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WHY DOES THE PAPER-BILL SPREAD PREDICT REAL ECONOMIC ACTIVITY?

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ABSTRACT

Evidence based on the past three decades of U.S. experience shows that the difference between the interest rates on commercial paper and Treasury bills has consistently borne a systematic relationship to subsequent fluctuations of nonfinancial economic activity. This interest rate spread typically widens in advance of recessions, and narrows again before recoveries. The relationship remains valid even after allowance for other financial variables that previous researchers have often advanced as potential business cycle predictors.

This paper provides support for each of three different explanations for this predictive power of the paper-bill spread. First, changing perceptions of default risk exert a clearly recognizable influence on the spread. This influence is all the more discernable after allowance for effects associated with the changing volume of paper issuance when investors view commercial paper and Treasury bills as imperfect portfolio substitutes -- a key assumption for which the evidence introduced here provides support. Second, again under conditions of imperfect substitutability, a widening paper-bill spread is also a symptom of the contraction in bank lending due to tighter monetary policy. Third, there is also evidence of a further role for independent changes in the behavior of borrowers in the commercial paper market due to their changing cash requirements over the course of the business cycle.

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People have always sought reliable ways to predict the future, and economic fluctuations are no exception. Public policymakers, charged with the responsibility to maintain full but not over-full employment of the economy's productive resources, want to know when to take actions that will either stimulate or retard economic activity. Business executives who plan to build new factories or modernize old ones, or who consider the introduction of new products, want to know when the markets for what their companies make will be strong. Both individual and institutional investors, allocating their portfolios across major asset categories like equities and fixed-income securities, and in some cases picking specific corporations' stocks, want to know whether recession or economic expansion will prevail over the relevant investment horizon.

A series of recent papers -- Stock and Watson (1989a), Friedman and Kuttner (1989), Bernanke (1990), Kashyap et.al (1991) -- has shown that, for the past three decades or so, the difference between the respective interest rates on commercial paper and Treasury bills has borne a systematic relationship to subsequent fluctuations of nonfinancial economic activity in the United States. As such relationships go, this one has been fairly robust. The paper-bill spread easily outperforms any single interest rate, either nominal or real, as

well as any of the monetary aggregates, as a predictor of real economic activity. The spread bears a statistically significant relationship not just to future movements of aggregate output and spending, but to almost all of the familiar components of real activity as well. Finally, in contrast to the monetary aggregates (the subject of an earlier literature along these lines, which ended in spectacular disappointment), there is no ambiguity about whether the paper-bill spread is related to the real or price side of nominal income fluctuations. (On the latest evidence, money is related to neither.) The spread is a predictor of real economic activity, not prices, and of nominal magnitudes only to the extent that they reflect real ones.

Why is all this so? And is there any ground for confidence that the relationships that have connected the paper-bill spread to subsequent business fluctuations in the past will continue to prevail for at least some time into the future? These questions motivate the analysis presented in this paper.

Section I briefly reviews and expands the evidence from previous work documenting the relationships between the paper-bill spread and real economic activity in the United States. Section II details some of the practical differences between commercial paper and Treasury bills that plausibly account for the spread between the respective interest rates on these two instruments. An important product of this part of the analysis is a decomposition of the observed spread into a component that covaries directly with the general level of interest rates; a component directly representing the variation over time in the perceived risk of default on commercial paper; and a component capturing other influences that vary over time in a way that may or may not be related to the business cycle. Section III uses a simple model of the behavior of borrowers and lenders in the short-term credit markets to develop three distinct (albeit not mutually exclusive) hypotheses to account for the relationship

between the paper-bill spread and fluctuations in business activity. Section IV applies a variety of statistical tests to provide evidence bearing on the validity of any or all of these three hypotheses. Section V brings together the principal conclusions developed throughout the paper.

To anticipate, the evidence presented in this paper suggests, at the least, a two-fold explanation for the predictive power of the paper-bill spread with respect to real economic activity, based on both default risk and monetary policy. First, changing perceptions of default risk, as business prospects alternatively strengthen and ebb, exert a clearly recognizeable influence on the spread and also account for part of the spread's relationship to subsequent movements of real output. Second, in a world in which investors view commercial paper as an imperfect substitute for Treasury bills -- a key assumption, for which the relationships estimated in Section IV provide some supporting evidence -- a widening paper-bill spread is also a symptom of the contraction in bank lending due to tighter monetary policy. Finally, independent changes in the behavior of borrowers in the commercial paper market, due to their changing cash requirements over the course of the business cycle, also influence the paper-bill spread in ways that connect it to subsequent economic fluctuations.

I. The Basic Relationship

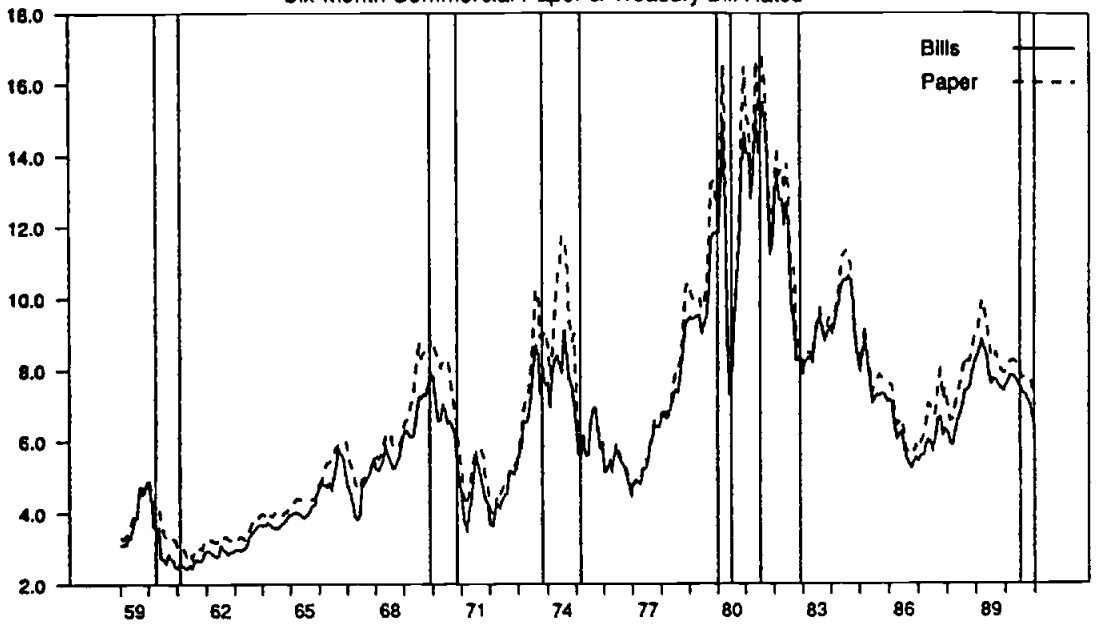
The upper panel of Figure 1 shows monthly-average values of the respective interest rates on 6-month prime-rated commercial paper and 180-day U.S. Treasury bills, for 1959-90.[1] Both series display the basic features characteristic of practically all U.S. interest rates during this period: a generally rising overall trend from the 1950s until the early 1980s, increasing volatility beginning in the early 1970s, a downward trend and reduced volatility in the mid to late 1980s, and the familiar cyclicality throughout. (The shaded areas in the figure represent recessions as designed by the National Bureau of Economics Research.) The commercial paper rate has, almost always, exceeded the Treasury bill rate.[2] While the covariation of the two series is hardly perfect, the dominant visual impression offered by these data is that the two interest rates tend to move roughly together over time.

The covariation of the two rates is not perfect, however, and the focus of this paper is on the movement over time of the difference between them. The lower panel of Figure 1 (with magnified scale compared to that of the upper panel) plots the monthly-average difference between the 6-month commercial paper rate and the 180-day Treasury bill rate for the same period. Over the entire 32-year sample, the mean spread was .57% per annum (that is, 57 basis points), with standard deviation .49%. In contrast to the upper panel, here there is little evidence of persistent time trends. But like the two interest rates themselves, the spread between them does display a distinct cyclicality. As Table 1 shows, the spread is typically wider not just during but also immediately prior to recessions (although the 1990 experience -- in which the spread widened much longer in advance of the recession, only then to narrow again before the recession began -- is an obvious counter-example).

Table 2, updated from Friedman and Kuttner (1989), shows that the widening

Figure 1

Six-Month Commercial Paper & Treasury Bill Rates



Six-Month Paper - Bill Spread

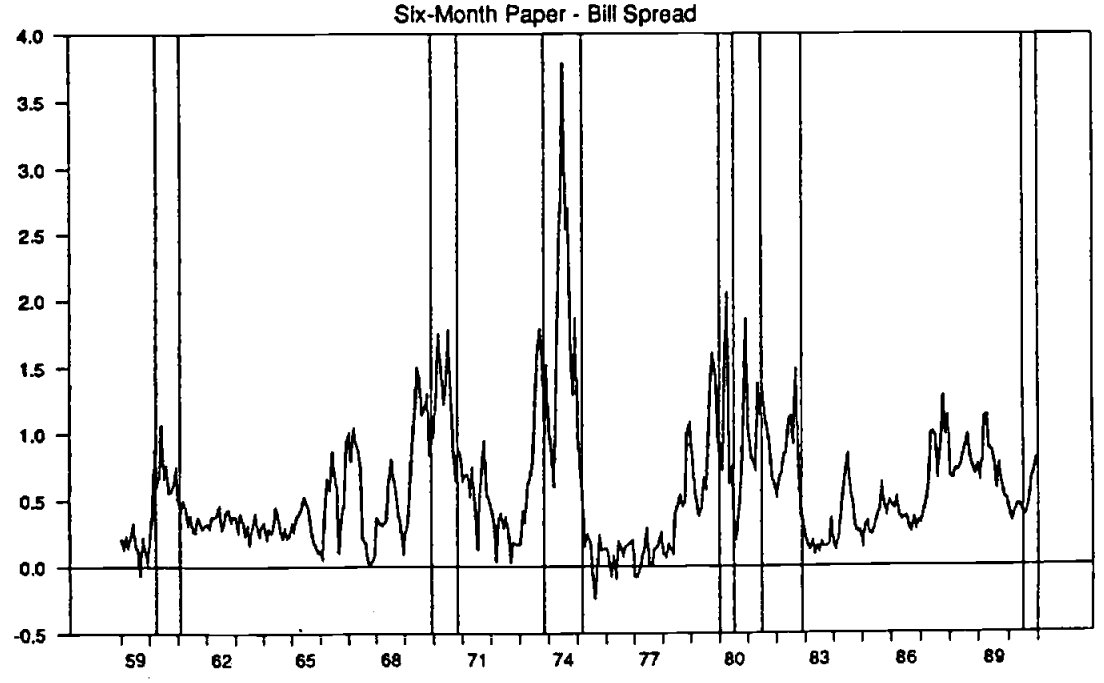


Table 1

Cyclical Behavior of the Paper–Bill Spread

	Spread (%)	Observations
Mean over entire 59:1–90:12 sample	0.57	384
Mean during recessions	1.10	66
Mean excluding recessions	0.46	318
Mean 1–6 months prior to recessions	0.88	36
Mean 7–12 months prior to recessions	0.50	36

Notes: Observations are monthly averages of daily data.
Underlying interest rates are for six-month commercial paper and six-month Treasury bills.
Source: Board of Governors of the Federal Reserve System.

Table 2

F-Statistics for Financial Variables in Quarterly Real Output Equations

Three-variable system (real output, price index, financial variable)

	60:2–90:4	60:2–79:3	70:3–90:4
$r_P - r_B$	7.70***	8.12***	5.32***
Δln(M1)	2.65**	2.59**	1.77
Δln(M2)	4.66***	3.78***	2.19*
Δln(Credit)	1.21	1.97	0.34
Δr_P	5.80***	1.95	4.14***
Δr_B	4.76***	2.21*	3.62***
$r_{10} - r_{FF}$	7.34***	4.44***	6.70***

Four-variable system (also including mid-expansion government expenditures)

	60:2–90:4	60:2–79:3	70:3–90:4
$r_P - r_B$	7.16***	7.10***	4.68***
Δln(M1)	2.85**	2.71**	1.81
Δln(M2)	4.32***	3.63***	1.81
Δln(Credit)	1.02	2.34*	0.16
Δr_P	5.61***	1.55	3.94***
Δr_B	4.52***	1.81	3.44**
$r_{10} - r_{FF}$	7.23***	3.82***	6.41***

* Significant at 10% level
** Significant at 5% level
*** Significant at 1% level

Notes: Regressions include four lags of each included variable.
Real output variable is gross national product in 1982 dollars.
Price index is the implicit GNP deflator.

of the paper-bill spread in anticipation of downturns in real economic activity represents information beyond that already contained in the serial correlation of real activity itself, or in fluctuations of either price inflation or federal government expenditures. The table also shows that other familiar financial variables, like interest rates or growth of the monetary aggregates, either do not contain such incremental information at all or do so to a lesser extent. The upper panel of the table presents F-statistics for the null hypothesis that all coefficients δ_i are zero in regressions of the form

$$\Delta X_t = \alpha + \sum_{i=1}^{4} \beta_i \Delta X_{t-i} + \sum_{i=1}^{4} \gamma_i \Delta P_{t-i} + \sum_{i=1}^{4} \delta_i Z_{t-i} + u_t \qquad (1)$$

where X and P are the natural logarithms of real gross national product and the corresponding price deflator, respectively; Z is, first, the difference between the 6-month prime commercial paper rate and the 180-day Treasury bill rate and then, in sequence, a series of other familiar financial variables as indicated in the table; u is a disturbance term; and α, β_i, γ_i and δ_i are all coefficients to be estimated. The lower panel presents analogous F-statistics based on equations that are identical to (1) except that they also include, as an additional set of regressors, a distributed lag on the (log) change in "mid-expansion" federal expenditures. The table presents results separately for the full 1960:II-1990:IV sample and for two sub-samples: 1960:II-1979:III (that is, until the Federal Reserve System's adoption of new monetary policy procedures in October 1979) and 1970:III-1990:IV (that is, since the elimination of Regulation Q interest ceilings on large certificates of deposit in June 1970).[3]

Among the seven financial variables considered, the paper-bill spread is

one of only two -- the other being the long-short spread -- that contain incremental information about subsequent movements of real output that is significant at the .01 level in the full 1960-90 sample and in both sub-samples separately, and regardless of whether the fiscal variable is included or not. Indeed, none of the other five financial variables considered meets this criterion even at the .10 significance level.

