MACROECONOMIC MODELS AND THE TERM STRUCTURE OF INTEREST RATES

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This paper examines the relationship between the term structure of interest rates and the macroeconomy. It does so by examining the ability of the term structure to forecast various economic variables. In this, it follows Fama (1990), Mishkin (1990), Hardouvelis (1988), and Bernanke (1990). However, in those papers the questions about forecasting were asked in a pure forecasting context, where in this paper the term structure's forecasting ability is used to analyze the underlying macroeconomic determinants of the term structure. Thus it attempts to provide some information about how asset models and macroeconomic models may relate to one another.

The power of the approach in the current application is derived from the fact that fairly clean hypotheses about what various shapes of the term structure should forecast can be derived from most macroeconomic models and these hypotheses fall broadly into three categories: Simple Fisher models with a constant real interest rate, technology shock models, and models where monetary policy can temporally distort the real cost of funds. The key point is that if the term structure is determined in a way consistent with a given type of model then the forecasting relationships that that class of model predicts for the term structure will in fact be observed in the data, and conversely if other factors are the key determinants of the term structure we will observe different forecasting relationships than those implied by the model.

Clearly, such a methodology requires that the various classes of models give very different predictions about the relationship of the term spread and economic observables and that the term-spread in turn has clear and precise forecasting relationships that are reasonably robust to the inclusion of additional variables. This is in fact the case. Further, a number of interesting stylized facts are suggested by the empirical results about the transmission channels of monetary policy, but these will be addressed later.

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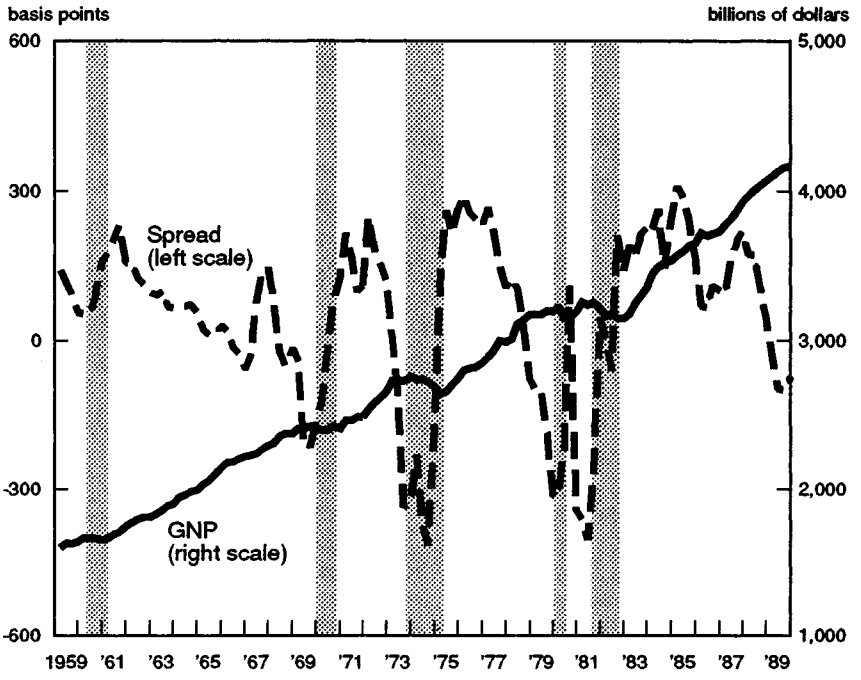
The issue of the determinants of the yield curve and the resulting interpretation of the term spread which in this paper is measured as the difference between the 10 year constant maturity yield to maturity on treasury bonds and the Federal funds rate, is especially interesting at this time because of its recent use in forecasting applications by Stock and Watson (1989), Laurent (1988), and Bernanke (1990) and the attention it has been receiving in monetary policy debates. The reason for the interest is not mysterious. As Graph 1 shows, the term-spread's relationship to the real economy is dramatic. It has inverted before every recession in the last 40 years and gone strongly positive before every expansion.

Figure 1
Real GNP and the Spread



This paper will first examine the three broad classes of models discussed above to see what they predict about the term-spread's forecasting abilities and then uses a series of VAR models to look at the actual forecasting

properties of the term-spread and compare the resulting Granger tests, impulse response functions and decomposition of variances in light of the predictions of the three types of models.

