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5 Why Does the Paper-Bill Spread Predict Real Economic Activity?

Benjamin M. Friedman and Kenneth N. Kuttner

People have always sought reliable ways to predict the future, and economic fluctuations are no exception. Public policymakers, charged with the responsibility of maintaining full but not overfull 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 (1989b), Friedman and Kuttner (1992), Bernanke (1990), and Kashyap, Stein, and Wilcox (1993)—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 relation to subsequent fluctuations of nonfinancial economic activity in the United States. As such relations 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 relation not just to

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future movements of aggregate output and spending but to almost all 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 disappointment), there is no ambiguity about whether the paper-bill spread is related to the real or the 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 relations 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 5.1 briefly reviews and expands the evidence from previous work documenting the relations between the paper-bill spread and real economic activity in the United States. Section 5.2 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 5.3 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 relation between the paper-bill spread and fluctuations in business activity. Section 5.4 applies a variety of statistical tests to provide evidence bearing on the validity of any or all of these three hypotheses. Section 5.5 brings together the principal conclusions developed throughout the paper.

To anticipate, the evidence presented in this paper suggests, at the least, a twofold explanation for the predictive power of the paper-bill spread with respect to real economic activity, an explanation based on both default risk and monetary policy. First, changing perceptions of default risk, as business prospects alternately strengthen and ebb, exert a clearly recognizable influence on the spread and also account for part of the spread's relation 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 relations estimated in section 5.4 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.

5.1 The Basic Relation

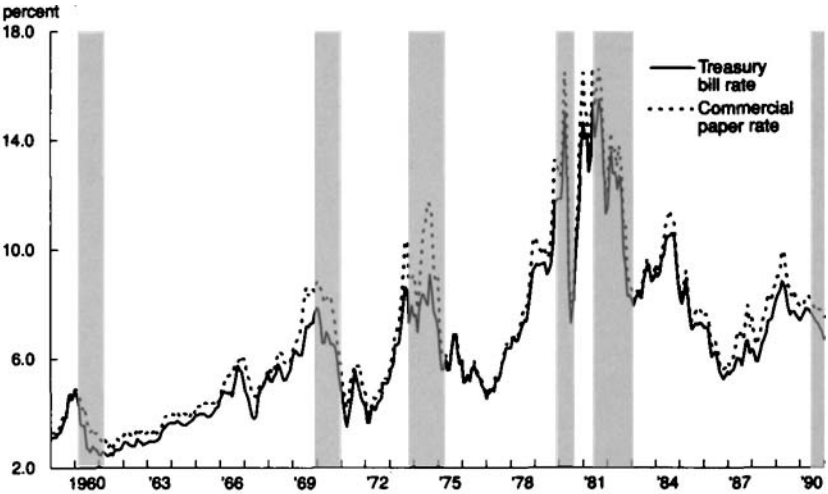
The upper panel of figure 5.1 shows monthly average values of the respective interest rates on six-month prime-rated commercial paper and 180-day U.S. Treasury bills, for 1959–90.[1] Both series display the basic features characteristic of practically all U.S. interest rates during this period: a generally 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 designated by the National Bureau of Economic 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 5.1 (with magnified scale compared to that of the upper panel) plots the monthly average difference between the six-month commercial paper rate and the 180-day Treasury bill rate for the same period. Over the entire thirty-two-year sample, the mean spread was 0.57 percent per annum (i.e., fifty-seven basis points), with a standard deviation of 0.49 percent. 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 5.1 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 counterexample).

Table 5.2, updated from Friedman and Kuttner (1992), shows that the widening 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.

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 "six-month" commercial paper rate recorded by the Federal Reserve Board actually corresponded to paper with maturities of 120–79 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 that period (see *Federal Reserve Bulletin* 65 [December 1979], A-27, no. 2).



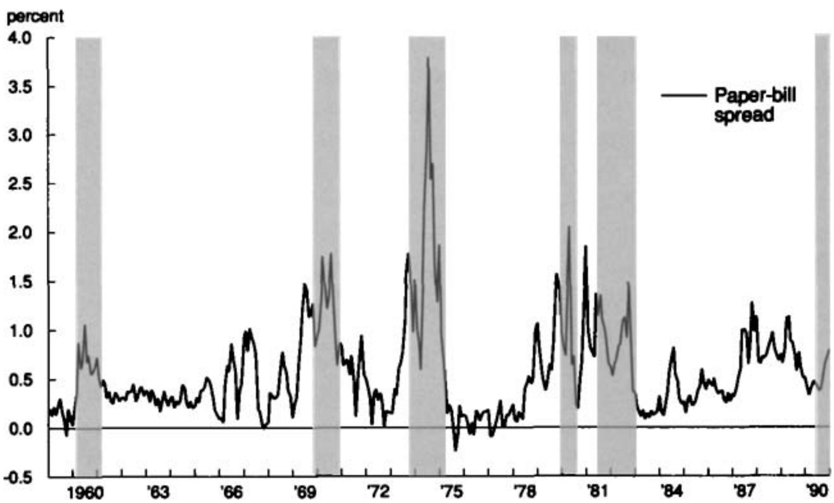


Fig. 5.1 Six-month commercial paper and Treasury bill rates and the paper-bill spread, 1959–1990

Table 5.1 Cyclical Behavior of the Paper-Bill Spread

	Spread (%)	Observations
Mean over entire 1959:1–1990:12 sample	.57	384
Mean during recessions	1.10	66
Mean excluding recessions	.46	318
Mean 1–6 months prior to recessions	.88	36
Mean 7–12 months prior to recessions	.50	36

Source: Board of Governors of the Federal Reserve System.

Note: Observations are monthly averages of daily data. Underlying interest rates are for 6-month commercial paper and 6-month Treasury bills.

Table 5.2 *F*-Statistics for Financial Variables in Quarterly Real Output Equations

	1960:2–1990:4	1960:2–1979:3	1970:3–1990:4
	Three-Variable System (real output, price index, financial variable)		
$r_P - r_B$	7.70***	8.12***	5.32***
$\Delta\ln(M1)$	2.65**	2.59**	1.77
$\Delta\ln(M2)$	4.66***	3.78***	2.19*
$\Delta\ln(\text{credit})$	1.21	1.97	.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)		
$r_P - r_B$	7.16***	7.10***	4.68***
$\Delta\ln(M1)$	2.85**	2.71**	1.81
$\Delta\ln(M2)$	4.32***	3.63***	1.81
$\Delta\ln(\text{credit})$	1.02	2.34*	.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***

Note: 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. r_P is the rate on 6-month prime commercial paper. r_B is the rate on 6-month Treasury bills. Credit is total domestic nonfinancial debt. r_{10} is the 10-year Treasury-bond yield. r_{FF} is the Federal funds rate.

* Significant at the 10% level.

** Significant at the 5% level.

*** Significant at the 1% level.

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

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

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 six-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 subsamples: 1960:II–1979:III (i.e., until the Federal Reserve System's adoption of new monetary policy procedures in October 1979) and 1970:III–1990:IV (i.e., 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 subsamples separately, regardless of whether the fiscal variable is included. Indeed, none of the other five financial variables considered meets this criterion even at the .10 significance level.

Table 5.3 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 5.2—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 subsamples 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 5.4 presents results for an alternative form of test, suggested by Stock and Watson (1989a), again based on monthly data. The Stock-Watson regression includes twelve lags each of the respective log changes in industrial pro-

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.

Table 5.3 **F-Statistics for Financial Variables in Monthly Real Output Equations**

	1960:2–1990:12	1960:2–1979:9	1970:7–1990:12
	Three-Variable System (real output, price index, financial variable)		
$r_P - r_B$	8.47***	6.33***	6.10***
$\Delta \ln(M1)$	2.27**	2.23**	.95
$\Delta \ln(M2)$	4.70***	3.69***	2.12**
$\Delta \ln(\text{credit})$	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**

Note: Regressions include six lags of each included variable. Real output variable is industrial production. Price index is the producer price index. For definitions of the other variables, see table 5.2

* Significant at the 10% level.