Table 3 presents an analogous set of results based on monthly data. Here industrial production takes the place of real gross national product, the producer price index takes the place of the GNP deflator, each distributed lag is of length 6, and the results shown correspond only to the upper panel of Table 2 -- that is, without the fiscal variable.[4] Here the paper-bill spread is alone among the seven variables tested in containing incremental information about subsequent movements of industrial production that is significant at the .01 level in the full 1960-90 sample as well as in both sub-samples separately. The growth rate of the M2 money stock, the change in the commercial paper rate and the long-short spread satisfy this criterion at the .05 level. None of the other financial variables does so even at the .10 level.

Table 4 presents results for an alternative form of test, suggested by Stock and Watson (1989b), again based on monthly data. The Stock-Watson regression includes 12 lags each of the respective log changes in industrial production and the producer price index, 12 lags of the change in the commercial paper rate (so that the list of variables corresponding to Z now excludes the paper rate change and the bill rate change), 6 lags on the designated financial variable, and a linear time trend. Here the paper-bill spread is again the only financial variable tested that contains incremental information about subsequent movements in industrial production that is significant at the .01 level regardless of sample. None of the others -- including the long-short spread --

Table 3

F-Statistics for Financial Variables in Monthly Real Output Equations

Three-variable system (real output, price index, financial variable)

	60:2–90:12	60:2–79:9	70:7–90:12
$r_P - r_B$	8.47***	6.33***	6.10***
Δln(M1)	2.27**	2.23**	0.95
Δln(M2)	4.70***	3.69***	2.12**
Δln(Credit)	1.45	1.44	1.46
Δr_P	2.89***	3.40***	2.09*
Δr_B	2.03*	1.17	1.61
$r_{10} - r_{FF}$	3.99***	4.73***	2.49**

* Significant at 10% level
** Significant at 5% level
*** Significant at 1% level

Notes: Regressions include six lags of each included variable.
Real output variable is industrial production.
Price index is the producer price index.

Table 4

F-Statistics for Financial Variables in Monthly Real Output Equations (Stock-Watson Specification)

Four-variable system (real output, price index, commercial paper rate, financial variable)

	60:2–90:12	60:2–79:9	70:7–90:12
$r_P - r_B$	6.04***	2.85***	4.24***
Δln(M1)	0.83	0.77	0.59
Δln(M2)	3.08***	2.25**	1.47
Δln(Credit)	1.10	0.93	1.29
$r_{10} - r_{FF}$	2.11*	1.16	1.62

* Significant at 10% level
** Significant at 5% level
*** Significant at 1% level

Notes: Regressions include six lags of the financial variable, twelve lags on each of the other three variables, and a linear time trend.
See Table 3 for variable definitions.

does so even at the .10 level.

Finally, Table 5 presents both F-statistics and variance decompositions based on a series of vector autoregression systems including, in each case, the respective log changes in real output and the corresponding price deflator, the paper-bill spread and, one at a time in succession, each of the other financial variables considered in Tables 2 and 3 above. The estimation is based on quarterly data, with variables and lag specification corresponding to that underlying the upper panel of Table 2. For each system, the table presents the F-statistics for the distributed lags on the paper-bill spread and the other financial variable in the equation for real output, and then the respective share of the variance of real output accounted for by the paper-bill spread and by the other financial variable (together with the corresponding 95% confidence intervals), measured at both four- and eight-quarter horizons. For purposes of these variance decompositions, the real output variable is ordered first, the price variable second, the other financial variable third, and the spread last.

When the measure of output used is real gross national product (the upper panel), the F-statistics presented in Table 5 indicate that the paper-bill spread contains incremental information about subsequent movements in real output that is significant at the .01 level in the presence of any of the additional financial variables except M2 and the long-short spread, in which case the relevant information is significant at the .05 level and the .10 level, respectively. Among the other financial variables considered, only the long-short spread and the bill rate change are significant here at the .10 level or better in the presence of the paper-bill spread.

When the output measure is real domestic absorption (the middle panel), however, the paper-bill spread contains information that is significant at the .01 level in the presence of <u>any</u> of the other financial variables. Among the

Table 5

Performance of Alternative Financial Indicators in Quarterly Real Output VARs

Output = real gross national product

	$\Delta\ln(M1)$	r_P-r_B	$\Delta\ln(M2)$	r_P-r_B	$\Delta\ln(Credit)$	r_P-r_B
F-Statistic	1.59	6.29***	0.76	3.33**	0.92	7.11***
% of variance @ 4Q	9 ± 9	18 ± 12	12 ± 10	9 ± 9	4 ± 5	22 ± 12
@ 8Q	11 ± 9	18 ± 12	15 ± 11	10 ± 8	5 ± 5	22 ± 12

	Δr_B	r_P-r_B	Δr_P	r_P-r_B	$r_{10}-r_{FF}$	r_P-r_B
F-Statistic	2.19*	4.81***	1.89	3.51***	2.09*	2.39*
% of variance @ 4Q	12 ± 10	14 ± 10	16 ± 11	9 ± 8	15 ± 11	7 ± 7
@ 8Q	16 ± 11	14 ± 10	18 ± 12	10 ± 8	17 ± 11	13 ± 11

Output = real domestic absorbtion

	$\Delta\ln(M1)$	r_P-r_B	$\Delta\ln(M2)$	r_P-r_B	$\Delta\ln(Credit)$	r_P-r_B
F-Statistic	1.44	8.57***	1.81	5.26***	1.34	10.30***
% of variance @ 4Q	10 ± 10	19 ± 12	15 ± 11	10 ± 9	3 ± 5	27 ± 14
@ 8Q	12 ± 10	20 ± 12	17 ± 12	13 ± 9	4 ± 5	27 ± 14

	Δr_B	r_P-r_B	Δr_P	r_P-r_B	$r_{10}-r_{FF}$	r_P-r_B
F-Statistic	3.45**	6.79***	2.88**	4.06***	1.48	3.96***
% of variance @ 4Q	16 ± 11	15 ± 11	22 ± 12	8 ± 8	18 ± 12	8 ± 8
@ 8Q	22 ± 13	17 ± 11	23 ± 12	14 ± 10	19 ± 12	18 ± 12

Table 5

(continued)

Output = real business fixed investment

	Δln(M1)	r_P–r_B	Δln(M2)	r_P–r_B	Δln(Credit)	r_P–r_B
F-Statistic	0.32	4.07***	0.68	2.14*	0.17	4.66***
% of variance @ 4Q	7 ± 9	17 ± 12	14 ± 12	9 ± 10	2 ± 4	21 ± 14
@ 8Q	8 ± 9	20 ± 14	17 ± 14	10 ± 10	3 ± 4	24 ± 16

	Δr_B	r_P–r_B	Δr_P	r_P–r_B	r_{10}–r_{FF}	r_P–r_B
F-Statistic	2.26*	4.71***	1.60	4.32***	0.89	3.54***
% of variance @ 4Q	4 ± 5	20 ± 14	8 ± 9	17 ± 13	6 ± 8	13 ± 12
@ 8Q	12 ± 11	19 ± 14	15 ± 14	16 ± 12	14 ± 12	14 ± 11

* Significant at 10% level
** Significant at 5% level
*** Significant at 1% level

Notes: Sample in each case is 1960:2–1990:4.
Equations include four lags of each variable.
The mean variance decomposition and its confidence interval were computed via Monte-Carlo with 1000 draws.

others, here only the paper rate change and the bill rate change (separately) contain significant incremental information in the presence of the paper-bill spread. Similarly, when the output measure is real investment in plant and equipment, the paper-bill spread again contains information that is significant at the .01 level in the presence of any of the other financial variables. Here the bill rate change is the only other variable to contain significant incremental information in the presence of the paper-bill spread.[5]

The variance decomposition results presented in Table 5 largely support these findings from significance tests based on the output equation alone. In most of the vector autoregression systems estimated, the paper-bill spread accounts for a percentage of the variance of the relevant real output measure, either four or eight quarters ahead, that is both economically important (typically between 10% and 20%) and statistically significant (at the .05 level). Further, in most cases the paper-bill spread dominates whatever is the other financial variable in the system despite the ordering of the paper-bill spread last in the underlying orthogonalization. Table 6 highlights the relevance of this ordering by presenting alternative variance decomposition results for those three financial variables which, for at least some output measures, account for a greater share of output in the decompositions shown in Table 5. In these alternative results, in which the paper-bill spread is ordered third and the other financial variable fourth, the dominance of the paper-bill spread is pervasive.

In sum, both single-equation significance tests and multiple-equation variance decompositions based on the last three decades of U.S. experience consistently point to a statistically significant relationship between movements of the paper-bill spread and subsequent fluctuations in real economic activity, even in the presence of other financial variables that previous researchers have

Table 6

Performance of Alternative Financial Indicators in Quarterly Real Output VARs

Orthogonalization Order Reversed

Output = real gross national product

	r_P–r_B	Δln(M2)	r_P–r_B	r_{10}–r_{FF}	r_P–r_B	Δr_P
F-Statistic	3.33***	0.76	2.39*	2.09*	3.51***	1.89
% of variance @ 4Q	17 ± 12	4 ± 5	16 ± 11	6 ± 7	18 ± 12	7 ± 7
@ 8Q	16 ± 11	8 ± 8	15 ± 10	15 ± 11	17 ± 11	12 ± 9

Output = real domestic absorbtion

	r_P–r_B	Δln(M2)	r_P–r_B	r_{10}–r_{FF}	r_P–r_B	Δr_P
F-Statistic	5.26***	1.81	3.96***	1.48	4.06***	2.88**
% of variance @ 4Q	21 ± 13	5 ± 6	21 ± 13	4 ± 7	21 ± 12	10 ± 8
@ 8Q	20 ± 12	11 ± 10	21 ± 12	17 ± 13	21 ± 11	17 ± 11

Output = real business fixed investment

	r_P–r_B	Δln(M2)	r_P–r_B	r_{10}–r_{FF}	r_P–r_B	Δr_P
F-Statistic	2.14*	0.68	3.54***	0.89	4.32***	1.60
% of variance @ 4Q	18 ± 14	5 ± 7	17 ± 14	3 ± 4	21 ± 14	3 ± 4
@ 8Q	19 ± 14	8 ± 9	16 ± 13	12 ± 12	23 ± 14	7 ± 7

Notes: See notes to Table 5.

researchers have often advanced as potential business cycle predictors.

II. Accounting for the Spread

Commercial paper represents the unsecured, discounted short-term (up to 270 days) liability of either nonfinancial business corporations or financial intermediaries. As of yearend 1989, the volume of such claims outstanding in the United States totaled $579 billion, of which approximately 18% was the liability of U.S. nonfinancial businesses, 8% of U.S. bank holding companies, 52% of U.S. nonbank financial intermediaries, and 11% of foreign obligors. Roughly one-third of the $579 billion had been originally issued directly by the obligors (in practically all cases financial institutions) and the remaining two-thirds through commercial paper dealers acting in the obligors' behalf. Although commercial paper in some form or other has existed in the United States for over a century, the commercial paper market in its current form is largely a post World War II phenomenon, and the market's growth in recent decades has been rapid. As recently as 1960, for example, the total volume outstanding was just $6.5 billion (13% issued by U.S. nonfinancial businesses, 57% by U.S. nonbank financial intermediaries, and 18% by foreign obligors).[6]

Treasury bills represent the short-term (up to one year) discount obligations of the U.S. Treasury, backed by the full faith and credit of the United States Government. The Treasury first issued discounted instruments resembling today's Treasury bills in 1929. Since then the volume outstanding has fluctuated with the level of the government's debt and also with the varying maturity patterns used to finance that debt. Given the enormous volume of debt of all maturities used to finance the U.S. military effort in World War II, the Treasury bill market has been large and well developed throughout the post-war period. The volume of Treasury bills outstanding in 1946 was $17 billion. At yearend 1990 it was $482 billion.