In general, the results point strongly to the conclusion that while technology shocks and Fisher type effects cannot be ruled out, it would appear that monetary policy or some other factor capable of generating short-term disturbances in the supply of credit, such as innovations in the intermediation process appears to dominate the term-spread. Thus, the current use of the term-spread as a measure of monetary policy would appear to be justified and that pure technology models are unlikely to be able to explain asset price behavior. In this the results are consistent with Mankiw and Miron (1986), Mankiw (1986), Strongin and Tarhan (1990) and Tarhan (1990) which all find clear evidence of Federal Reserve impact on the term structure especially in the short end.

The paper is in 4 sections. The first is a review of the relevant models and their predictions. The second examines a set of bivariate VAR results where the relationship of the term-spread to future economic activity is explored. The third covers some additional direct tests on the term structure suggested by the forecast results. The final section examines some additional robustness tests to understand how sensitive the previous results are to sample choice and to the presence of an alternative interest rate spread concept.

I. Three classes of macroeconomic models

Constant Real Rate Models

Simple Fisher equation models have the longest history. In these models the real interest rate is constant and the Fisher equation reduces to a simple relationship between nominal rates and inflation. This view probably is best exemplified by Fama (1976) in his work on interest rates as a predictor of short-run inflation. The cornerstone of these models is their strong assumption about the time path of real interest rates.

The justification for this assumption normally follows from some combination of two arguments. First, the variability in the marginal product of capital is extremely small in comparison with the variability in inflation expectations. Second, the Federal Reserve cannot affect the real cost of credit because the markets will arbitrage the excess credit away. With a constant real rate, it

follows trivially that nominal rates minus a constant are the market's expectation of inflation.

The implications for these types of models for the term-spread are quite simple. A positive term-spread (i.e. when long rates are significantly higher than short rates) will imply that inflation will be higher in the far future then in the near future. In the context of a VAR model there are no predictions about real quantities, but there should be a tight relationship with inflation. Second, the shape of the impulse response function from the term-spread to inflation should be rising across time. The model has no implication about the initial shape of the impulse response function which would depend on the level of rates relative to current inflation and not on the term-spread.

Real Business Cycle Models

Real business cycle models in their early forms have similar implications for the forecast relationship of the term-spread to inflation. In Long-Plosser (1983) for example, real rates are determined by the formula

$$r = \rho + \mu - \sigma \qquad (1)$$

where ρ is the discount rate, μ is the expected future growth rate and σ is a risk adjustment. The intuition is that agents will equalize the relative marginal utility of consumption across time based on their internal discount rate, the growth of future output and a risk factor. Since none of these terms is time dependent, real rates are constant, reducing to the previous case. This type of result will hold in any model that either does not have capital or in which capital adjusts in one period or less.

In more recent models, more interesting time paths for real rates are possible, producing some potentially useful variance in the term-spread beyond inflation. In these models, Christiano (1987), for example, the term structure not only contains information about inflation but also about the marginal product of capital. In general the intuition works as follows. A permanent negative productivity shock lowers the equilibrium desired capital stock, this in turn depresses the desire to invest until the capital stock falls to its new equilibrium level. This means that the marginal product of capital (the interest rate) is sharply reduced and then slowly rises to its long-run equilibrium as the capital stock declines. Consumption is less effected because part of the adjustment is smoothed by disinvesting. Thus, a positive

spread would be associated with high leisure periods with low investment, consumption and output.

On the other hand, a temporary shock to productivity would lower consumption primarily since the long-run value of capital is unaffected (although there must be some short-run negative effects). In both cases (transient and permanent shocks), the effect on consumption and investment is unambiguously negative.

This point is extremely general to the class of neo-classical models in which there are no credit market imperfections or liquidity constraints. This can be seen mathematically from a simple example. (The general case is examined in an appendix). In general, consumption has to follow an Euler equation of the form:

$$U'(C_t)/\ \beta U'(C_{t+1}) = 1+r_t \tag{2}$$

where r_t is the riskless real interest rate and β is the rate of pure time preference. If utility is taken as logarithmic of the form

$$U = \Sigma_t \quad \beta^t \log(\ C_t) \tag{3}$$

then it follows that

$$C_{t+1}\ /\ \beta C_t = 1+r_t \tag{4}$$

Using the fact that log(1+r) approximates r when r is small, it follows that

$$r_t = \log(\ C_{t+1}) - \log(\ C_t) - \log(\beta) \tag{5}$$

or more simply

$$r_t = \Delta c_{t+1} - \log(\beta) \tag{6}$$

where Δc_{t+1} is the continuously compounded rate growth in consumption in period t+1.