** Significant at the 5% level.

*** Significant at the 1% level.

Table 5.4 **F-Statistics for Financial Variables in Monthly Real Output Equations (Stock-Watson specification)**

	1960:2–1990:12	1960:2–1979:9	1970:7–1990:12
	Four-Variable System (real output, price index, commercial paper rate, financial variable)		
$r_P - r_B$	6.04***	2.85***	4.24***
$\Delta \ln(M1)$	.83	.77	.59
$\Delta \ln(M2)$	3.08***	2.25**	1.47
$\Delta \ln(\text{credit})$	1.10	.93	1.29
$r_{10} - r_{FF}$	2.11*	1.16	1.62

Note: Regressions include six lags of the financial variable, twelve lags of each of the other three variables, and a linear time trend. Variables are defined as in tables 5.2 and 5.3

* Significant at the 10% level.

** Significant at the 5% level.

*** Significant at the 1% level.

duction and the producer price index, twelve 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), six 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—does so even at the .10 level.

Finally, table 5.5 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 5.2 and 5.3 above. The estimation is based on quarterly data, with variables and lag specification corresponding to those underlying the upper panel of table 5.2. 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, 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 percent 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 paper-bill spread last.

When the measure of output used is real gross national product (the upper panel), the F-statistics presented in table 5.5 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 *any* of the other financial variables. Among the 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 lower panel), 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 5.5 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 percent) 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

5. In related work, Wizman (1990) has shown that results like those presented in table 5.5 carry over to systems simultaneously containing many more variables.

Table 5.5 Performance of Alternative Financial Indicators in Quarterly Real Output VARs

	Output = Real Gross National Product					
	$\Delta\ln(M1)$	$r_P - r_B$	$\Delta\ln(M2)$	$r_P - r_B$	$\Delta\ln(\text{credit})$	$r_P - r_B$
F-statistic	1.59	6.29***	.76	3.33**	.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 Absorption					
	$\Delta\ln(M1)$	$r_P - r_B$	$\Delta\ln(M2)$	$r_P - r_B$	$\Delta\ln(\text{credit})$	$r_P - r_B$
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
	Output = Real Business Fixed Investment					
	$\Delta\ln(M1)$	$r_P - r_B$	$\Delta\ln(M2)$	$r_P - r_B$	$\Delta\ln(\text{credit})$	$r_P - r_B$
F-statistic	.32	4.07***	.68	2.14*	.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***	.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

Note: 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 simulations with 1,000 draws. Variables are defined as in table 5.2. The ordering for the decompositions is as follows: output, prices, financial variable, paper-bill spread.

* Significant at the 10% level.

** Significant at the 5% level.

*** Significant at the 1% level.

last in the underlying orthogonalization. Table 5.6 highlights the relevance of this ordering by presenting alternative variance decomposition results for those three financial variables that, for at least some output measures, account for a greater share of output in the decompositions shown in table 5.5. 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 relation 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 often advanced as potential business-cycle predictors.

5.2 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 year-end 1990, the volume of such claims outstanding in the United States totaled $610 billion, of which approximately 19 percent was the liability of U.S. nonfinancial businesses, 5 percent of U.S. bank holding companies, 55 percent of U.S. nonbank financial intermediaries, and 12 percent of foreign obligors. Roughly one-third of the $610 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 percent issued by U.S. nonfinancial businesses, 57 percent by U.S. nonbank financial intermediaries, and 18 percent 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 U.S. 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 postwar period. The volume of Treasury bills outstanding in 1946 was $17 billion. At year-end 1990, it was $482 billion.

Three factors appear most important in accounting for the typically greater

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).

Table 5.6 **Performance of Alternative Financial Indicators in Quarterly Real Output VARs, Orthogonalization Order Reversed**

	$r_P - r_B$	$\Delta\ln(M2)$	$r_P - r_B$	$r_{10} - r_{FF}$	$r_P - r_B$	Δr_P
	Output = Real Gross National Product					
F-statistic	3.33***	.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 Absorption					
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					
F-statistic	2.14*	.68	3.54***	.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

Note: The ordering for the decompositions is as follows: output, prices, paper-bill spread, financial variable. See also note to table 5.5.

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, forty-three states (plus the District of Columbia) had individual income taxes, with rates applicable to interest income varying up to a high of 14 percent in Connecticut. Similarly, twenty-eight 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 percent.[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

7. In addition, seventeen states had a franchise tax on business income, and eighteen states levied an excise tax on bank income (see *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.

$$(2) \qquad (1 - \tau)r_P = r_B,$$

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 spread required for this purpose varies directly with the level of the tax-exempt rate, according to

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

Given values of 0.57 percent for the spread and 6.48 percent for the bill rate, on average for the 1959–90 sample period spanned in figure 5.1 above, the implied effective tax rate would be 8.1 percent (i.e., 0.081) if differential taxability were the sole factor accounting for a nonzero average spread over time. (A 9.7 percent 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

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

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, 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 relation between the two (promised) interest rates that leaves the investor just indifferent between the two assets at the margin is

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

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 interwar 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 postwar 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-rated paper, but also designating three separate categories of prime-rated paper (P1, P2, and P3 by Moody's; A1, A2, and A3 by Standard and Poor's). Since the introduction of these ratings, only six rated issuers had experienced defaults by the end of 1991, and four 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 (see, e.g., Bernanke 1990). To be sure, this argument is plausible if the question at hand is whether default risk *alone* can explain the spread. As with 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" (see, e.g., Krasker 1980). 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 manager's embarrassment in the event of a client's holding defaulted paper may matter, in addition to the pecuniary loss to the account.) 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 the aggregate data would suggest.

Figure 5.2 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

9. For an account of the interwar experience, see Selden (1963).

10. For a detailed history of experience under the rating system, see Moody's Investors Service (1992).

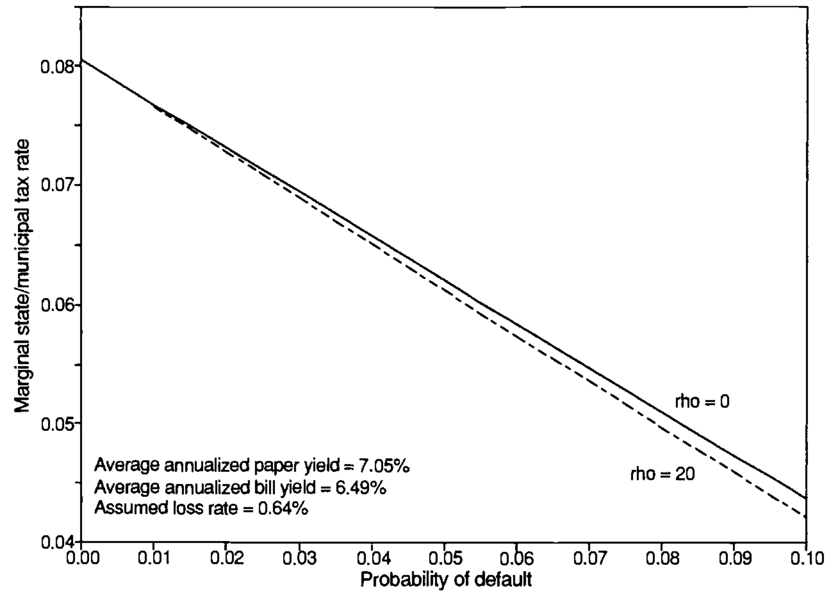


Fig. 5.2 Tax rates and default probabilities consistent with the observed 1959–90 average paper-bill spread

relation in (5) for the average values of r_P and r_B observed over 1959–90, given the default-state loss rate ϕ = .0064, portfolio proportion α = .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 ρ: zero (i.e., risk neutrality) and twenty. 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 percent 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 nonzero probability of default makes the observed mean spread consistent with a lower tax rate. For example, if investors believe that there is a one-in-twenty chance of default on 0.64 percent of their commercial paper holdings (i.e., 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.[11] 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 effect 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 analytic terms, a liquidity value of bills over paper might simply take the form of a constant subtracted from the left-hand side of (5), which in turn would shift both curves in figure 5.2. But differential liquidity could also account for either cyclical variation of the paper-bill spread (e.g., 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 for suspecting that the value that investors place on the greater liquidity of bills over paper does so. Further, as figure 5.3 shows, both the frequency of business failures and the vol-

11. The classic discussion of liquidity in this context is that of Kessel (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.

