtain the most generous tax treatment. Conglomerate organization, for example, allows use of nondebt-related shields by firms whose other activities would not normally generate them, for example.

19. See Cohen, Zinbarg and Zeikel, *Investment Analysis and Portfolio Management*, Richard D. Irwin, Inc, 1977, p. 127 for a description of the construction of the Standard and Poor's value-weighted stock indices.

20. The aggregate of corporate liabilities and assets is reported annually by industry in Internal Revenue Services, *Statistics of Income: Corporation Tax Returns* and its predecessor publications. See also, L. Tambini, "Financial Policy and the Corporation Income Tax," in A. Harberger and M. Bailey, eds., *The Taxation of Income from Capital*, Brookings Institution, 1969, pp. 185-222.

To the author's knowledge, the IRS data is the only consistent source of data both on liabilities and assets of U.S. corporations that includes the pre-war period. However, the flow-of-funds data of the Board of Governors of the Federal Reserve System provides quarterly estimates of the book value of outstanding debt for the nonfinancial corporate sector from 1952 to the present, and annual balance sheets for nonfinancial corporations are available in "Balance Sheets For the U.S. Economy," Board of Governors of the Federal Reserve System, Washington, D.C., from 1947. An attempt is made in this publication to assign market values to debt and equity, but the estimates likely suffer the handicaps cited in the text. Regressions run with these measures, however, generally conform to those presented here.

21. At best, dividend policy is considered irrelevant by most economists. See, for example, F. Black and M. Scholes, "The Effects of Dividend Yield and Dividend Policy on Common Stock Prices and Returns," *Journal of Financial Economics*, May 1974, pp. 1-22.

22. M. Miller, *op cit.*

23. The tax shield variable is constructed as follows. Total deductions for depletion, depreciation and interest costs and total investment tax credits taken by all nonfinancial corporations is reported annually in the Internal Revenue, *Statistics on Income: Corporate Income Tax Returns* and its predecessor publications for the study period. The "deduction equivalent" of the investment tax credit (ITC) is computed using the current primary corporate income tax rate. A variable called "Nondebt Shield" is computed by taking the ratio of depletion, depreciation, and the deduction equivalent of the ITC to total deductions.

24. Since the ability to convert dividend income to capital gains and to delay payment of taxes on capital gains exists even if the statutory rate of tax on capital gains is the same as that on ordinary income, no attempt is made to imbed this condition in the regression analyses presented below.

25. A first differences formulation and various simple and polynomial distributed lag structures on the coefficients of the independent variables were examined as well. There was no evidence of significant lagged effects or qualitative differences among the performance of the simple regressions, the lagged representations, and first difference representations.

26. Both first differences and Cochran-Orcutt specifications were employed.

27. Data is available from Hickman for the period 1900-1943, Atkinson for the period 1944-1965, and Altman and Namacher and IDD Information Services, and the Board of Governors of the Federal Reserve System for 1970 to the present. Data permitting separation of public and private placements is not always available, so the regressions reported below are based on total (that is, public and privately placed) debt. Junk debt is considered debt issued with a Moody's rating below Baa or equivalent plus unrated corporate debt. Tests were conducted on sub-periods of the data to explore the sensitivity of the findings in this paper to the definition of junk debt.

See W. Hickman, *Statistical Measures of Corporate Bond Financing Since 1900*, Princeton University Press, 1960, T. Atkinson, *Trends in Corporate Bond Quality*, Columbia University Press, 1967, and E. Altman and S. Nammacher, *Investing in Junk Bonds: Inside the High-Yield Debt Market*, John Wiley and Sons, 1987, for additional discussion of the market in bonds of various quality ratings.

28. See the individual data sources cited in the previous note for details on the treatment of privately placed and unrated debt.

29. As was noted above, the conceptually appropriate treatment of these flow measures would require that the difference in the percentage changes of debt versus equity be studied. In the absence of accurate measures of outstanding stocks of debt and equity, expression of the issuance flow data relative to the gross national product may be justified as the basis that GNP may move in proportion to total corporate assets.

30. In fact, the effective marginal tax rate for middle income individuals can be as high as 33 percent because of a provision that phases out exemptions as gross income rises. In either case, however, the highest marginal personal income tax rate is lower than the corporate rate.

31. By lengthening the allowable life of depreciable assets for tax purposes and by eliminating the investment tax credit, the availability of nondebt shields relative to debt-related shields is reduced.

32. In these projections, a corporate tax rate of 34 percent and a personal tax rate of 28 percent are assumed. In addition, the difference between the capital gains tax rate and the tax rate on ordinary income is set equal to zero (that is, the tax on equity income is assumed equal to the tax on ordinary income) and the nondebt shield variable is set to 0.5. Finally, the three percent change in the inflation rate is assumed. The projections are generated by the first regression in Tables 1, 2 and 3; the numbers cited in the text are approximations derived from those simulations.