Three factors appear most important in accounting for the typically greater

observed interest rate on commercial paper than on Treasury bills. First, federal statute precludes states or municipalities from taxing income earned as interest on any U.S. Treasury obligations, bills included, except for those states that employ the franchise tax on business income or impose an excise tax on bank income. By contrast, interest earned on privately issued obligations, like commercial paper, is typically taxable at the state or municipal level. As of 1990, 43 states (plus the District of Columbia) had individual income taxes, with rates applicable to interest income varying up to a high of 14% in Connecticut. Similarly, 28 states (plus the District of Columbia) had corporate income taxes.[7] In addition, some municipalities have income taxes applicable to interest income. In 1990 New York City taxed income earned by residents at a maximum rate of 3.95%.[8]

To the extent that an investor choosing between commercial paper and Treasury bills is a taxable entity domiciled in a state and/or municipality with an income tax, therefore, some positive interest rate spread between paper and bills is necessary to render the two instruments' respective returns identical on an after-tax basis -- that is, to achieve

$$(1-\tau)\, r_P = r_B \tag{2}$$

where r_P and r_B are the nominal interest rates paid on commercial paper and Treasury bills, respectively, and τ is the effective state/municipal tax rate. Moreover, the required spread for this purpose varies directly with the level of the tax-exempt rate, according to

$$r_P - r_B = \left(\frac{\tau}{1-\tau}\right) r_B \tag{3}$$

Given values of 0.57% for the spread and 6.48% for the bill rate, on average for the 1959-90 sample period spanned in Figure 1, the implied effective tax rate would be 8.1% (that is, .081) if differential taxability were the sole factor accounting for a nonzero average spread over time. (A 9.7% tax rate would be required to explain in full the average spread between commercial paper and Treasury bills at three months maturity.)

A second factor clearly differentiating Treasury bills from commercial paper is that payment on the paper is subject to potential default by private obligors. Moreover, in the event of bankruptcy, the unsecured status of commercial paper typically places it low on the scale in the application of the conventional "me-first" rules. Given any nonzero probability of default, even a risk-neutral investor would require a positive paper-bill spread to want to hold commercial paper instead of Treasury bills. The expected after-tax returns on the two assets are identical when

$$(1 - \pi\phi)(1-\tau)\, r_P - \pi\phi = r_B \qquad (4)$$

where r_P is now the promised interest rate on the commercial paper; π is the probability that a default on the paper will occur within the time horizon that is relevant for this investment; ϕ is the fraction, $0 \leq \phi \leq 1$, of the stated principal amount that the investor will lose in the event of default; and τ is again the state/municipal tax rate.

If investors are risk-averse, however, mere equality of expected returns is insufficient to make an investor willing to hold a risky rather than a risk-free asset, and so the required spread is correspondingly greater. To take a simple example, suppose that an investor's portfolio consists entirely of Treasury bills and commercial paper, and that the investor's choice between them is

governed by maximization of expected utility of nominal end-of-period wealth, where the "period" is identical to the stated maturity of the bills and the paper (so that the bills are genuinely riskless), and utility is characterized by constant relative risk aversion. Then the relationship between the two (promised) interest rates that leaves the investor just indifferent between the two assets at the margin is

$$[1 - \pi\phi - 2\alpha\rho\pi(1-\pi)\phi^2](1-\tau)\ r_P - \alpha\rho\pi(1-\pi)\phi^2(1-\tau)^2\ r_P^2 - \pi\phi[1 - \alpha(1-\pi)\phi] = r_B \qquad (5)$$

where α is the fraction of the investor's portfolio invested in commercial paper and ρ is the coefficient of relative risk aversion.

In contrast to the experience of the inter-war period, which included 171 separate default episodes, few issuers have defaulted on their outstanding commercial paper since World War II.[9] By far the most significant post-war default was Penn Central's failure to meet payment on $82 million of paper due in June 1970. Following the Penn Central default, the major credit rating agencies introduced new systems of rating commercial paper, not only distinguishing prime-rated from non-prime paper but also designating three separate categories of prime-rated paper (P-1, P-2 and P-3 by Moody's; A-1, A-2 and A-3 by Standard and Poor's). Since the introduction of these ratings, only five rated issuers have experienced defaults, and three of these had lost their prime ratings before their respective defaults occurred.[10]

Some authors have pointed to the scant experience of actual defaults to argue that default risk must play a small if not negligible role in accounting for the observed positive spread between the promised interest rate on commercial paper and the Treasury bill rate.[11] To be sure, this argument is

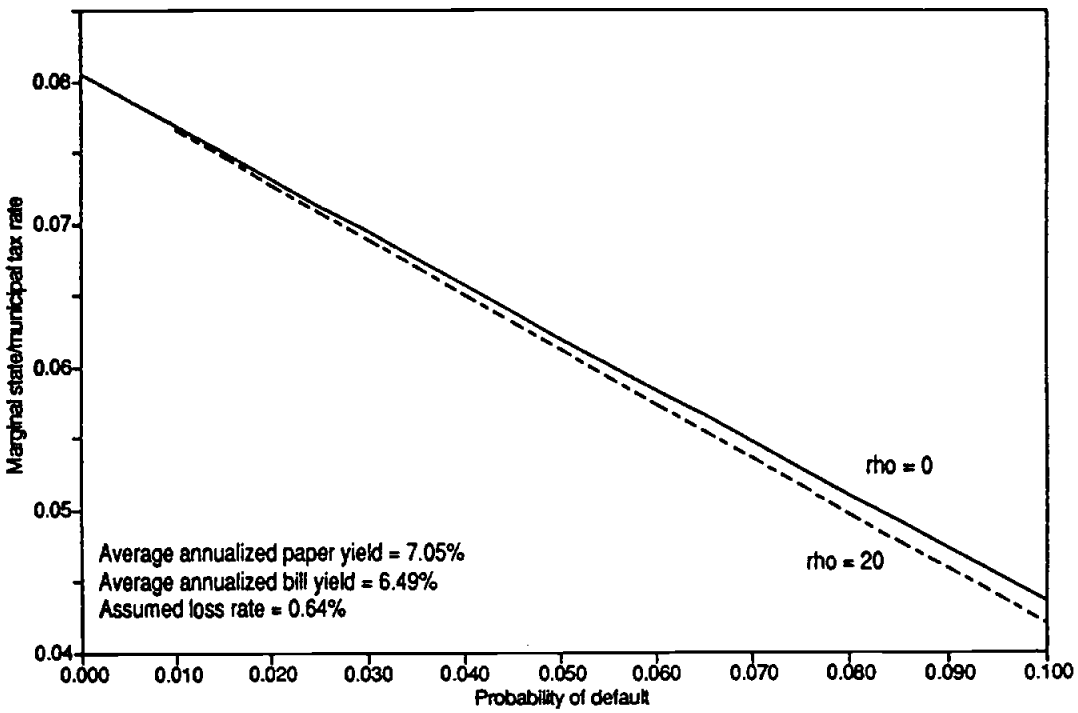
plausible if the question at hand is whether default risk alone can explain the spread. Like the two instruments' differing tax status, however, the relevant issue is the potential role played by default risk in conjunction with other factors.

Gauging the relevant default rate π and loss rate ϕ to employ in an expression like (5) is problematic for several reasons. One is just the distinction between event frequencies observed within any (finite) sample and the corresponding subjective probabilities as assessed by rational agents -- in other words, the familiar "Peso problem."[12] A second is that there is no guarantee that the relevant agents whose subjective probabilities have mattered for the relative pricing of commercial paper and Treasury bills were in fact "rational" in the usual technical sense. Yet a third is that many of these agents -- those acting in a fiduciary capacity, for example -- may have been responding to incentives not encompassed within the usual risk-return utility calculus. (The embarrassment in the event of a client's holding defaulted paper may matter, in addition to the pecuniary loss to the client's accounts.) Finally, many investors in commercial paper either cannot or do not diversify their holdings sufficiently to render their own potential loss rates equivalent to those of the commercial paper universe outstanding. Such investors therefore plausibly perceive a potential default as a more catastrophic event than what the aggregate data suggest.

Figure 2 plots combinations of default probability π (for values up to a maximum of .1) and state tax rate τ (for values up to .09) that satisfy the relationship in (5) for the average values of r_P and r_B observed over 1959-90, given loss rate $\phi = .0064$, portfolio proportion $\alpha = .37$ (the most recent actual paper/(paper + bill) ratio as measured in the Federal Reserve's Flow of Funds accounts), and two separate values of the coefficient of relative risk aversion

Figure 2

Tax Rates and Default Probabilities Consistent with the Mean Spread



ρ: 0 (that is, risk neutrality) and 20. A loss rate of .0064 corresponds to the worst recorded experience for the commercial paper market in any given year since World War I, when 0.64% of the outstanding paper was lost in defaults in 1931. Parameter π therefore represents the probability that investors associate with a given year's replicating the 1931 default experience.

As the discussion of equations (2) and (3) above indicates, a state tax rate of .081 would be sufficient to account fully for the observed mean paper-bill spread in the absence of any possibility at all of default. A non-zero probability of default makes the observed mean spread consistent with a lower tax rate. For example, if investors believe there is a one-in-twenty chance of default on 0.64% of their commercial paper holdings (that is, π = .05), this default probability together with a state tax rate of approximately .06 would be sufficient to account for the entire observed mean spread. As the figure makes clear, these results are not very sensitive to the assumed risk aversion.

Finally, a third factor potentially also underlying the positive average paper-bill spread is the greater liquidity of Treasury bills compared to commercial paper.[13] The market for U.S. Treasury bills has traditionally been the most liquid of any asset market in the United States (in recent decades, in the entire world) in terms of an investor's ability to buy or sell large amounts of securities with minimum transactions costs, minimum impact of the investor's own action on the market price, maximum availability of agents willing to act in the investor's behalf, and maximum availability of either financing for margined long positions or securities to borrow against short positions. Despite substantial advances in the last decade or two, the commercial paper market has never met this standard. Firms issuing commercial paper, or dealers acting in their behalf, are usually willing to take back paper presented by investors

before the stated maturity date, but they bear no legal obligation to do so. Finding third-party buyers is also problematic.

Various legal restrictions also contribute to making Treasury bills a more liquid asset than commercial paper for the specific categories of investors to which they apply. Commercial banks and other depository institutions, for example, can use Treasury bills as collateral when they borrow from the Federal Reserve discount window. Commercial paper is not eligible collateral for this purpose. Similarly, under current federal tax law, state governments undertaking advance refunding of outstanding obligations must invest the proceeds in Treasury securities to avoid sacrificing the exemption of the interest that they pay from taxability at the federal level. Here too, commercial paper does not qualify.

Differential liquidity therefore presumably accounts for at least some part of the positive paper-bill spread on average over time. In analytical terms, a liquidity value of bills over paper would simply take the form of a constant subtracted from the left-hand-side of (5), which in turn would shift both of the curves in Figure 2. In addition, differential liquidity could also account for either cyclical variation of the paper-bill spread (for example, if investors value liquidity more highly when a recession increases the uncertainty surrounding their own cash flows) or a time trend in the spread (presumably negative, to reflect the gradually increasing efficiency of the commercial paper market during the past few decades).

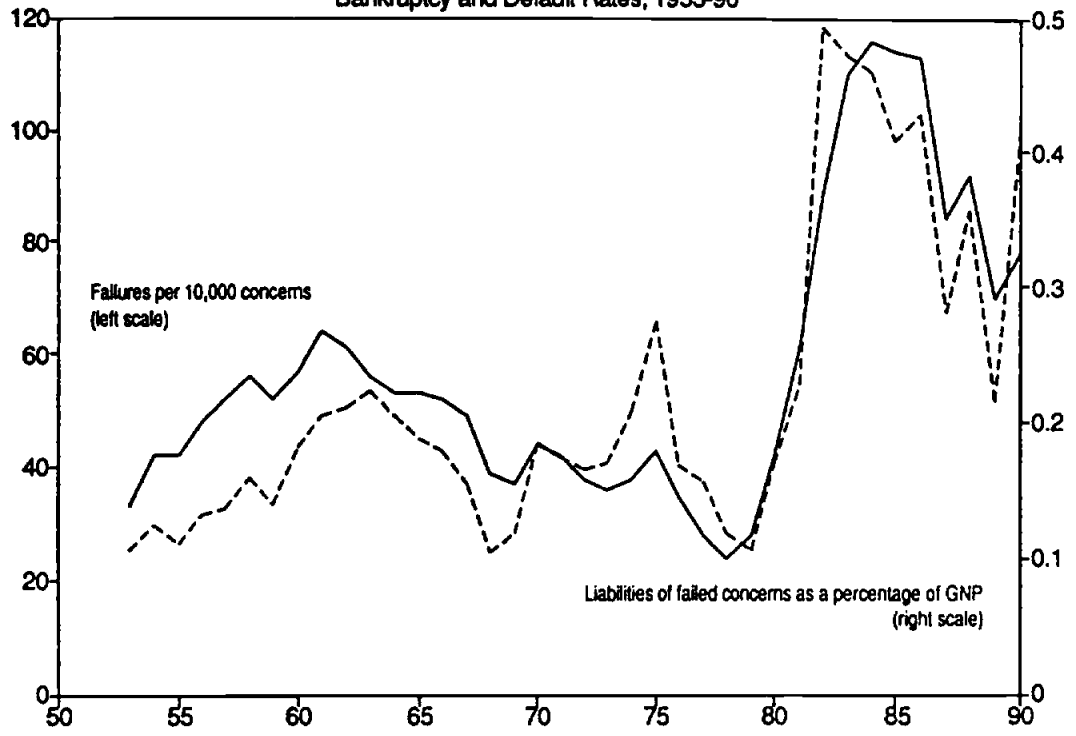
In the end, what is most interesting about the paper-bill spread is neither the mean spread over time nor the presence or absence of a time trend, but the way in which variation of the spread through time corresponds, with some lead period, to fluctuations in real economic activity. There is little reason to think that state or municipal income tax rates vary systematically with the

business cycle. By contrast, there is some ground to suspect that the value investors place on the greater liquidity of bills over paper does so. Further, as Figure 3 shows, both the frequency of business failures and the volume of defaulted business liabilities (scaled by gross national product) vary inversely with the pace of real economic activity.[14] As a result, it is also plausible to suppose that rational investors increase their subjective assessment of default rate π (and perhaps also reduce their assessment of recovery rate ϕ) if they have independent information indicating that a business recession is imminent. And if they do, then arbitrage behavior like that underlying the relationship in (5) would, in turn, deliver time variation in the paper-bill spread that would anticipate business fluctuations.