Noting that the n period long rate is the average of the n one period rates, it follows that

$$r_{Nt} = 1/N \sum_i \Delta c_{t+i} - log(\beta). \quad (7)$$

Thus, it follows that

$$r_{Nt} - r_{1t} = 1/N \{\sum_i \Delta c_{t+i}\} - \Delta c_{t+1} \quad (8)$$

where r_{1t} is the one period rate at time t. This says that if Δc_{t+1} , next period's growth, is higher than average future consumption growth there will be a negative spread. Thus, for any model of this type a negative spread will be associated with high next period growth in consumption, which would then fall over time back to equilibrium growth levels. The only conditions in which this would not be the case is where consumption continued to grow at ever faster rates (in any damped process the contrary case reverts in short order as consumption growth nears its peak). Sims (1980) discusses this case as plausibly holding at a point in time for a two year time span. To avoid potential problems with this pleasant, but not very realistic possibility, only very long spreads are examined although the results turn out to be insensitive to this. (It should also be noted that if this was a significant problem it would imply impulse response function that sloped upward for significant periods of time rather than dampening as those estimated later in the paper.)

Thus, in this class of models using the Christiano model as a exemplar, the term-spread would Granger cause output, consumption and investment. The association would be that a positive spread would forecast falling growth and declining investment. Again, it would allow for the inflation effects outlined in the constant real interest rate case, but would suggest that the inflation relationship might be considerably looser than would be expected in the simple Fisher model.

Monetary Distortion Models

The third type of model is the monetary distortion model. In this class of model the Central bank has the ability to depress the real cost of funds and thus create a distortion in the term structure away from expectations. (This could also be modeled as an innovation process in the financial sector, but such a distinction is mostly a matter of semantics.) There are a variety of models of this sort, including a large number of Keynesian (Rotemberg 1987) and cash-in-advance models (Svensson 1985); however a series of recent papers, Grossman and Weiss (1983), Rotemberg (1984), Baxter, Fisher, King, and Rouwenhorst (1990) and Fuerst (1990) provide a very clear notion of the underlying economics of what makes a monetary distortion model different.

These models are all cash-in-advance although the specific structure beyond that differs widely. The commonalty derives from the fact that all of these models focus on the notion that rigidities create circumstances where an influx of cash into the economy creates temporarily low interest rates and cheap goods. Agents arbitrage these conditions by buying goods.

In this class of cash-in-advance model, the central bank is able to create cheap cash i.e. a temporary reduction in the real rate of interest. But only certain individuals have access to this cash and are constrained from selling it to other agents. As a result they can only arbitrage the Central Bank action by buying goods. Thus, a failure in credit market arbitrage produces arbitrage possibilities in the goods market. In such models, a positive spread is associated with positive growth centered in consumption, i.e. temporally cheap credit causes consumption.

None of these models contain a durable good. Although technically difficult, adding durable goods would have fairly obvious implications. Durables would provide a superior method of arbitrage since durable goods would allow agents to spread the value of cheap cash over a number of periods. This is a straight forward implication of the permanent income hypothesis. Thus when applied to data these types of models would predict that a positive spread would be associated with increased consumption, especially durable goods consumption. Investment would not be the primary channel of effect since the long-run marginal product of capital is largely unaffected[1].

Thus, if monetary distortion factors are dominate in the formation of the term structure, Granger tests would show that the term-spread causes GNP and consumption, with a very sharp positive spike in the impulse response function for durables goods in response to a positive innovation in the spread (opposite of the sign for RBC models). There might also be a causal link to inflation and investment, but with much weaker results than the previous models would suggest.

Identical results are available from a large class of models, the cited models provide useful examples because of their focus on the role of the goods markets to arbitrage market rigidities as opposed to the productivity shock models where the credit markets simply reflect the time path of the marginal product of capital. The key point mathematically is that the Euler equations used above no longer fully describe the agents maximization problem. The monetary distortion makes goods seem temporarily cheap causing agents to

shift consumption into the "cheap" period. This follows directly from the first order conditions

$$C_{t+1} / \beta C_t = 1 + r_t \tag{9}$$

If r_t is reduced by Federal Reserve action, cash is purchased and then used to buy goods. The one trick to remember in comparing this to previous models is that in a cash-in-advance model the asset market opens at the beginning of a period and then closes and only then does the goods market opens. In the current context, the dating would be better thought of as the asset market operating at the end of the period and the goods market the beginning of the next period. Thus, equation 9 should be rewritten