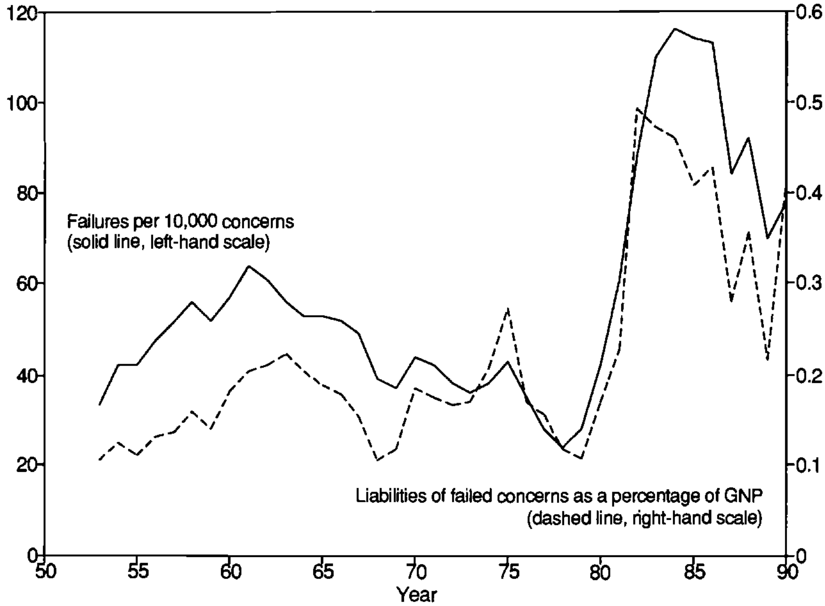


Fig. 5.3 Bankruptcy and default rates, 1953–90
Source: Dun and Bradstreet.
Note: Coverage does not include all industry sectors.

ume of defaulted business liabilities (scaled by gross national product) vary inversely with the pace of real economic activity.[12] As a result, it is also plausible to suppose that rational investors increase their subjective assessment of default rate π (and perhaps also their assessment of loss rate ϕ) if they have independent information indicating that a business recession is imminent. If they do, then arbitrage behavior like that underlying the relation 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 liquidity 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 5.3 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

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

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 reinvesting the proceeds of advance refundings). So do 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, although 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 5.7 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.[13] 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 differential 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, e.g., might represent a declining liquidity value of bills over paper as the commercial paper market has developed over time.)

The lower panel of table 5.7 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

13. 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 nonstandard 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, e.g., differential taxation).

Table 5.7 Decompositions of the Paper-Bill Spread

	Constant	Interest Rate Level	Quality Differential	Trend	$\bar{R}^2$	SE	D-W
	Using the Commercial Paper Quality Differential (sample 1974:1–1990:12)						
1	.12	.09			.16	.50	.30
	(.23)	(.02)					
2	.25		.70		.22	.48	.33
	(.15)		(.20)				
3	−.11	.05	.54		.30	.47	.32
	(.27)	(.03)	(.27)				
4	−.76	.05	.68	−.0015	.28	.46	.33
	(.83)	(.02)	(.15)	(.0018)			
	Using the Corporate Bond Quality Differential (sample 1959:1–1990:12)						
1	.12	.07			.16	.44	.31
	(.09)	(.02)					
2	.43		.13		.01	.48	.28
	(.13)		(.11)				
3	.19	.09	−.20		.18	.44	.33
	(.09)	(.03)	(.13)				
4	.31	.11	−.15	−.0008	.19	.43	.34
	(.15)	(.03)	(.12)	(.0007)			

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

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 twenty- or thirty-year bond, however, so the default-risk aspect of the attempt to extend these results backward to the longer sample does not deliver significant results.[14] (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 relation 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.

14. 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.

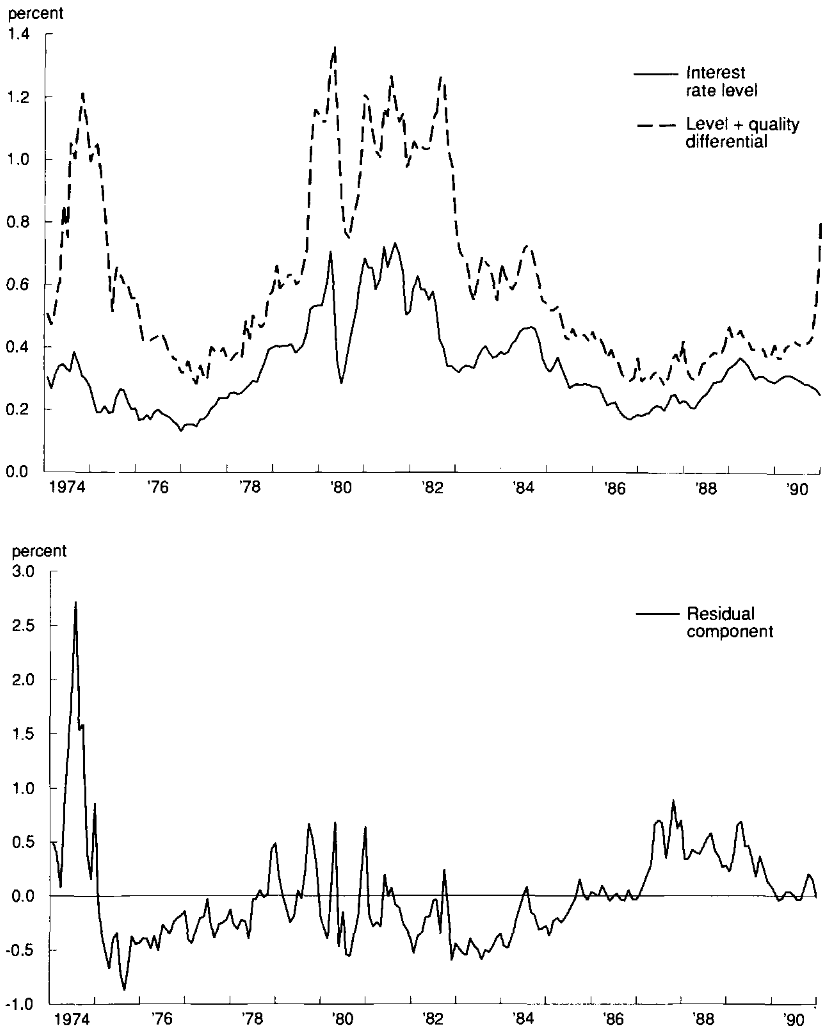


Fig. 5.4 Interest rate level, default risk, and residual components of the paper-bill spread, 1974–90

Figure 5.4, based on the regression in the third row of the upper panel of table 5.7, 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 differential; and the regression residual (augmented by the constant term). Table 5.8 presents summary statistics for these three components, including their respective simple correlations with changes in real output, as

Table 5.8 **Analysis of Components of the Paper-Bill Spread**

	Mean	SD	Correlation with: $\Delta\ln(IP_t)$	$\Delta\ln(IP_{t+1})$	F-Statistic
Constant	−.12	. . .	. . .	. . .	. . .
Interest rate level	.45	.14	−.11	−.21***	2.65**
Quality differential	.28	.20	−.43***	−.42***	4.00***
Residual	. . .	.47	−.13*	−.24***	2.60**

Note: Results for the residual are based on the regression in the top panel of table 5.7, row 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 5.3, for the 1974:7–1990:12 sample. IP is the index of industrial production.