In addition, given that such features as the favorable tax treatment of bills, the default risk on paper and the superior liqudity of bills render these two instruments imperfect portfolio substitutes, fluctuations in their relative market supplies will also lead to fluctuations in the spread along the lines illustrated in (5). As the discussion in Section III below explains, some of these supply movements, and hence some of the resulting fluctuations in the spread, are plausibly related to the business cycle. Others, however, may merely reflect institutional technicalities of the Treasury bill market. Short-term fluctuations in the Treasury's cash flow alternatively swell the supply of bills or increase the demand (by forcing banks to present eligible collateral against enlarged tax and loan account balances). These fluctuations occur in part on a seasonal basis, but also in part irregularly. Fluctuations in the volume of advance debt refundings by state and local governments, as sometimes occur in anticipation of changes in tax legislation, also affect the demand for Treasury bills (because of legal restrictions on these borrowers' options for temporarily re-investing the proceeds of advance refundings). So do

Figure 3

Bankruptcy and Default Rates, 1953-90



Source: Dun and Bradstreet. Coverage does not include all industry sectors.

fluctuations in the Federal Reserve's open market operations (because most open market purchases and sales take place in Treasury securities). So do most exchange market interventions by foreign central banks (because most central banks, though nowadays not all, hold a disproportionately large share of their dollar portfolios in Treasury bills compared to the portfolio of the typical private market participant). So do the "window dressing" activities of banks and other private investors that choose to sacrifice a few days' interest differential in order to show atypically large Treasury bill holdings on their year- or even quarter-end financial statements. The effect of each of these institutional distortions is presumably to introduce "noise" in the paper-bill spread, in the sense of movement unlikely to correspond to what matters in financial markets for nonfinancial economic activity.

Table 7 presents estimation results for a series of regressions intended to capture some of the main elements in the discussion above of the determinants of the paper-bill spread. The coefficient values in the first row of the table, based on monthly data spanning 1974:1-1990:12, show that the paper-bill spread is positively (and strongly) related to the level of the bill rate, as the tax argument and the default-risk argument presented above both suggest.[15] The results in the second row show that the spread is also positively (and strongly) related to the perceived commercial paper default risk, measured here by the spread between the respective interest rates on P2- and P1-rated paper. The results in the third row show that both findings hold up, to at least a marginally significant degree, when the regression includes the two variables together. Finally, the results in the fourth row show that, even in the presence of these two variables, there is again no statistically significant evidence of a time trend in the spread. (A negative time trend, for example, might represent a declining liquidity value of bills over paper as the

Table 7

Decompositions of the Paper–Bill Spread

Using the commercial paper quality differential (sample 1974:1–1990:12)

	Constant	Interest rate level	Quality differential	Trend	$\bar{R}^2$	SE	DW
1	0.12 (0.23)	0.09 (0.02)			0.16	0.50	0.30
2	0.25 (0.15)		0.70 (0.20)		0.22	0.48	0.33
3	–0.11 (0.27)	0.05 (0.03)	0.54 (0.27)		0.30	0.47	0.32
4	–0.76 (0.83)	0.05 (0.02)	0.68 (0.15)	–0.0015 (0.0018)	0.28	0.46	0.33

Using the corporate bond quality differential (sample 1959:1–1990:12)

	Constant	Interest rate level	Quality differential	Trend	$\bar{R}^2$	SE	DW
1	0.12 (0.09)	0.07 (0.02)			0.16	0.44	0.31
2	0.43 (0.13)		0.13 (0.11)		0.01	0.48	0.28
3	0.19 (0.09)	0.09 (0.03)	–0.20 (0.13)		0.18	0.44	0.33
4	0.31 (0.15)	0.11 (0.03)	–0.15 (0.12)	–0.0008 (0.0007)	0.19	0.43	0.34

Note: Numbers in parentheses are robust standard errors, corrected for 12th order moving-average serial correlation.

commercial paper market has developed over time.)

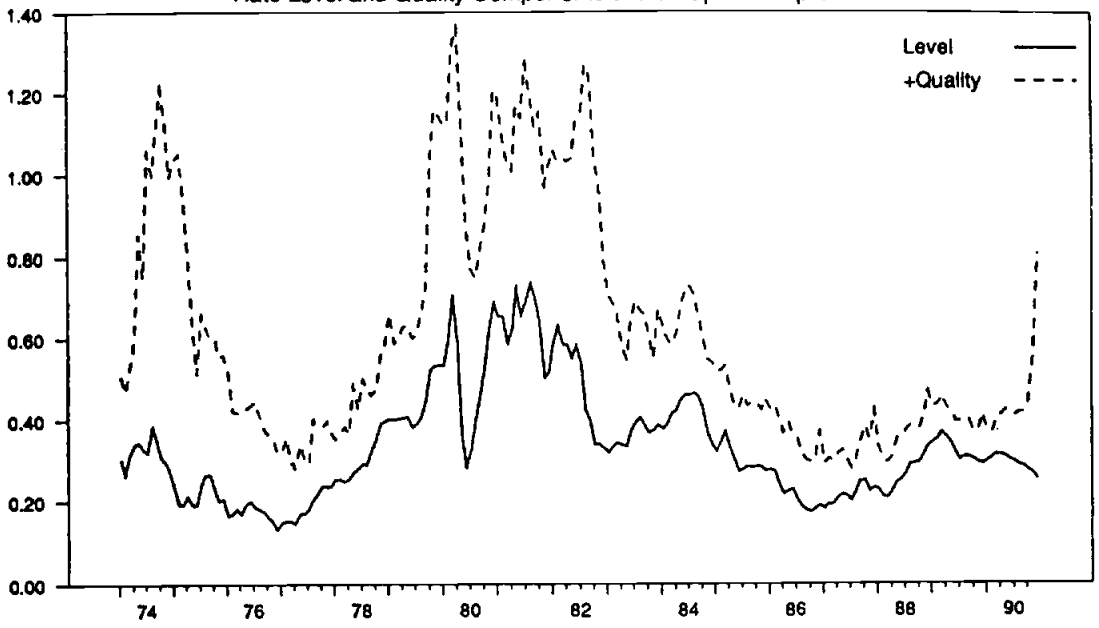
The lower panel of of Table 7 shows the results of an attempt to replicate, for the longer sample spanning 1959:1-1990:12, the four regressions shown just above. Because published commercial paper ratings were not introduced until after the Penn Central default, however -- hence the 1974 starting date of the sample used for the regressions in the upper panel -- here the spread between the respective interest rates on Baa- and Aaa-rated corporate bonds is used as a proxy for perceived commercial paper default risk. Risk of default over the coming six months need not be the same as risk of default over the life of a 20- or 30- year bond, however, and so the default-risk aspect of the attempt to extend these results backward to the longer sample does not deliver significant results.[16] (Indeed, in equations combining the bill rate level and the bond quality spread, the point estimates for the spread variable's coefficient are, nonsensically, negative). By contrast, the strongly positive relationship between the paper-bill spread and the level of the bill rate corresponds well to the result found in the shorter sample. So does the absence of any evidence of a time trend.

Figure 4, based on the regression in the third row of the upper panel of Table 7, shows a decomposition of the monthly variation of the paper-bill spread during 1974-90 into three components: a part attributed to variation in the bill rate; a part attributed to perceived default risk, as measured by the P2-P1 spread; and the regression residual (augmented by the constant term). Table 8 presents summary statistics for these three components, including their respective simple correlations with changes in real output, as well as F-statistics for the significance of distributed lags on these components in equations for real output analogous to (1) above.

What stands out in these results is that all three components of the

Figure 4

Rate Level and Quality Components of the Paper-Bill Spread



Residual Component of the Paper-Bill Spread

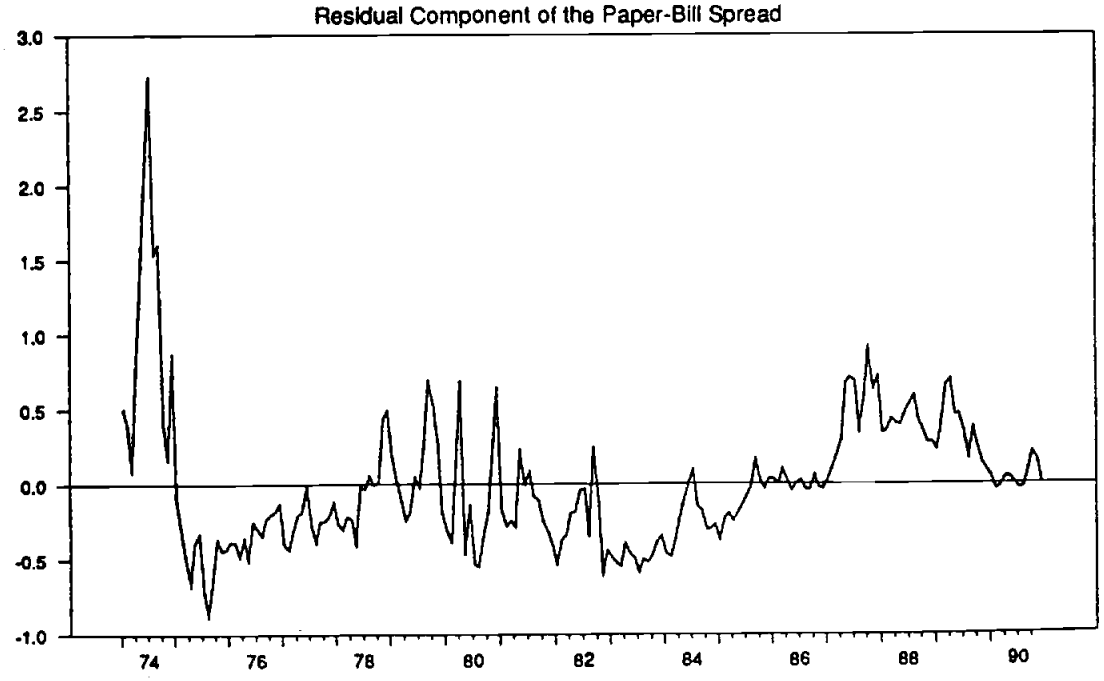


Table 8

Analysis of Components of the Paper–Bill Spread

	Mean	Standard Deviation	Correlation with: $\Delta\ln(IP_t)$	$\Delta\ln(IP_{t+1})$	F-statistic
Constant	–0.12	. . .	. . .	. . .	. . .
Interest rate level	0.45	0.14	–0.11	–0.21***	2.65**
Quality differential	0.28	0.20	–0.43***	–0.42***	4.00***
Residual	0	0.47	–0.13*	–0.24***	2.60**

* Significant at 10% level
** Significant at 5% level
*** Significant at 1% level

Notes: Results are based on the residual from the regression in the top panel of Table 7, line 3.
The correlations use data from 1974:1–1990:12.
The F-statistics are from reduced-form real output regressions analogous to those in Table 3, for the 1974:7–1990:12 sample.

paper-bill spread -- the part attributed to variation in the bill rate, the part attributed to perceived default risk, and the unattributed residual component -- contain statistically significant incremental information about subsequent fluctuations in real output. The simple correlation of each component with the change in real output one month ahead is significant at the .01 level. The distributed lag on each component in equations for real output analogous to those reported in Table 3 is significant at the .05 level or better.

Hence factors like state and municipal taxation, which plausibly account for a major part of the average spread over time but do not themselves plausibly fluctuate in a systematic way over the business cycle, may still play a role in the spread's predictive content by virtue of the way in which their effect on the spread interacts with the level of the bill rate. Perceived default risk (as measured by the P2-P1 spread) more plausibly fluctuates with prospects for business activity, and it is also apparently part of the story.[17] Finally, the significance of the residual component may represent a role for either variation in the liquidity value of bills over paper, or variation in perceived default risk not captured by the P2-P1 spread, or both.

III. Borrowers and Lenders in the Short-Term Credit Markets

The analysis in Section II suggests a role for both time-varying default risk and a time-varying liquidity premium as explanations for the predictive power of the paper-bill spread with respect to real output. Based as it is entirely on the observed spread and on inferred components of the spread, that analysis has little to say about how variations over time in either default risk or the liquidity value of bills over paper arise, or why these variations are related to fluctuations in real output. Given the nature of recorded bankruptcies, it is straightforward to see why perceived default risk might covary with the business cycle. Why the liquidity value of bills over paper might do so bears further investigation. In both cases, however, developing hypotheses about financial behavior that facilitate bringing to bear data on debt quantities as well as interest rates is likely to be helpful as a way of distinguishing empirically among competing explanations for the predictive properties of the spread.