$$C_{t+2} / \beta C_{t+1} = 1 + r_t \tag{10}$$

A one period drop in r_t implies a rise in C_{t+1} since C_{t+2} should be largely unaffected by a one period drop in interest rates. The only effects on C_{t+2} would arise from an increase in the capital stock resulting from lower interest rates and this, besides being small, would only reinforce the effect on C_{t+1}. Thus, as noted before, a Central Bank action which drove r_t down would drive both $r_{t+1} - r_t$ and $C_{t+1} - C_t$ up. In some models, of course, the effects would linger. In any case, the maximum effect on interest rates coincides with the one period forward maximum effect on consumption, i.e. the cheapest cash generates the biggest consumption bulge in the subsequent purchase period. In this class of model, the impulse response path beyond the initial impact would hinge critically on persistence of the innovation in the term spread, the more persistent the innovation in the spread the smoother and more prolonged the consumption response; however, without a precise model of the determination of the term spread very little can be stated generally about this.

Summary of predictions

Thus, the three classes of models provide significantly different hypotheses about the relationship of the term-spread to various real and nominal variables. To summarize, constant real rate models, including some simple real business cycle models, imply that the term structure should forecast inflation tightly. More recent productivity shock (real business cycle) models suggest that the term-spread may be able to forecast GNP, investment, and consumption, with a positive spread forecasting negative growth in all three. Monetary distortion models would, on the other hand, imply that a positive term-spread would forecast rising consumption and GNP, the opposite of the

real business cycle model, and further that there should be a sharp spike in consumption, especially durables consumption. No general predictions about investment are possible beyond the general notion that a reduction in GNP and consumption is probably bad for investment.

It should be noted that the tests of these hypotheses are not tests of the models, but tests of what types of factors are influencing the term structure. Thus, the evidence that follows which suggests that the monetary model is most consistent with the data should be interpreted as saying that monetary factors are very important for the term structure not that monetary models are right and real business cycle models are wrong. By running the tests through the term-spread's ability to forecast, other channels of impact are ignored. However, to the extent that the forecasting relationships are significant, it would also indicate that monetary factors do have some implications for real activity. Also no implications can be drawn from these results about the stability the relationship between the term-spread and real output and in fact given the extremely different implications from the three classes of models some caution would be indicated.

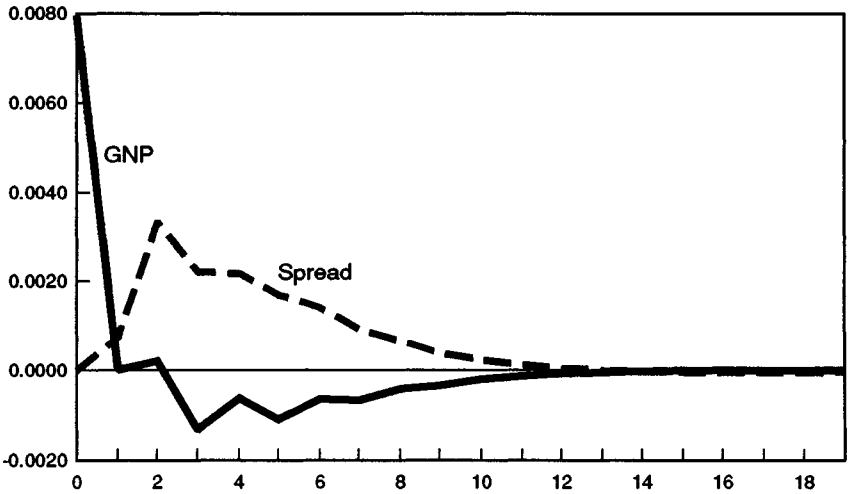
II. Bivariate results

The definitions of the tested series do not precisely follow normal national income accounting but are divided by type of decision agent. Thus, consumption is defined as personal consumption expenditures plus residential spending. Durables is durables consumed by consumers and is defined as the sum of durables plus residential housing. Non-durables is non-durables plus services. Investment is non-residential fixed investment. The definitions are set up this way to more closely parallel the models discussed above. The CPI, both complete and less food and energy and the fixed weight GNP deflator are used to measure inflation. The term spread is defined as the simple difference between the 10 year constant maturity treasury bond yield and the Federal Funds rate The ten year bond has the longest continuous history. Laurent (1989) used a spliced series of 20 and 30 year bond yields; this provides slightly stronger results than those presented, but the spliced series raises some questions about comparability across time periods. Alternate definitions have little impact on the results. The data sample runs from the first quarter of 1963 to fourth quarter of 1989. All impulse response functions and decompositions of variances are calculated with the term spread as the last variable in the ordering. All variables except for the interest rate spreads are log rates of change.