* Significant at the 10% level.

** Significant at the 5% level.

*** Significant at the 1% level.

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 *each of the three components* of the 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 5.3 above 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 differential) more plausibly fluctuates with prospects for business activity, and it is also apparently part of the story.[15] 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 differential, or both.

5.3 Borrowers and Lenders in the Short-Term Credit Markets

The analysis presented in section 5.2 suggests a role for both time-varying default risk and a time-varying liquidity premium as explanations of the pre-

15. As the analysis above indicates, default risk may also explain why the level of the bill rate would influence the spread. (The relation in [4], e.g., implies that the spread is proportional to the bill rate, with coefficient determined in part by the default probability.)

dictive 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.

5.3.1 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 5.1 above.

Figure 5.5 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.[16] 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

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

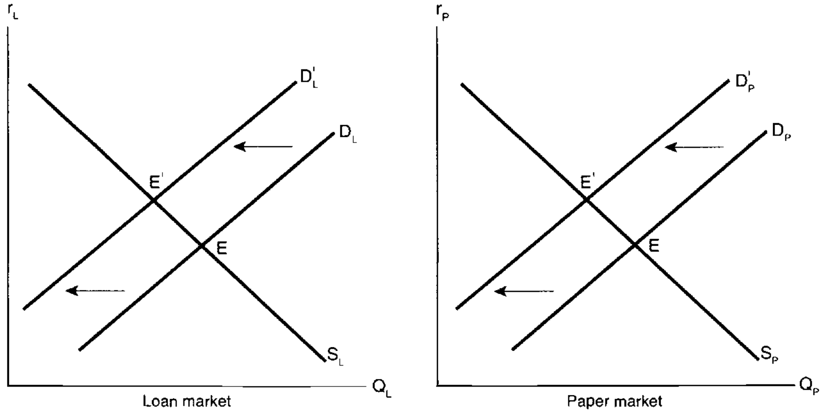


Fig. 5.5 The default risk hypothesis

case empirically for the loan spread, however.[17] One reason is probably that bank loans have many implicit (i.e., noninterest) 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 5.1 above shows, the widening of the paper-bill spread before recessions is a matter of at most six months.)

5.3.2 Changes in Monetary Policy

A second explanation of the predictive power of the paper-bill spread, emphasized by Bernanke (1990) and implicit in the work of Kashyap, Stein, and Wilcox (1993), points to monetary policy. Figure 5.6 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 5.5 above, 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.[18] Hence the quantity of paper issued rises, as does the commercial paper interest rate.

17. In regressions analogous to those summarized in table 5.3 above, e.g., the loan-bill spread is significant at the .05 level in the second subsample but not in the first and not for the full sample. In the context represented by table 5.5 above, the loan-bill spread is not significant, even at the .10 level, in regressions also including the paper-bill spread. (Kashyap, Stein, and Wilcox (1993) have advanced an argument for what amounts to the loan-to-paper *quantity* ratio.)

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

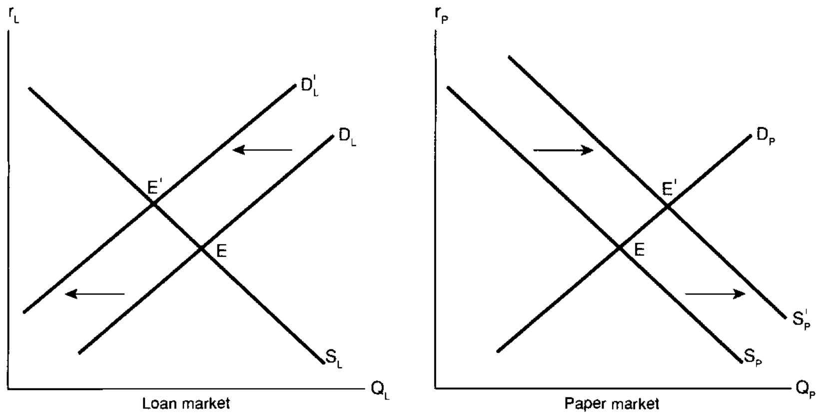


Fig. 5.6 The monetary policy hypothesis

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 5.2 above, 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 loss 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 5.8 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 mutually exclusive) explanation offered by Bernanke and by Kashyap et al. emphasizes, in part, heterogeneity among 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 of 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 consists of commercial paper.

5.3.3 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 that of borrowers. As table 5.1 above 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.[19] (The analogous point does not apply to hypotheses based on time-varying default risk since, as is clear from fig. 5.3 above, 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 5.7 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 5.5 above, 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 argument 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.

5.4 Some Evidence on Competing Hypotheses

The results presented in tables 5.7 and 5.8 above 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 5.7) as well as the spread's predictive power with respect to fluctuations of real output (table 5.8). In terms of the more structural analysis of section 5.3 above, an increase in perceived default

19. As fig. 5.1 above shows, the spread does in fact tend to decrease before the recession ends.

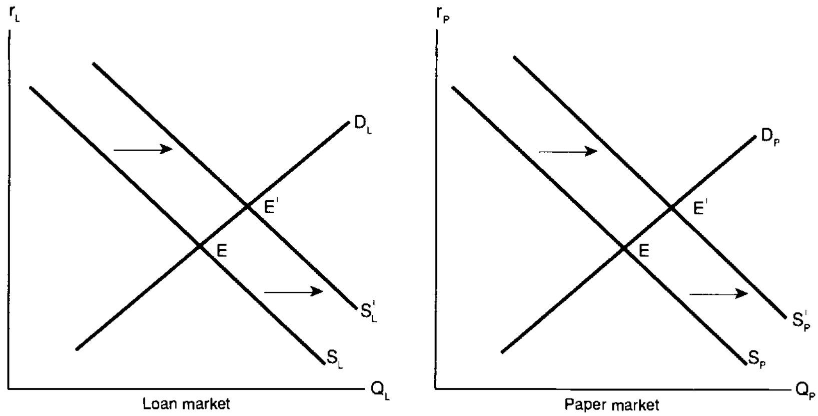


Fig. 5.7 The cash flows hypothesis

risk represents a straightforward influence on the behavior of lenders. A widening of the paper-bill spread due to the 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 5.8 and 5.9 present the basic data corresponding to the *quantities* at issue in the discussion of competing hypotheses in section 5.3. The top panel of figure 5.8 shows that the four-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, although much more so in 1957. The figure's bottom panel (with greatly reduced scale) plots analogous four-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 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 it tends 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.[20]