Three such hypotheses are especially interesting in this context.

Changes in Perceptions of Default Risk. First, a widening of the paper-bill spread in advance of business downturns may reflect anticipations, on the part of investors, that a downturn is likely to occur and hence that default by private borrowers with cyclically sensitive cash flows has become more likely. To the extent that these anticipations tend on average to be correct, fluctuations in the spread will predict fluctuations in the growth of real output. Further, if investors' anticipations in this regard embody information from disparate sources, or information that is otherwise difficult to quantify or to summarize in a compact way, the paper-bill spread will have predictive content that is significant even in the presence of other standard predictors of output fluctuations like those included in the regressions presented in

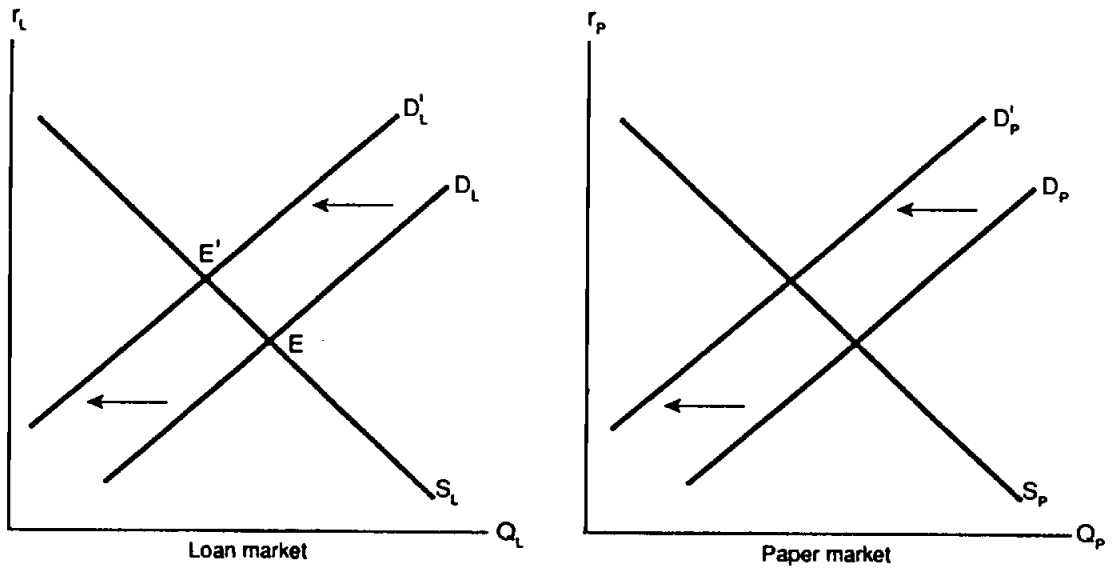
Section I.

Figure 5 shows schematically the implications, for the bank loan market (left) and the commercial paper market (right), of an increase in the default risk that lenders in the short-term credit markets associate with private obligations, on the assumption that the interest rate on (default-free) Treasury bills remains unchanged. As is consistent with the effect of an increase in π in equation (4) above, the upward-sloping curves representing lenders' portfolio demands (alternatively, their supply of credit) in both markets shift inward.[18] As a result, the new equilibrium in each market exhibits a smaller quantity of credit extended, and a higher interest rate (relative to default-free bills) than before the increase in perceived default risk. Hence the implied covariation between the observed spread to bills and the relevant credit quantity is negative in each market.

In principle, therefore, the loan-bill spread and the paper-bill spread might equally predict fluctuations in real output. No one has forcefully argued this case empirically for the loan spread, however.[19] One reason is probably that bank loans have many implicit (that is, non-interest) price elements, so that changes in observed loan interest rates are not a good measure of changes in the cost of loans over short time horizons. Another likely reason is that bank lending often involves long-term customer relationships in which what may appear to be short-term departures from market-clearing price behavior may be perfectly rational. On both counts, it is not surprising that the paper-bill spread is superior as a short-run predictor of fluctuations in real output. (As Table 1 shows, the widening of the paper-bill spread before recessions is a matter of at most six months).

Changes in Monetary Policy. A second explanation for the predictive power of the paper-bill spread, emphasized by Bernanke (1990) and implicit in the work

Figure 5
The Default Risk Hypothesis



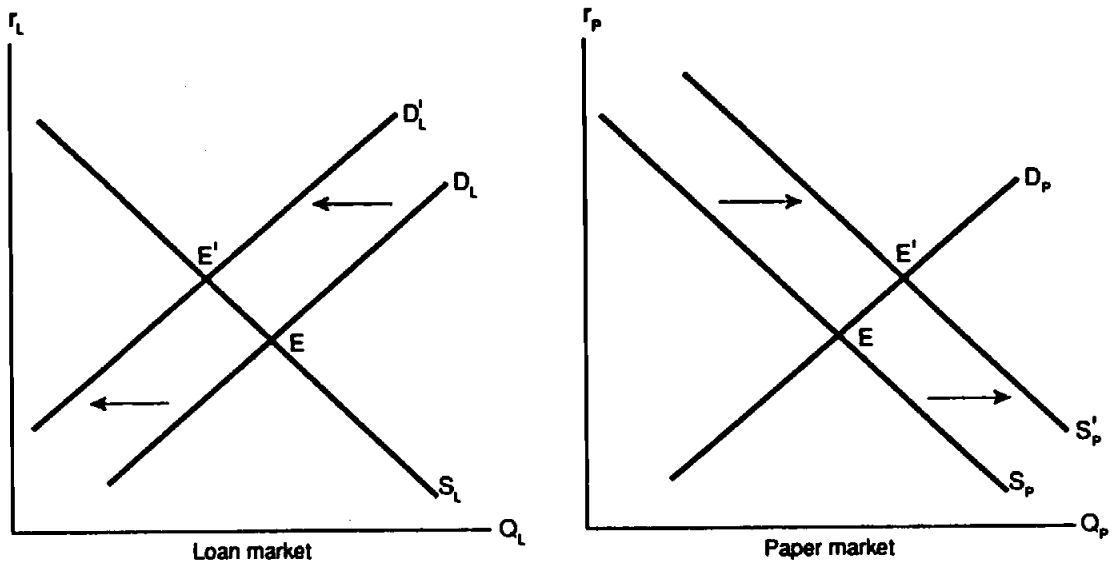
of Kashyap et al. (1991), points to monetary policy. Figure 6 illustrates the basic mechanics at work here, again focusing on the respective markets for bank loans and commercial paper. A tightening of monetary policy (smaller growth of bank reserves) causes banks' demand for loans to shift inward. As in Figure 5, the result is a higher loan rate and a smaller loan quantity. Here, however, nonbank investors' demand for commercial paper has not changed. As would-be borrowers who do not receive bank loans seek credit elsewhere, supply in the paper market shifts outward.[20] Hence the quantity of paper issued rises, as does the commercial paper interest rate.

What is missing in the argument thus far is a reason why this increase in the paper rate would also represent an increase in the paper-bill spread. Tighter monetary policy presumably raises the bill rate too. If the predictive content of the paper-bill spread arises because changes in the spread reflect changes in monetary policy, which in turn affects output for any or all of the standard reasons, tighter monetary policy must raise the paper rate not just absolutely but also relative to the bill rate.

One answer to this question, following the analysis in Section II, is that both the tax component of the spread (for given state/municipal tax rates) and the default risk component (for given default probability and expected recovery rate) depend directly on the level of the bill rate. To the extent that tight monetary policy raises the bill rate, therefore, it also widens the paper-bill spread. This line of argument is satisfactory as far as it goes, but ultimately insufficient. As the correlations and F-statistics presented in Table 8 show, the predictive content of the paper-bill spread is not simply a matter of the spread's proportional covariation with the bill rate.

An alternative (albeit not mutally exclusive) explanation offered by Bernanke and by Kashyap et al. emphasizes, in part, heterogeneity among

Figure 6
The Monetary Policy Hypothesis



borrowers. If the obligations of borrowers who shift from the bank loan market to the commercial paper market when monetary policy tightens are systematically less attractive to commercial paper investors than the obligations of borrowers whose paper is already outstanding -- either because these new borrowers are less creditworthy, or because they deal in smaller volume so that their paper is less liquid -- then the resulting rise in default risk or loss of liquidity for the representative issuer's paper will lead the market-average commercial paper rate to rise relative to the rate on Treasury bills (or any other instrument the risk and liquidity of which remain unchanged).

Yet a third potential explanation (again not mutually exclusive with the other two) reflects the behavior of investors allocating their portfolios among different assets, as captured in equation (5). Even apart from changing objective characteristics like default risk or liquidity, the mere fact that investors regard commercial paper and Treasury bills as imperfect substitutes implies that some widening of the paper-bill spread is necessary, when tight monetary policy forces borrowers out of the banks and into the open market, to induce investors to increase the share of their assets that consist of commercial paper.

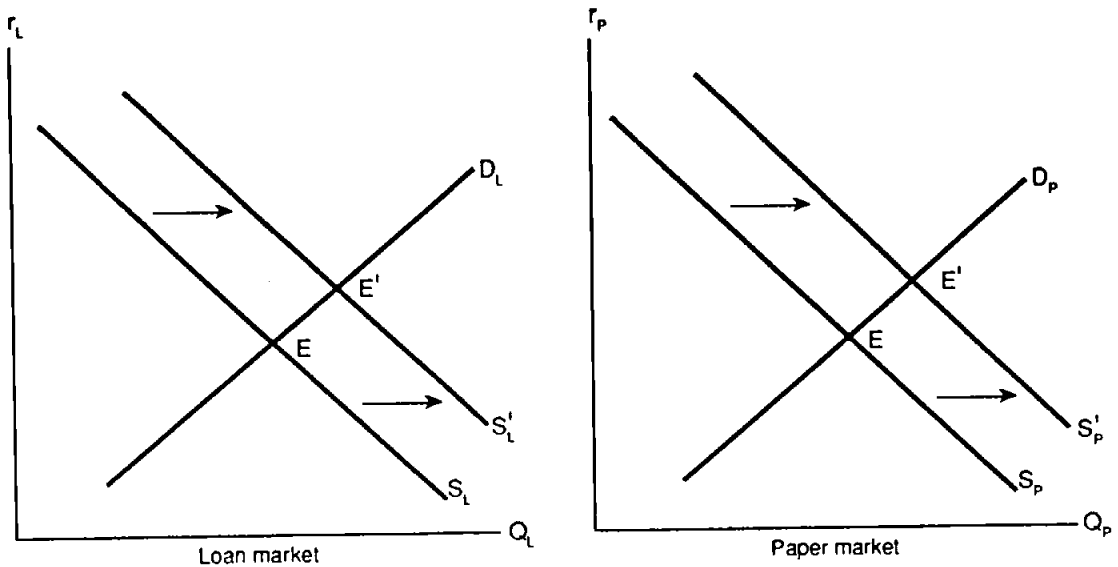
Changes in Borrowers' Cash Flows. Finally, it is also possible that the behavior that shifts in such a way as to increase the paper-bill spread when real economic activity turns downward is not that of lenders but of borrowers. As Table 1 shows, the spread is especially wide not only just before recessions but during recessions as well. Influences like tight monetary policy, by contrast, might well be expected to change direction during the course of a recession, leading the spread to decrease.[21] (The analogous point does not apply to hypotheses based on time-varying default risk since, as is clear from Figure 3, bankruptcy and default rates typically remain high for at least a year

after a recession ends.)

One major influence on borrowers' behavior that could plausibly account for movements of the paper-bill spread in this context is the cyclical variation of firms' cash flows. As revenue growth ebbs and both inventory accumulation and operating costs continue to rise, in the final stages of a business expansion, firms' credit requirements increase. Figure 7 shows such an increase as an outward shift in the supply of both bank loans and commercial paper. As in the case of the default risk hypothesis, shown in Figure 5, the underlying mechanics are the same in both markets, at least in principle. The cash flows hypothesis, however, implies a positive correlation between changes in the paper rate and changes in the paper quantity.

As in the case of the monetary policy hypothesis, here too some further arugment is necessary to render the implied absolute increase in the paper rate an increase also relative to the bill rate. Once again, either the borrower-heterogeneity argument or the imperfect-substitutes argument, or both, will suffice.

Figure 7
The Cash Flow Hypothesis



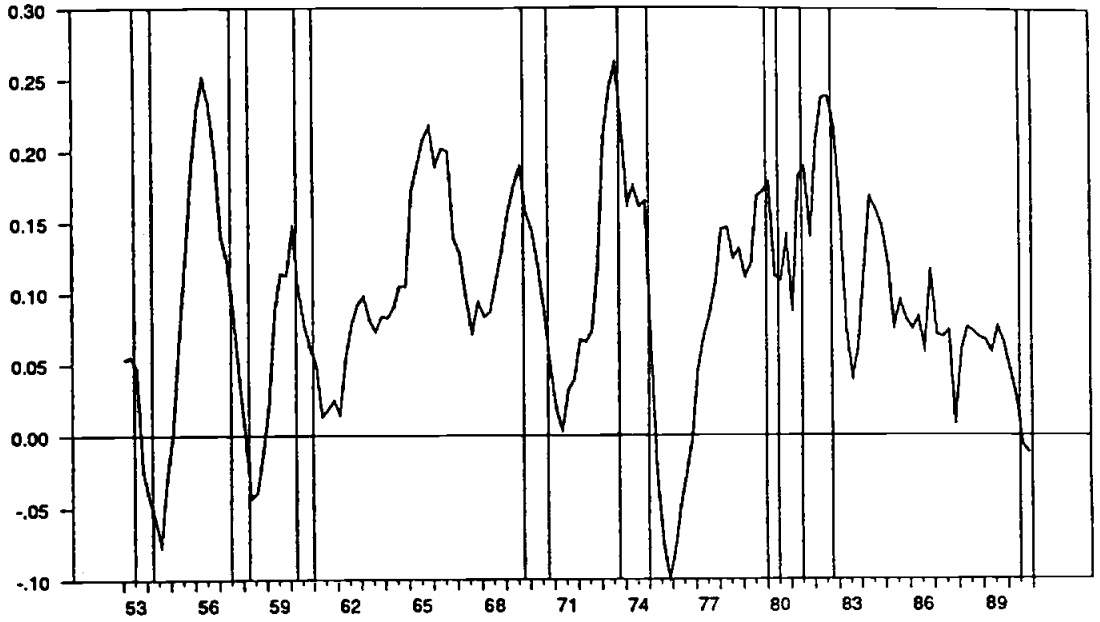
IV. Some Evidence on Competing Hypotheses

The results presented in Tables 7 and 8 indicate that such factors as taxes, default risk and liquidity, which plausibly explain much of the positive average paper-bill spread, also play some role in accounting for the movement of the spread over time (Table 7) as well as the spread's predictive power with respect to fluctuations of real output (Table 8). In terms of the more structural analysis of Section III, an increase in perceived default risk represents a straightforward influence on the behavior of lenders. A widening of the paper-bill spread due to increasing importance of differential taxation, as the general level of interest rates rises, likewise represents an influence on lenders' behavior; but the reason why interest rates rose in the first instance may reflect tighter monetary policy or still other influences on either borrowers' or lenders' behavior. The same is true of arguments based on liquidity. A shift in the composition of the "market portfolio" toward a greater weight on commercial paper may well cause the spread between the respective returns to paper and other assets (including bills) to widen, but the question once again is why the outstanding volume in the paper market grew so rapidly in the first place. Answering questions like these on the basis of information about interest rates alone is clearly impossible.

Figures 8 and 9 present the basic data corresponding to the quantities at issue in the discussion of competing hypotheses in Section III. The top panel of Figure 8 shows that the 4-quarter growth rate in the outstanding volume of bank loans (commercial and industrial loans) typically peaks in advance of the onset of recessions -- very slightly in advance in most episodes, though much more so in 1957. The table's bottom panel plots analogous 4-quarter growth rates for the total volume of non-bank-related domestic commercial paper outstanding, as well as for the components of this total representing the

Figure 8

Nominal Four-Quarter Bank Loan Growth



Nominal Four-Quarter Commercial Paper Growth

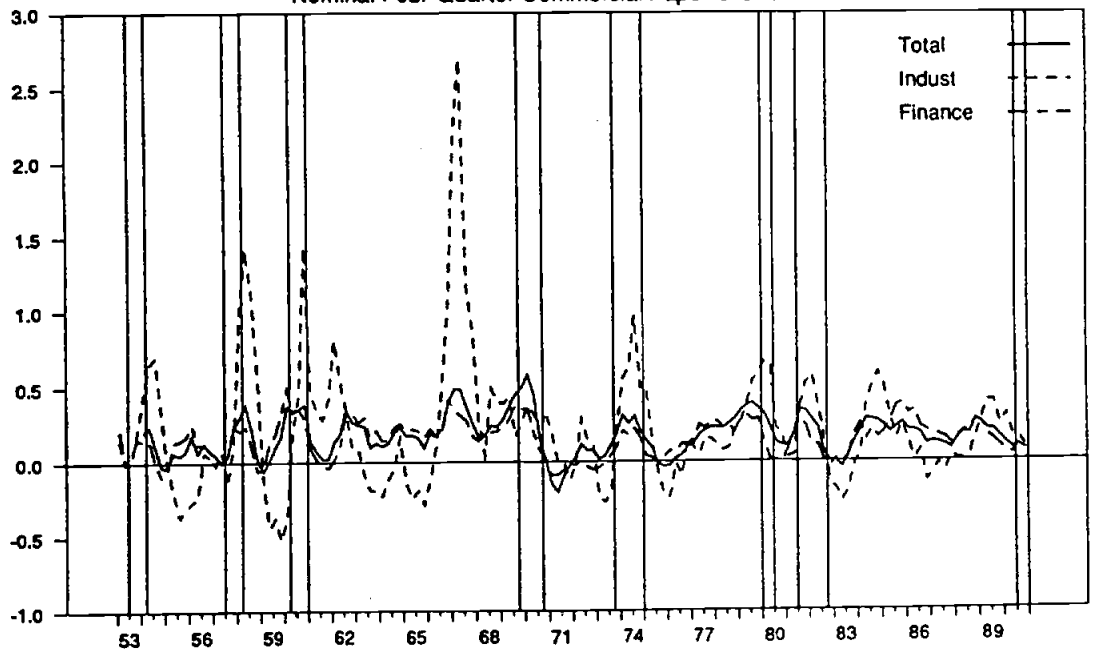
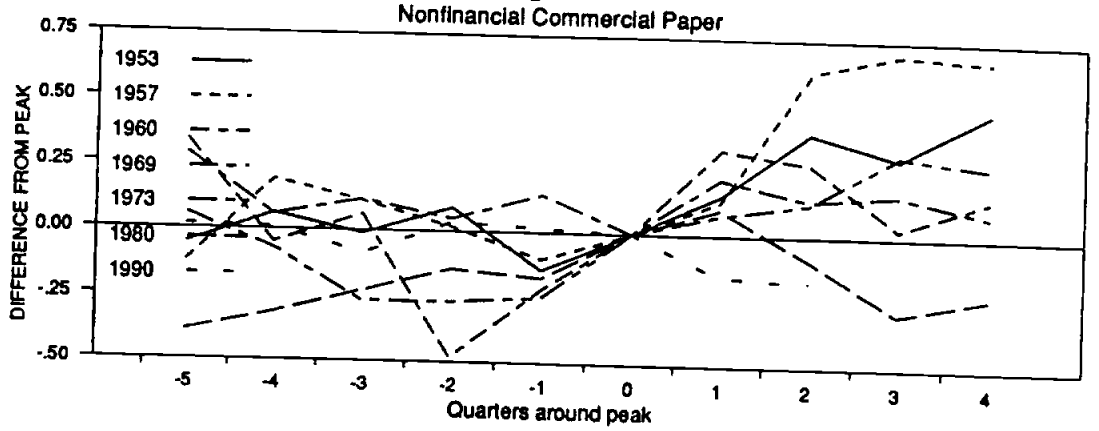
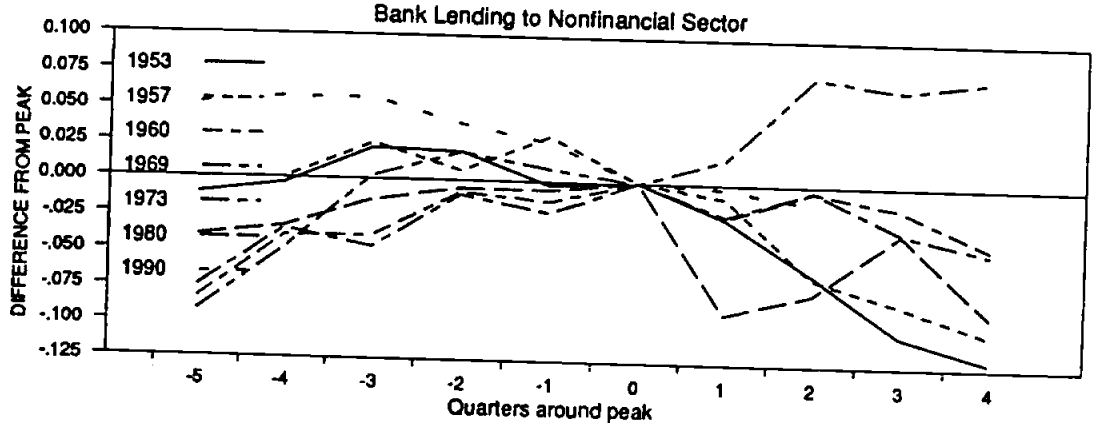
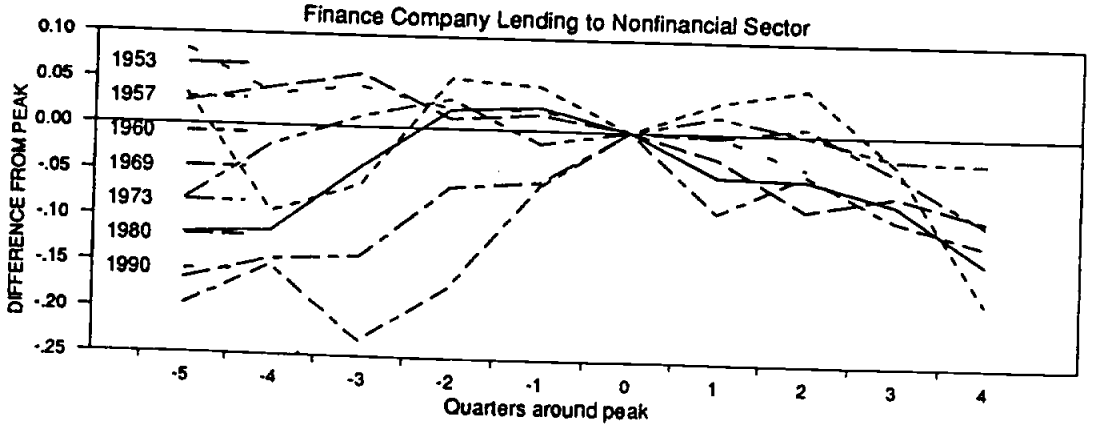


Figure 9


Nonfinancial Commercial Paper
DIFFERENCE FROM PEAK
0.75
0.50
0.25
0.00
-.25
-.50
1953
1957
1960
1969
1973
1980
1990
-5
-4
-3
-2
-1
0
1
2
3
4
Quarters around peak


Bank Lending to Nonfinancial Sector
DIFFERENCE FROM PEAK
0.100
0.075
0.050
0.025
0.000
-.025
-.050
-.075
-.100
-.125
1953
1957
1960
1969
1973
1980
1990
-5
-4
-3
-2
-1
0
1
2
3
4
Quarters around peak


Finance Company Lending to Nonfinancial Sector
DIFFERENCE FROM PEAK
0.10
0.05
0.00
-.05
-.10
-.15
-.20
-.25
1953
1957
1960
1969
1973
1980
1990
-5
-4
-3
-2
-1
0
1
2
3
4
Quarters around peak

obligations of nonfinancial corporations and finance companies, respectively. In contrast to bank loan growth, the growth of nonfinancial paper tends to surge during recessions (1953, 1957, 1960, 1973, 1981) more often than to peak beforehand (1970 and 1980). Growth of finance company paper, however -- and therefore of the total too, since finance companies typically have nearly three times as much in outstandings as nonfinancial issuers -- is more like that of bank loans.[22]

Figure 9 draws the same comparisons in a different way by plotting the respective changes in outstanding bank loans, commercial paper issued by nonfinancial corporations, and finance company lending to nonfinancial corporations (all deflated by the gross national product deflator) during 10-quarter intervals surrounding business cycle peaks. Each (deflated) series is expressed as the log deviation from the corresponding Hansen-Prescott trend, normalized to equal zero in the peak quarter. Here again, the tendency for the growth of bank loans and finance company paper to peak in advance of the recession, and for the growth of nonfinancial-issuer commercial paper to continue -- in some episodes, to accelerate -- on into the recession, is apparent.[23]

Given the tendency of the paper-bill spread to widen in advance of recessions, and to remain wide during recessions, these observed quantity movements provide support for either the monetary policy hypothesis or the cash flows hypothesis as outlined in Section III. Declining growth of bank loan volume, triggered by tighter monetary policy, leads to increases both in the growth of commercial paper volume and in the paper-bill spread, as either of these two hypotheses (but not the default risk hypothesis) implies.