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

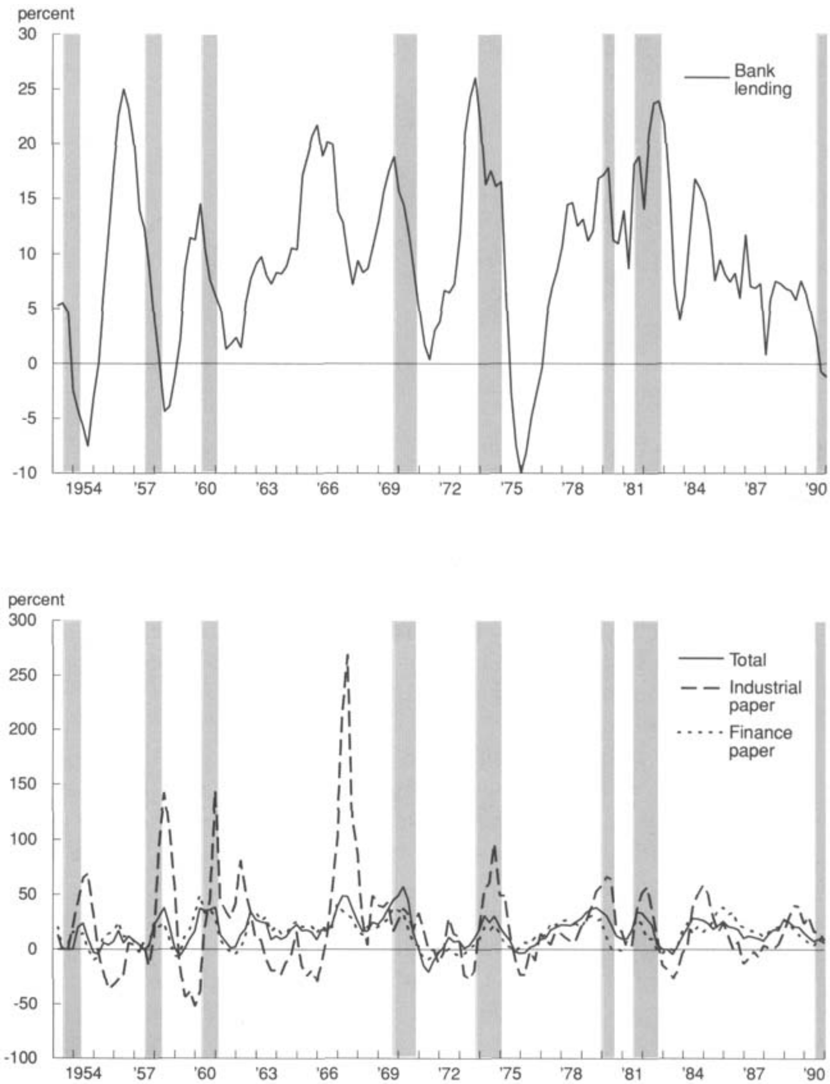


Fig. 5.8 Nominal four-quarter bank loan and commercial paper growth, 1953–90

Figure 5.9 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 ten-quarter intervals surrounding business-cycle peaks. Each (deflated) series is expressed as the log deviation from the corresponding Hodrick-Prescott trend, normalized to equal zero in the peak quarter. Here again, the tendency for the

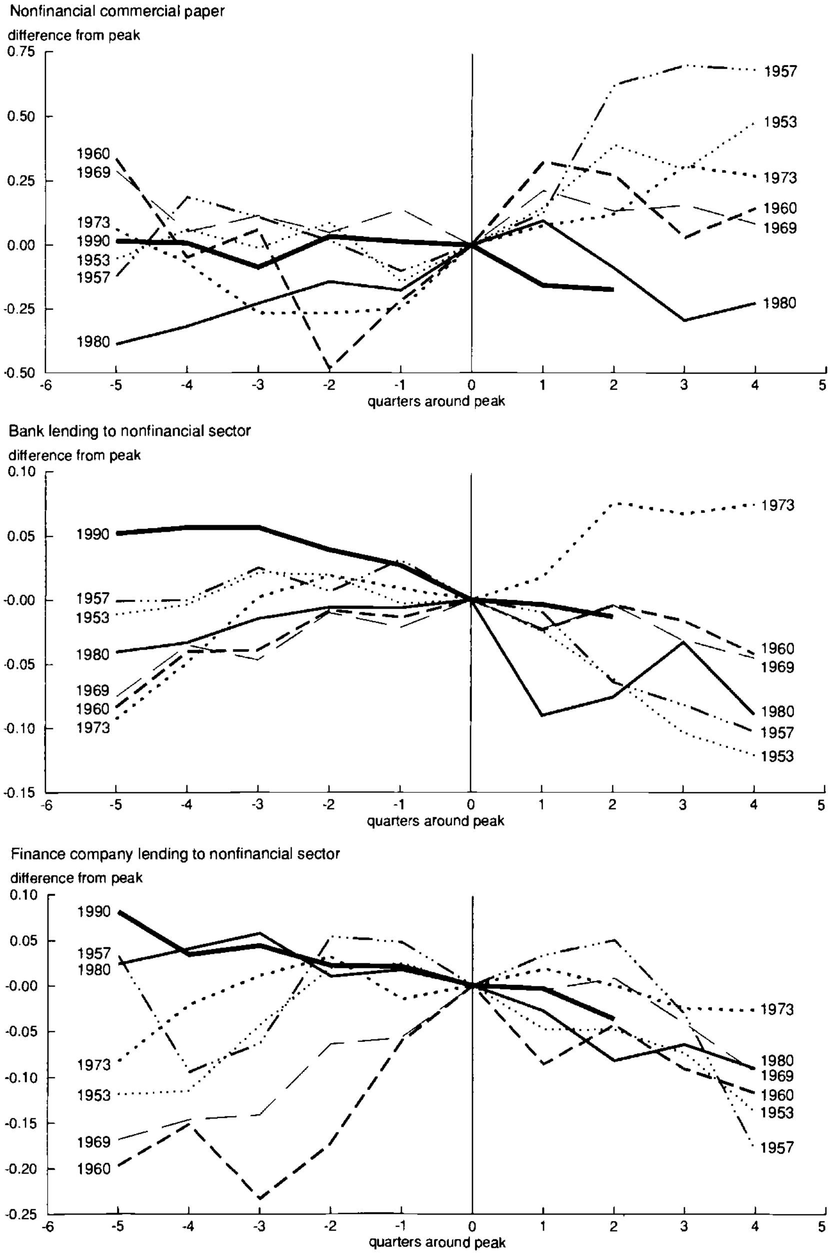


Fig. 5.9 Nonfinancial sector commercial paper issuance, borrowing from banks, and borrowing from finance companies around cyclical peaks

Table 5.9 **Correlation Coefficients between the Paper-Bill Spread and Selected Variables**

	Real	Nominal
% change in commercial paper issued by the nonfinancial corporate sector	.32***	.33***
% change in bank loans to the nonfinancial corporate sector	.17*	.17*
Nonfinancial sector financing deficit	.35***	.24***
GNP, leading 2 quarters	−.47***	−.23***
GNP, leading 1 quarter	−.51***	−.23***
GNP, current	−.46***	−.15*
GNP, lagging 1 quarter	−.29***	−.03
GNP, lagging 2 quarters	−.24***	−.001

Note: Observations are quarterly; the sample is 1952:2–1990:3. Financial flow variables are from the flow-of-funds data base. Real variables are deflated by the implicit GNP deflator. The financing deficit is the difference between capital expenditures and after-tax cash flow for the nonfarm, nonfinancial corporate sector.

* Significant at the 10% level.

** Significant at the 5% level.

*** Significant at the 1% level.

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.[21]

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 5.3. 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 5.9 provide further support, especially for the cash flows hypothesis. The paper-bill 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

21. Kashyap, Stein, and Wilcox (in press) examined similar plots, but ones 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.

weight to the cash flows hypothesis in preference to the monetary policy hypothesis. First, as the third row of table 5.9 shows, the paper-bill spread is also strongly correlated with contemporaneous growth of the cash deficit that nonfinancial corporations need to finance.[22] 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, with the result 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 5.8 and 5.9 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 5.10 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 ordinary least squares regression reported in row 1 of the table shows that the spread 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. It also shows that the time trend is not only negative (as usual) but statistically significant along with the other three variables. The relation 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 relation 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 relation that makes at least some allowance for supply effects on the relative yields of commercial paper and Treasury bills (in contrast to, e.g., the insignificant time trends shown in table 5.7 above).