The simple correlations shown in the first two rows of Table 9 provide further support, especially for the cash flows hypothesis. The paper-bill

Table 9

Correlation Coefficients Between the Paper–Bill Spread and Selected Variables:

	Real	Nominal
Percent change in commercial paper issued by the nonfinancial corporate sector	0.32***	0.33***
Percent change in bank loans to the nonfinancial corporate sector	0.17*	0.17*
Nonfinancial sector financing deficit	0.35***	0.24***
GNP, leading 2 quarters	–0.47***	–0.23***
GNP, leading 1 quarter	–0.51***	–0.23***
GNP, current	–0.46***	–0.15*
GNP, lagging 1 quarter	–0.29***	–0.03
GNP, lagging 2 quarters	–0.24***	–0.001

* Significant at 10% level
** Significant at 5% level
*** Significant at 1% level

Notes: Observations are quarterly; the sample is 1952:2–1990:3.
Financial flow variables are from the Flow of Funds database.
Real variables are deflated by the implicit GNP deflator.
The financing deficit is the difference between capital expenditure and after-tax cash flow of the nonfarm, nonfinancial corporate sector.

spread is positively correlated with the contemporaneous real growth rates of commercial paper volume and bank loan volume, but the correlation with paper volume growth is far greater. Under the cash flows hypothesis both correlations would be positive, while under the monetary policy hypothesis the spread-to-paper-growth correlation would be positive and the spread-to-loan-growth correlation would be negative. By contrast, under the default risk hypothesis both correlations would be negative.

Two further elements of this price-quantity interaction give still further weight to the cash flows hypothesis in preference to the monetary policy hypothesis. First, as the third row of Table 9 shows, the paper-bill spread is also strongly correlated with contemporaneous growth of the cash deficit that nonfinancial corporations need to finance.[24] Second, the role of the finance companies presents a particular puzzle for the monetary policy hypothesis. Tighter monetary policy would, in the first instance, restrict the lending of banks but not finance companies. Would-be borrowers not accommodated by banks would then turn to finance companies, so that these institutions' lending (and hence their borrowing to fund that lending) would rise along with that of nonfinancial issuers of commercial paper. As Figures 8 and 9 show, however, growth of finance paper fluctuates more in step with growth of bank loans than with growth of paper issued by nonfinancial corporations.

Especially when they relate prices and quantities, simple correlations can often be misleading. Table 10 therefore presents the results of estimating several variations of a regression relating the paper-bill spread to contemporaneous and lagged growth in the total volume of non-bank-related domestic commercial paper outstanding (including issues of both nonfinancial firms and finance companies) and to a direct measure of perceived default risk.

The OLS regression reported in row (1) of the table shows that the spread

Table 10

Structural Equations for the Paper–Bill Spread

	Dependent Variable	Method	Sample	CPFLOW (t)	TBSHARE ($t-1$)	CPQ (t)	BAQ (t)	RTB06 (t)	Constant	Trend	PENN	SEE	D-W
1.	RCP6 – RTB06	OLS	74:2–90:4	10.99	–6.78	0.61			5.10	–0.027		0.36	0.87
				(4.90)	(1.64)	(0.10)			(1.34)	(0.010)			
2.	RCP6 – RTB06	TSLS	74:2–90:4	25.31	–6.04	0.77			4.26	–0.024		0.40	1.20
				(10.49)	(1.87)	(0.15)			(1.52)	(0.012)			
3.	RCP3 – RTB03	TSLS	74:2–90:4	25.26	–6.36	0.94			4.63	–0.026		0.46	1.30
				(9.67)	(2.32)	(0.17)			(1.90)	(0.014)			
4.	RCP6	TSLS	74:2–90:4	18.36	–6.58	0.80		0.97	4.95	–0.025		0.37	1.09
				(8.82)	(1.72)	(0.18)		(0.01)	(1.43)	(0.011)			
5.	RCP6 – RTB06	OLS	67:3–90:4	11.83	–6.32		0.23		4.69	–0.024	0.45	0.41	0.87
				(3.04)	(0.70)		(0.12)		(0.62)	(0.003)	(0.19)		
6.	RCP6 – RTB06	TSLS	67:3–90:4	40.11	–6.23		0.55		3.93	–0.028	1.57	0.55	1.35
				(17.74)	(1.17)		(0.18)		(0.96)	(0.007)	(0.64)		
7.	RCP6	TSLS	67:3–90:4	23.33	–6.14		0.33	1.01	4.22	–0.026	0.92	0.44	1.10
				(13.52)	(0.84)		(0.13)	(0.03)	(0.65)	(0.005)	(0.46)		

Variable definitions:

RCP6	6-month commercial paper rate	RCP3	3-month commercial paper rate
RTB06	6-month T-bill rate	RTB03	3-month T-bill rate
BAQ	Baa–Aaa corporate bond quality spread	CPQ	P2–P1 paper quality differential
CPFLOW	Change in total commercial paper + total stock of commercial paper and T-bills		
TBSHARE	T-bill outstandings + total stock of commercial paper and T-bills		
PENN	Dummy variable equal to 1 in 1970:3, the date of the Penn Central default		

Notes: Estimates are based on quarterly observations, for the sample indicated.
Numbers in parentheses are robust standard errors, corrected for 4th order moving-average serial correlation.
In the TSLS regressions, CPFLOW is replaced by the instrument formed by its projection onto a constant, the lagged dependent variable, and the current value and one lag of: real monetary base growth, real non-borrowed reserve growth, and the difference between non-financial firms' investment expenditures and their after-tax profits.

is related positively both to lagged paper volume growth (expressed relative to the total amount of paper and bills outstanding) and to perceived default risk as measured by the P2-P1 differential, and negatively to the relative quantity of Treasury bills outstanding, and that the time trend is not only negative (as usual) but statistically significant along with the other three variables. The relationship of the paper-bill spread to paper volume growth and the bill quantity provides evidence supporting the assumption that investors regard commercial paper and Treasury bills as imperfect portfolio substitutes, which is an important element in either the monetary policy hypothesis or the cash flows hypothesis. The relationship of the spread to the P2-P1 differential, even in the presence of growth in paper volume, provides evidence in favor of the default risk hypothesis. The significance here of the negative time trend -- indicating a declining spread on average over time, as the commercial paper market has become more fully developed -- presumably reflects the advantage of using a relationship that makes at least some allowance for supply effects on the relative yields of commercial paper and Treasury bills (in contrast to, for example, the insignificant time trends shown in Table 7).

Allowing for the simultaneity of supply and demand renders this evidence in favor of imperfect substitutability and the role of perceived default risk even more persuasive. Row (2) of Table 10 reports two-stage least-squares estimates of the same regression, using as instruments the log change in the real monetary base, current and lagged once; the log change in real nonborrowed reserves (augumented to include "extended credit"), current and lagged once; and the financing deficit of nonfinancial corporations (as a share of the amount of paper and bills outstanding), current and lagged once -- all variables plausibly related to either monetary policy or borrowers' financing needs.[25] TSLS estimation based on these variables as instruments for the change in the volume

of commercial paper outstanding increases the coefficients on paper volume growth and on the pure default risk variable.[26] The regression reported in row (3) shows that comparable results also follow from measuring the respective interest rates on commercial paper and Treasury bills at three- rather than six-months maturity.[27]

The regression reported in row (4), again using six-month rates, further confirms these findings and indicates once more the importance of simultaneity in this context. If the correct dependent variable for studying investors' willingness to buy commercial paper versus Treasury bills is the paper-bill spread, then adding the bill rate to both sides of the equation (so that the dependent variable is simply the paper rate) should result in a coefficient of unity on the bill rate as an independent variable and unchanged coefficients elsewhere. Comparison of rows (4) and (2) shows that, the bill rate indeed has a coefficient of approximately unity and that in other respects the new regression corresponds quite closely to its earlier equivalent.[28] Once again, the conclusions to be drawn are that investors regard commercial paper and Treasury bills as imperfect substitutes in a way that matters for the paper-bill spread, that the spread is related to fluctuations in paper volume growth that correspond to variables plausibly reflecting changes in either monetary policy or business financing needs, and that there is a further, independent role for changes in perceived default risk.

The results shown in rows (5), (6) and (7) indicate that using the Baa-Aaa bond rate differential in place of the P2-P1 paper rate differential (which, following the discussion above, permits lengthening the sample) preserves the overall flavor of the evidence. The coefficient on the quality variable is much smaller (albeit still statistically significant), as is consistent with the bond differential's measuring much more inaccurately the default probabilities that

are relevant to commercial paper investors, but in other respects the results for the longer sample are highly similar to those shown above.

Finally, the question remains whether the information about real output contained in the paper-bill spread cannot be just as easily (or almost as easily) represented with more standard variables, including variables corresponding conceptually to the several hypotheses developed in this paper. On the evidence, the answer is no. The results summarized in Table 11, and in Figures 10 and 11, show that even after allowing for such variables as money growth and perceived default risk and the general level of interest rates, there is still a further element of the paper-bill spread that contains predictive content with respect to fluctuations in real output that is both statistically significant and economically important.

The first column of Table 11 shows F-statistics for the real output equation of a 6-variable vector autoregression including the respective log changes in industrial production, the producer price index and M1; the change in the bill rate; the Baa-Aaa differential; and the paper-bill spread. The estimation uses monthly data spanning 1960:1-1990:12, with lag length 6. Even in the presence of these five other variables, representing so many of the hypotheses considered in this paper, the distributed lag on the paper-bill rate is still significant at the .01 level. The table's second column shows F-statistics for an analogous system with the P2-P1 differential in place of the Baa-Aaa differential, and sample 1974:7-1990:12. Here the paper-bill spread is again significant at the .01 level.

Moreover, this "residual" explanatory power of the paper-bill spread is not just statistically significant but quantitatively important. Figures 10 and 11 show the respective sets of impulse response functions indicating the effects on real output (estimated responses, bounded by 95% confidence intervals) due to

Table 11

F-statistics for Financial Variables in Augmented Monthly Real Output Equations

	60:1–90:12	74:7–90:12
$\Delta\ln(M1)$	0.56	0.65
Δr_B	0.87	1.84*
Baa–Aaa bond quality differential	3.94***	
P2–P1 paper quality differential		2.25**
Paper–bill spread	5.26***	4.08***

* Significant at 10% level
** Significant at 5% level
*** Significant at 1% level

Notes: The estimated six-variable system includes the first differences of the logs of industrial production, producer price index, and M1; the first difference of the six-month Treasury bill rate; the quality differential in levels; and the paper–bill spread in levels.
Six lags are included for each regressor.

Figure 10

Impulse Response Functions for Real Output (using Bond Quality Differential)

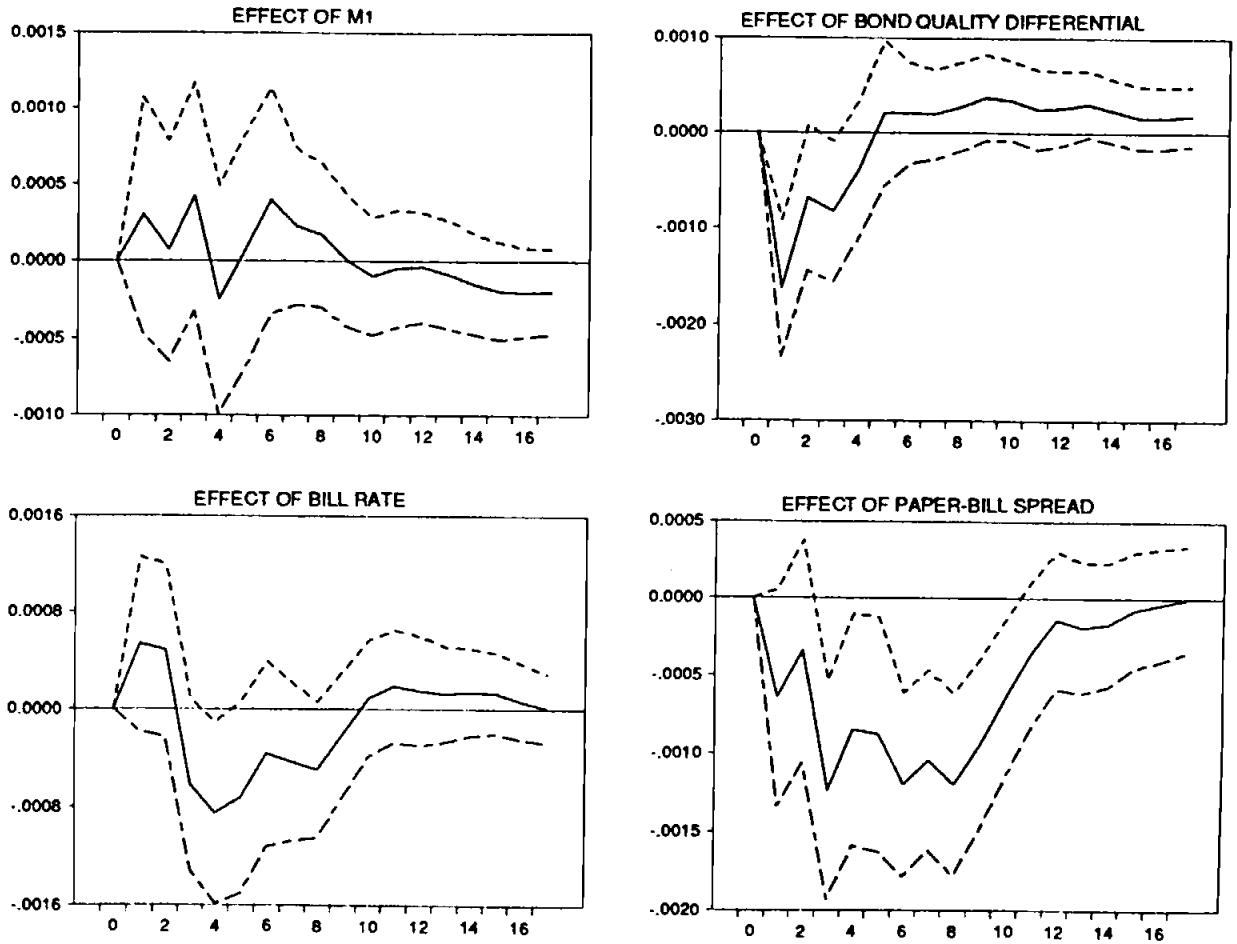
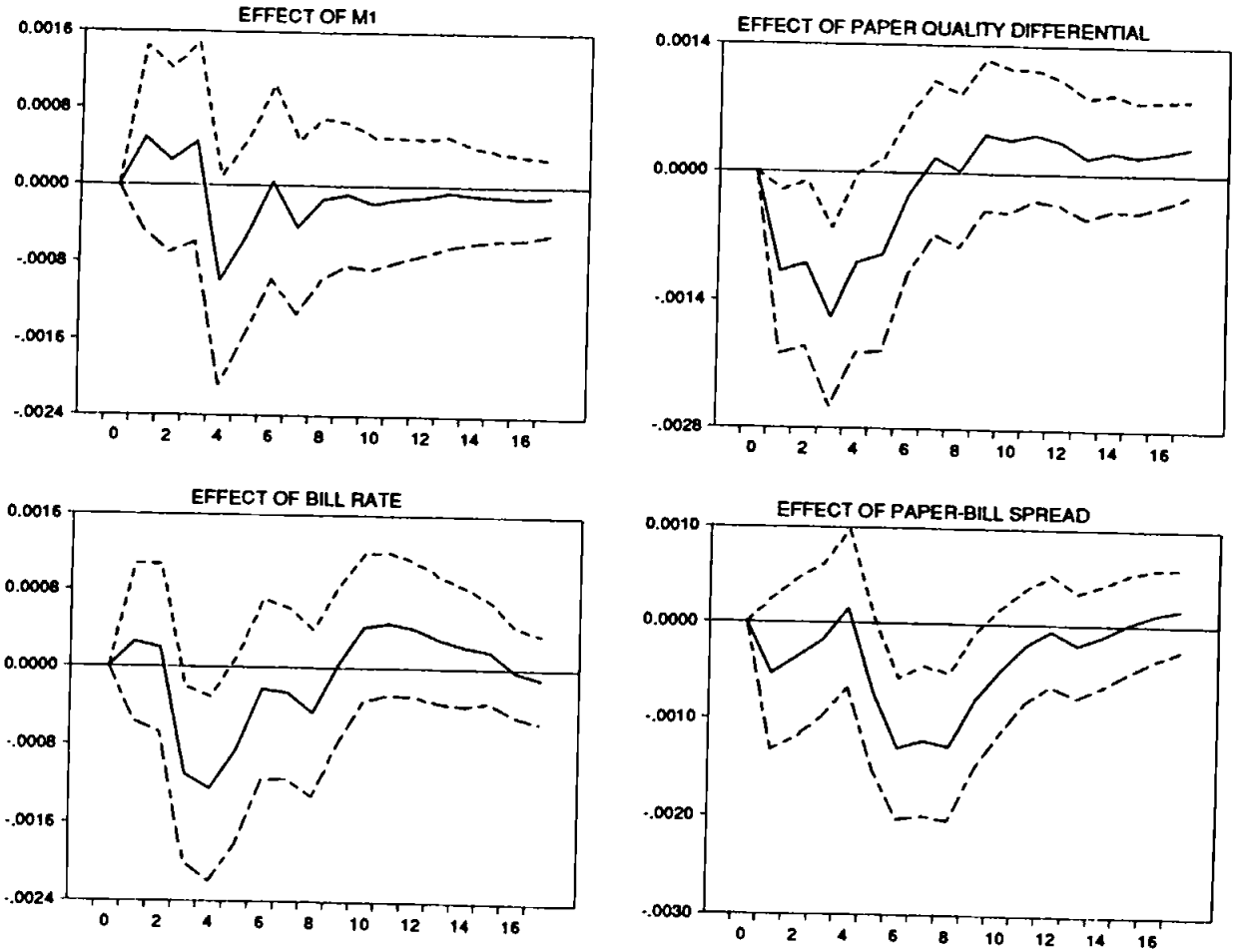


Figure 11

Impulse Response Functions for Real Output (using Paper Quality Differential)



the financial variables in these two systems, orthogonalized in the order that the variables are listed above -- that is, with the paper-bill spread placed last. In the system estimated for the longer sample, the "residual" effect of the spread on real output is immediate, large, and prolonged. In the system estimated for the shorter sample, the effect is less regular but is clearly visible nonetheless.

Even if it were true, therefore, that changes in monetary policy or changes in perceived default risk in principle account fully for the fluctuation of the paper-bill spread and for its relationship to fluctuations in real output, the spread would remain a potentially useful predictor because of its ability to embody relevant aspects of those influences that are not captured by standard variables like money growth and observed debt quality spreads.

V. Summary of Conclusions

The empirical evidence assembled in this paper supports several specific conclusions about the relationship between the paper-bill spread and real economic activity in the United States. To begin, regression-based evidence for the last three decades of U.S. experience -- including two sub-periods delineated by key structural changes in financial institutions -- consistently points to a statistically significant relationship between movements of the paper-bill spread and subsequent fluctuations in real output, even in the presence of other financial variables that previous researchers have often advanced as potential business cycle predictors. This evidence includes not only significant explanatory power of the spread in equations for real output movements but also significant ability of the spread to account for the variance of real output at forecast horizons relevant in a business cycle context.

Next, readily identifiable features of commercial paper and Treasury bills -- including the favorable tax treatment of bills at the state and municipal level, the default risk on paper, and the superior liquidity of bills -- distinguish these two instruments in such a way that rational investors would not plausibly treat them as perfect substitutes. These factors can reasonably account for the average spread observed over time between the two instruments' respective interest rates. The central focus of this paper, however, is not the mean paper-bill spread but the spread's variation over time, and in particular the predictive power of that variation with respect to real output. In this context an important finding of this paper is that a decomposition of the spread into components reflecting the interest rate level, a time-varying measure of default risk and a residual delivers three components each of which bears a significant relationship to subsequent movements in real output.

Finally, evidence based on a more structural approach exploiting the

presumed imperfect portfolio substitutability of commercial paper and Treasury bills provides support for each of three hypotheses about why movements of the spread anticipate movements in real output. First, changing perceptions of default risk exert a clearly recognizeable influence on the spread, an influence that is all the more discernable after allowance for supply effects associated with imperfect substitutability. In this respect, the spread serves as a useful "indicator" variable, compactly summarizing information available to investors from a variety of disparate sources; but the underlying relationships play no directly causal role in affecting economic activity. Second, given imperfect substitutability, a widening paper-bill spread is also a symptom of the contraction in bank lending due to tighter monetary policy. In this respect, the spread does in part reflect a causal influence on economic activity. Third, there is also some evidence of a further role for independent changes in the behavior of borrowers in the commercial paper market due to their changing cash requirements over the course of the business cycle, but for the most part this third channel remains a potential object of further research.

These findings are subject to numerous caveats, of course, and for the most part there is no need to reiterate them here. The one reservation that does perhaps deserve explicit attention in conclusion is that the abilty to sort out these three competing hypotheses (or, for that matter, still others) with time-series data relies crucially on the presence of multiple independent shocks generating movements in economic activity. For example, if changes in monetary policy were the only factor determining whether the economy were to be in a boom or a recession, then the effect associated above with changing perceptions of default probabilities and the effect associated with changing business cash flows would both merely be subsidiary reflections of monetary policy. In this respect, investigation of the relationship between the paper-bill spread and

real economic activity is little different from much of empirical macroeconomics. Given the rich data potentially available on commercial paper transactions by individual borrowers and lenders, however, in this case a useful supplement to research based on the aggregate time series would be the parallel exploitation of micro-level data.

Footnotes

*Harvard University and the Federal Reserve Bank of Chicago, respectively. The ideas presented in this paper are the authors'; they do not necessarily reflect the official stance of the Federal Reserve Bank of Chicago. The authors are grateful to Ben Bernanke, Timothy Cook, Mark Watson, Jeff Wooldridge and an anonymous referee for helpful comments on a preliminary draft, and to the General Electric Foundation and the Harvard Program for Financial Research for research support.

1. Here, as well as elsewhere throughout this paper, the interest rates shown are discounts calculated on a 360-day basis. Data are from the Federal Reserve Board's H.15 release.

2. The only exceptions in this 384-month series are 1975:7-9, 1976:3, 1976:5 and 1977:1-3. Prior to November 1979, the "6-month" paper rate recorded by the Federal Reserve Board actually corresponded to paper with maturities of 120-179 days. The few anomalous negative values of the paper-bill spread may therefore reflect a steep, upward-sloping term structure for commercial paper in specific months during over that period. See the Federal Reserve Bulletin, December 1979, page A-27, footnote 2.

3. Data for gross national product, the deflator, mid-expansion federal spending, and the monetary aggregates are seasonally adjusted. Data for interest rates and the paper-bill spread are not.

4. There is no readily available monthly series corresponding to mid-expansion federal government expenditures.

5. Wizman (1990), in related work, has shown that results like those presented in Table 5 carry over to systems simultaneously containing many more variables.

6. Data are from the Federal Reserve System's flow-of-funds accounts. Useful descriptive accounts of the development and functioning of the commercial paper market include Selden (1963), Baxter (1966), Hurley (1977, 1982), and Stigum (1990).

7. In addition, 17 states had a franchise tax on business income, and 18 states levied an excise tax on bank income. See Commerce Clearing House, State Tax Handbook (1990).

8. Cook and Lawler (1983) provided a highly useful discussion of the role of taxes in accounting for the paper-bill spread.

9. See Selden (1963) for an account of the inter-war experience.

10. See Moody's Investors Service (1989) for a detailed history of experience under the rating system.

11. See, for example, Bernanke (1990).

12. See, for example, Krasker (1980).

13. The classic discussion of liquidity in this context is that of Kessell (1965). An aspect of Kessel's treatment that is especially relevant to some of the results presented below is his argument that the premium placed on liquidity would (like the tax effect and the default risk effect discussed above) vary directly with the level of interest rates.

14. See Friedman (1986, 1990) for discussions of the increase in the failure rate and the default rate as a result of increased financial fragility in the 1980s.

15. Although augmented Dickey-Fuller tests for stationarity of the paper-bill spread reject the nonstationarity null at the .01 level, the fact that analogous tests for the interest rate level do not reject at the .10 level warrants care in interpreting the standard errors on the interest rate in these regressions, which may have non-standard asymptotic distributions. Indeed, the observation that the spread is I(0) while the interest rate is I(1) is inconsistent with any hypothesis that the spread merely captures the effect of the interest rate level (via, for example, differential taxation).

16. An additional symptom of the weak link between the paper-bill spread and the Baa-Aaa bond spread is that while the paper-bill spread is I(0)the bond quality differential appears to be I(1) over the 1959-90 sample. (Augmented Dickey-Fuller tests are unable to reject the null hypothesis of nonstationarity of the bond quality differential even at the .10 level, while analogous tests for the paper-bill spread over the shorter 1974-90 sample do reject the null at the .05 level.) In other words, the bond

quality differential appears to contain an integrated component that is not shared by the paper-bill spread.

17. As the analysis above indicates, default risk may also explain why the level of the bill rate would influence the spread. (The relationship in (4), for example, implies that the spread is proportional to the bill rate, with coefficient determined in part by the default probability.)

18. Here and below, the curve representing banks' demand for loans (supply of credit) is drawn with positive but finite slope. Making the curve vertical -- that is, assuming that banks in the aggregate have no flexiblity to expand credit for a given quantity of reserves supported by the central bank -- would not materially change the analysis.

19. In regressions analogous to those summarized in Table 3, for example, the loan-bill spread is significant at the .05 level in the second sub-sample but not in the first, and not for the full sample. In the context represented by Table 5, the loan-bill spread is not significant, even at the .10 level, in regressions also including the paper-bill spread. (Kashyap et al. have advanced an argument for what amounts to the loan-to-paper <u>quantity</u> ratio.)

20. An alternative way to express the same relationship is to note that demand in the paper market depends on the loan rate.

21. As Figure 1 shows, the spread does in fact tend to decrease before the recession ends.

22. Data are from the flow-of-funds accounts.

23. Kashyap et al. (1991) examined similar plots, but based on the dates identified by Romer and Romer (1989) with changes in monetary policy, rather than on actual business cycle peaks. Kashyap et al. also did not incorporate finance company paper in their analysis.

24. The deficit is the difference between internally generated funds (gross of depreciation) and investment outlays. Data are from the flow-of-funds accounts.

25. The P2-P1 spread and the lagged bill share are also included as instruments, because they are treated as exogenous in the regression.

26. These results are robust to such changes in the instrument list as dropping the financing deficit, or including instruments constructed from interest rates.

27. The increase in the estimated coefficient on the quality differential in this regression is reassuring, in that the P2-P1 differential is actually measured for 1-month maturities.

28. Because the commercial paper rate and the Treasury bill rate are each I(1), the limiting distribution of the coefficient on the bill rate in line (4) is non-normal, and so its t-statistic overstates the precision of the parameter estimate. The coefficients on the remaining stationary regressors will have normal limiting distributions, however.

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