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 5.10 reports two-stage least squares estimates of the same regression, using as instruments the log change in the real

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

Table 5.10 **Structural Equations for the Paper-Bill Spread**

	Dependent Variable	Method	Sample	CPFLOW (t)	TBSHARE ($t-1$)	CPQ (t)	BONDQ (t)	r_{B6} (t)	Constant	Trend	PENN	SE	D-W
1	$r_{P6} - r_{B6}$	OLS	74:2–90:4	10.99	−6.78	.61			5.10	−.027		.36	.87
				(4.90)	(1.64)	(.10)			(1.34)	(.010)			
2	$r_{P6} - r_{B6}$	2SLS	74:2–90:4	25.31	−6.04	.77			4.26	−.024		.40	1.20
				(10.49)	(1.87)	(.15)			(1.52)	(.012)			
3	$r_{P3} - r_{B3}$	2SLS	74:2–90:4	25.26	−6.36	.94			4.63	−.026		.46	1.30
				(9.67)	(2.32)	(.17)			(1.90)	(.014)			
4	r_{P6}	2SLS	74:2–90:4	18.36	−6.58	.80		.97	4.95	−.025		.37	1.09
				(8.82)	(1.72)	(.18)		(.01)	(1.43)	(.011)			
5	$r_{P6} - r_{B6}$	OLS	67:3–90:4	11.83	−6.32		.23		4.69	−.024	.45	.41	.87
				(3.04)	(.70)		(.12)		(.62)	(.003)	(.19)		
6	$r_{P6} - r_{B6}$	2SLS	67:3–90:4	40.11	−6.23		.55		3.93	−.028	1.57	.55	1.35
				(17.74)	(1.17)		(.18)		(.96)	(.007)	(.64)		
7	r_{P6}	2SLS	67:3–90:4	23.33	−6.14		.33	1.01	4.22	−.026	.92	.44	1.10
				(13.52)	(.84)		(.13)	(.03)	(.65)	(.005)	(.46)		

Note: Variable definitions: r_{P6} = 6-month commercial paper rate (%); r_{P3} = 3-month commercial paper rate (%); r_{B6} = 6-month Treasury bill rate (%); r_{B3} = 3-month Treasury bill rate (%); BONDQ = Baa-Aaa corporate bond quality differential (%); CPQ = P2-P1 paper quality differential (%); CPFLOW = change in total commercial paper ÷ total stock of commercial paper and Treasury bills; TBSHARE = Treasury bill outstandings ÷ total stock of commercial paper and Treasury bills; PENN = dummy variable equal to 1 in 1970:3, the date of the Penn Central default. 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 2SLS 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 the following: real monetary base growth, real nonborrowed reserve growth, and the difference between nonfinancial firms' investment expenditures and their after-tax cash flow.

monetary base, current and lagged once; the log change in real nonborrowed reserves (augmented 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 that are plausibly related to either monetary policy or borrowers' financing needs.[23] Two-stage least squares 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.[24] 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.[25]

The regression reported in row 4 of table 5.10, 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 does indeed have a coefficient of approximately unity and that, in other respects, the new regression corresponds quite closely to its earlier equivalent.[26] 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 5–7 of table 5.10 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 less accurately 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.

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

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

25. 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 one-month maturities.

26. 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 row 4 is nonnormal, so its t-statistic overstates the precision of the parameter estimate. The coefficients on the remaining stationary regressors will have normal limiting distributions, however.

Table 5.11 ***F*-Statistics for Financial Variables in Augmented Monthly Real Output Equations**

	1960:1–1990:12	1974:7–1990:12
$\Delta\ln(M1)$	.56	.65
Δr_B	.87	1.84*
Baa-Aaa bond quality differential	3.94***	
P2-P1 paper quality differential		2.25**
$r_P - r_B$	5.26***	4.08***

Note: The estimated six-variable system includes the first-differences of the logs of industrial production, the producer price index, and M1; the first-difference of the 6-month Treasury bill rate; the quality differential in levels; and the paper-bill spread in levels. Six lags are included for each regressor.

* Significant at the 10% level.

** Significant at the 5% level.

*** Significant at the 1% level.

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 section 5.3. On the evidence, the answer is no. The results summarized in table 5.11 and in figures 5.10 and 5.11 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 5.11 shows F-statistics for the real output equation of a six-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 a lag length of six. 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 5.10 and 5.11 show the respective sets of impulse response functions indicating the effects on real output (estimated responses, bounded by 95 percent confidence intervals) due to 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 "resid-

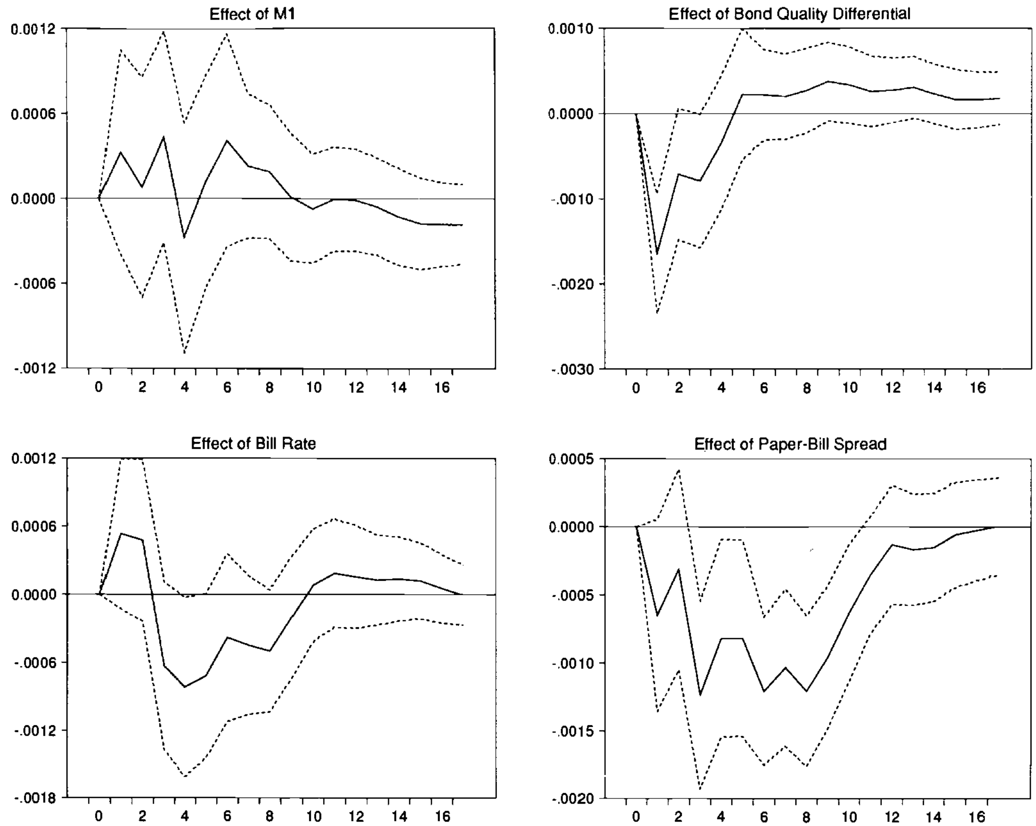


Fig. 5.10 Impulse response functions for real output (using the Baa-Aaa bond quality differential)

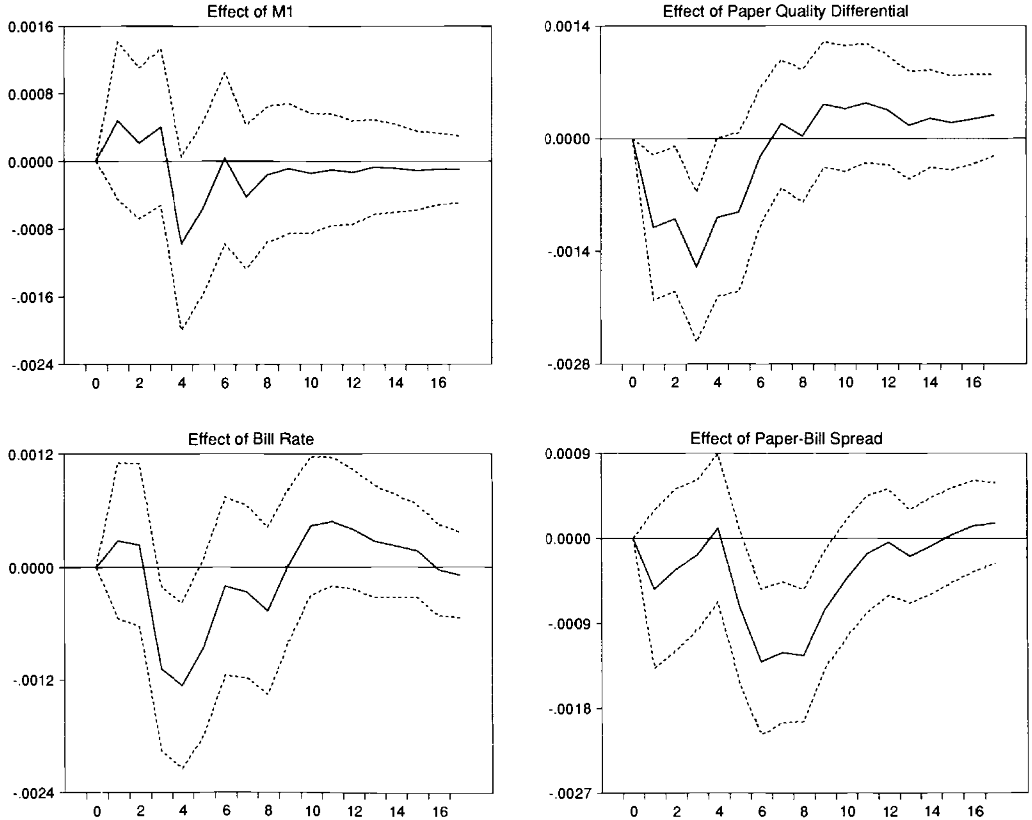


Fig. 5.11 Impulse response functions for real output (using the P2-P1 paper quality differential)

ual" 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 clearly visible nonetheless and statistically significant at the familiar six-month horizon by which a widening of the spread usually anticipates recessions.

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 relation 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 differentials.

5.5 Summary of Conclusions

The empirical evidence assembled in this paper supports several specific conclusions about the relation 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 subperiods delineated by key structural changes in financial institutions—consistently points to a statistically significant relation 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 relation 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 recognizable influence on the spread, an influence that is all the more discernible 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 relations 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 in most cases there is no need to reiterate them here. The one reservation that does perhaps deserve explicit attention in conclusion is that the ability 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 be merely subsidiary reflections of monetary policy. In this respect, investigation of the relation 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 parallel exploitation of micro-level data.

References

Baxter, Nevins D. 1966. *The commercial paper market.* Boston: Bankers Publishing Co.

Bernanke, Ben S. 1990. On the predictive power of interest rates and interest rate spreads. *New England Economic Review* (November/December), 51–68.

Cook, Timothy Q., and Thomas A. Lawler. 1983. The behavior of the spread between Treasury bill rates and private money market rates since 1978. *Federal Reserve Bank of Richmond Economic Review* 69 (November/December): 3–15.

Friedman, Benjamin M. 1986. Increasing indebtedness and financial fragility in the United States. In *Debt, financial stability and public policy.* Kansas City: Federal Reserve Bank of Kansas City.

———. 1990. *Implications of increasing corporate indebtedness for monetary policy.* London: Group of Thirty.

Friedman, Benjamin M., and Kenneth N. Kuttner. 1992. Money, income, prices and interest rates. *American Economic Review* 82 (June): 472–92.

Hurley, Evelyn. 1977. The commercial paper market. *Federal Reserve Bulletin* 63 (June): 525–36.
———. 1982. The commercial paper market since the mid-seventies. *Federal Reserve Bulletin* 68 (June): 327–33.
Kashyap, Anil, Jeremy C. Stein, and David Wilcox. 1993. Monetary policy and credit conditions: Evidence from the composition of external finance. *American Economic Review* 83:79–98.
Kessel, Reuben A. 1965. The cyclical behavior of the term structure of interest rates. Occasional Paper no. 91. New York: NBER.
Krasker, William S. 1980. The "peso problem" in testing the efficiency of forward exchange markets. *Journal of Monetary Economics* 6 (April): 269–76.
Moody's Investors Service. 1992. *Defaults and orderly exits of commercial paper issuers*. New York: Moody's, February.
Romer, Christina D., and David H. Romer. 1989. Does monetary policy matter? A new test in the spirit of Friedman and Schwartz. *NBER Macroeconomics Annual*, 121–69.
Selden, Richard T. 1963. Trends and cycles in the commercial paper market. Occasional Paper no. 85. New York: NBER.
State tax handbook. 1990. Chicago: Commerce Clearing House.
Stigum, Marcia. 1990. *The money market*. Homewood, Ill.: Dow Jones Irwin.
Stock, James, and Mark W. Watson. 1989a. Interpreting the evidence on money-income causality. *Journal of Econometrics* 40 (January): 161–82.
———. 1989b. New indexes of coincident and leading economic indicators. *NBER Macroeconomics Annual*, 351–94.
Wizman, Thierry. 1992. The role of monetary shocks: Evidence from tests of the relation between interest-rate spreads and economic activity. In Essays in empirical macroeconomics and finance. Ph.D. diss., Harvard University.

Comment Ben S. Bernanke

The classic challenge to economic researchers is to make a statement about the economy that is both true and surprising. The observation that the spread between the commercial paper and the Treasury-bill interest rates has remarkable predictive power for the economy, documented in earlier work by Friedman and Kuttner (1990) and by Stock and Watson (1989), appears to satisfy both conditions. In this interesting and nicely executed contribution, Friedman and Kuttner build on their previous analysis of the paper-bill spread to try to explain *why* the spread appears to predict so well. Understanding why the spread predicts is important, both for the light it sheds on the workings of the economy and for helping us assess whether this spread will continue to be informative in the future.

In tackling the question of why the paper-bill spread predicts economic

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activity, Friedman and Kuttner follow the most obvious leads (differential taxation of interest on the two instruments, default risk, and monetary policy effects) and add a new explanation (changing cash requirements of borrowers over the cycle). I generally agree with their approach and their list of suspects; my comments consist primarily of reactions to some details of the paper.

Friedman and Kuttner begin in section 5.1 by documenting the strong predictive power of the paper-bill spread. While this is by now fairly familiar ground, several points are worth highlighting.

First, as a general rule, the most striking results for the paper-bill spread are found when predictive power is assessed by a Granger-causality metric. Indeed, while Friedman and Kuttner in most cases trace the paper-bill spread against only one or two other financial variables at a time, Bernanke and Blinder (1992) show that the spread retains its strong Granger-causality properties even in kitchen-sink VARs with a number of other financial variables included simultaneously. For example, in a forecasting equation for industrial production that also included six monthly lags each of industrial production, the CPI, M1, M2, the term structure premium, and the Federal funds rate, Bernanke and Blinder found that the marginal probability that the paper-bill spread can be excluded from the equation was .0049, while none of the other monetary or financial variables was significant even at the .20 level. Similarly, Bernanke (1990) showed that the paper-bill spread is an effective predictor in the Granger sense even when the official index of leading indicators is included in the prediction equation.

On the other hand, when the metric of forecasting power is the percentage of forecast variance explained at various horizons, the performance of the paper-bill spread is good but somewhat less dominant (see Friedman and Kuttner's tables 5.5 and 5.6). Bernanke and Blinder (1992) found that, on the variance decomposition metric, the Federal funds rate (or the spread between the funds rate and the Treasury-bond rate) does somewhat better than the paper-bill spread in predicting a variety of macro variables at monthly frequencies (Friedman and Kuttner still give the edge to the paper-bill spread). Bernanke and Blinder argue that the contrast between the Granger-causality and the variance decomposition findings is consistent with the joint hypothesis that (1) monetary policy is an important source of fluctuations, (2) the funds rate is the best financial indicator of the stance of monetary policy, but (3) the paper-bill spread is the best indicator of overall conditions in credit markets, as determined by both monetary policy and other factors.

Second, while it may be true that the paper-bill spread is the overall winner in the forecasting derby (a result also found for a long list of macro variables by Bernanke [1990]), there really is quite a bit of independent information in some other interest rate indicators as well, including the aforementioned funds rate and the funds rate–bond spread, the spread between one-year and ten-year government bonds, the CD-bill spread, quality spreads (such as the Baa-Aaa corporate spread or the P1-P2 paper spread), and others. An alternative to Friedman and Kuttner's approach of focusing on the single best indicator (the paper-bill spread) would have been to undertake a more multivariate analysis. For example, one might apply factor-analysis techniques to try to extract the best-predicting factors from a list of interest rate indicators and then attempt to interpret these factors economically (e.g., as indicators of monetary policy, default risk, etc.). This is not an easy exercise, but it seems to me to be a useful direction for future research.

A final point on section 5.1 is that Friedman and Kuttner's results do not directly address the question of whether the predictive power of the paper-bill spread has survived into the 1980s. Bernanke (1990) suggested that the forecasting power of the spread significantly weakened in the last decade, and, as Friedman and Kuttner note, the spread did not do well in forecasting the 1990 recession. True, it is not easy to assess the extent to which the paper-bill spread's predictive power has recently declined, as we have only eight or nine years of data since the Volcker experiment ended in 1982. However, the issue is an important one, not only for forecasting reasons, but also for trying to understand the economic reasons for the spread's predictive power. For example, if the spread predicts the course of the real economy because it measures default risk, its forecasting power should not have deteriorated in the last decade; but, if the relative illiquidity of the commercial paper market is a key factor, then the spread's forecasting power might have declined over time as that market has gotten deeper.

Section 5.2 of the paper discusses factors that account for the average size of the paper-bill spread, particularly differences in taxability and differences in default risk of the two types of assets. I found the authors' discussion of the role of default risk to be very helpful, but I still disagree somewhat with their implied conclusion that default risk is quantitatively an equal partner in explaining the level and movements of the spread. Even admitting factors such as imperfect diversification and differences between objective and subjective assessments of default risk, it is hard to see how default risk could account for more than ten to twenty basis points of the level of the spread given actual loss experience in the postwar period. Perhaps more important, *changes* in default risk over time seem unlikely to account for a major part of the rather large observed changes in the spread. On the other hand, changes in the spread due to changes in default risk could be informative about the economy even if they are quantitatively small.

The principal empirical exercise of section 5.2 is an attempt to break down movements in the spread to parts attributed to (1) movements in the level of interest rates, (2) changes in default risk (as measured by the commercial paper and corporate-bond quality spreads), and (3) the residual. I am not quite clear as to the motivation for this decomposition since (as the authors discuss later in the paper) the economic interpretation of this decomposition is not unambiguous. Changes in the level of interest rates in particular could be the result of a number of factors, such as monetary policy, for example. Similarly, the "quality spread" in the commercial paper market could conceivably reflect changing liquidity differentials between the thick P1 market and the thin P2 market as well as default risk. For this reason, I prefer the more explicitly structural analysis that is performed later in the paper.

Section 5.3 discusses major candidate explanations for the predictive power of the spread using a simple but instructive supply-demand framework, and section 5.4 presents some evidence on these competing hypotheses. An important contribution of section 5.4 is the use of data on both interest rates and asset quantities to help discriminate between the various hypotheses. The evidence seems very clear that the assumption of imperfect substitutability between paper and other assets is essential for explaining why the paper-bill spread is predictive; imperfect substitutability is a key element in stories that link the behavior of the spread to monetary policy actions. There also seems to be some support for Friedman and Kuttner's hypothesis that changing borrower needs for liquidity help drive the spread. A perhaps naive question about this hypothesis is why shortages of borrower liquidity (as signaled by an increase in the spread) necessarily foretell recessions. It seems that an expanded demand for external finance by borrowers might as easily signal an anticipated boom as the end of an expansion.

The results of this section cast some light on the work by Kashyap, Stein, and Wilcox (in press), who interpreted the tendency of commercial paper outstanding to expand during periods of loan contraction as evidence for the idea that monetary policy works by affecting bank loan supply. The argument of Kashyap et al. was that the negative correlation of loan growth and commercial paper growth implies that borrowers are being forced to substitute away from loans when monetary stringency reduces loan supply; if bank loan growth were driven instead by changes in credit demand, then the growth rates of loans and commercial paper would be positively correlated. Friedman and Kuttner note that finance company lending to business, which may be an even closer substitute for bank loans than commercial paper, does not generally expand during periods of loan contraction—which, from the point of view of the thesis of Kashyap et al., is a puzzle. In this respect, the recent behavior of these credit quantities is interesting: as Bernanke and Lown (1991) have noted, during the initial phases of the current "credit crunch," for example, during the year before the beginning of the current (1990) recession, slowdowns in bank lending *were* accompanied by expansions in both commercial paper and finance company lending, which is consistent with the idea that there was a constraint on loan supply during that period. During the recession itself (1990:II–1991:I), however, commercial paper and finance company lending both weakened along with bank lending. The failure of commercial paper issuance to expand in particular suggests either that the 1990 recession is the first not to have been associated with a contraction in the supply of alternatives to commercial paper or, alternatively, that some force has restricted the supply of funds to the commercial paper market as well as the supply of bank and finance company loans.

In the end, Friedman and Kuttner reject monocausal explanations and conclude that several factors contribute to the predictive power of the paper-bill spread. However, even when one attempts to control for these various factors, it seems impossible to wipe out the residual predictive power of the paper-bill spread. I think that, despite the excellent start made by this paper, there may still be more to learn about why the paper-bill spread contains so much information about the future.

References

Bernanke, Ben S. 1990. On the predictive power of interest rates and interest rate spreads. *New England Economic Review* (November/December), 51–68.

Bernanke, Ben S., and Alan S. Blinder. 1992. The Federal funds rate and the channels of monetary transmission. *American Economic Review* 82 (September): 901–21.

Bernanke, Ben S., and Cara Lown. 1991. The credit crunch. *Brookings Papers on Economic Activity* (2), 205–39.

Friedman, Benjamin M., and Kenneth N. Kuttner. 1990. Money, income, prices and interest rates after the 1980s. Working Paper no. 90-11. Federal Reserve Bank of Chicago.

Kashyap, Anil K., Jeremy C. Stein, and David W. Wilcox. 1993. Monetary policy and credit conditions: Evidence from the composition of external finance. *American Economic Review* 83:79–98.

Stock, James, and Mark W. Watson. 1989. New indexes of coincident and leading economic indicators. *NBER Macroeconomics Annual*, 351–94.

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