Graphs 2-9 show the impulse response functions for each of the bivariate VARs with 4 lags. Table 1 shows the Granger tests, the R^2 and the decomposition of variance at lag 4 and 20 for the output or price variable, as well as the contemporaneous correlation of errors.

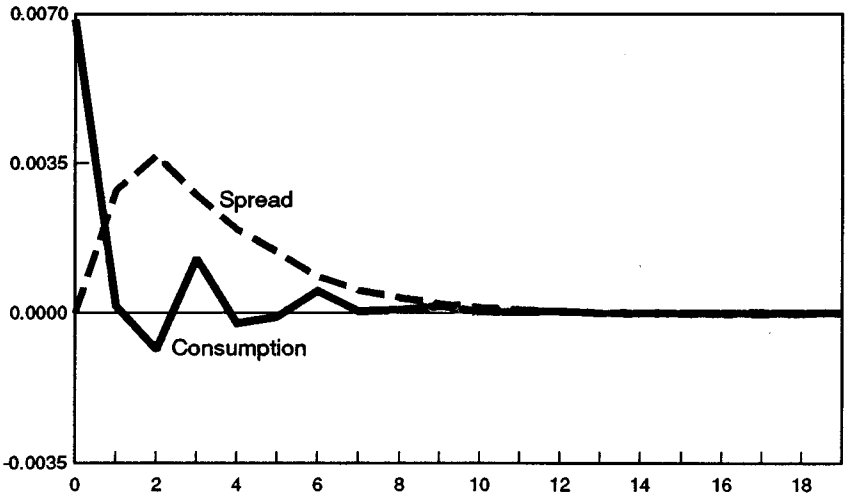
At least at this level the results are extremely clear. There is clear evidence that there is a substantial forecasting relationship between the term-spread and output and that relationship closely follows the predictions of the monetary distortion class of models. The effect is focused in consumption and is sharpest in durables exactly as the monetary distortions models would predict. In terms of the productivity shock models, the signs are all wrong and investment effect is relatively weak. In terms of testing the sign of the impulse response function for statistical significance, the term spread generates such a simple pattern of impact that a direct test is possible. Basically all of the explanatorily power in the consumption cases is in the first lag of the spread which has a t-statistic of at least 4 regardless of lag structure and specific consumption measure and is positive. In the GNP case the t bottoms out around 2.5. Single equation term-spread specifications strongly reinforce this result. This is also consistent with the cross section literature on Euler equations and consumption, for example, Mankiw, Rotemberg and Summers (1985).

Figure 2
Plot of Responses of GNP*



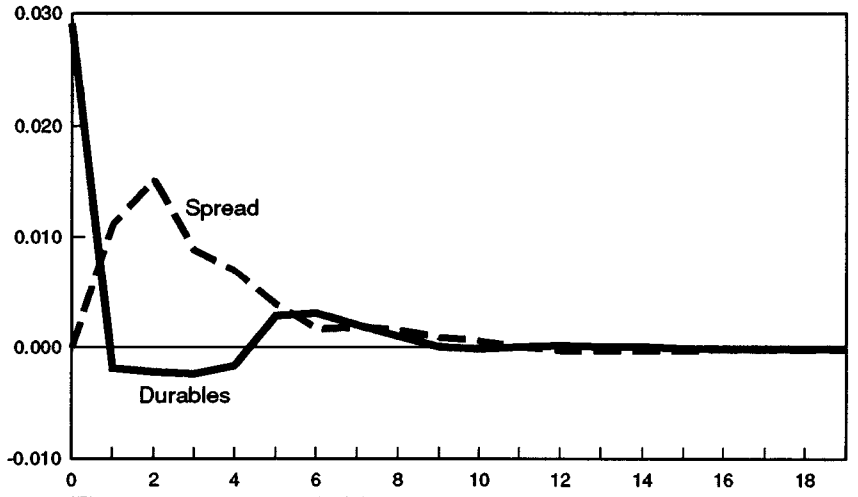
*The response to a one standard deviation shock in the labeled variable.

Figure 3
Plot of Responses of Consumption*



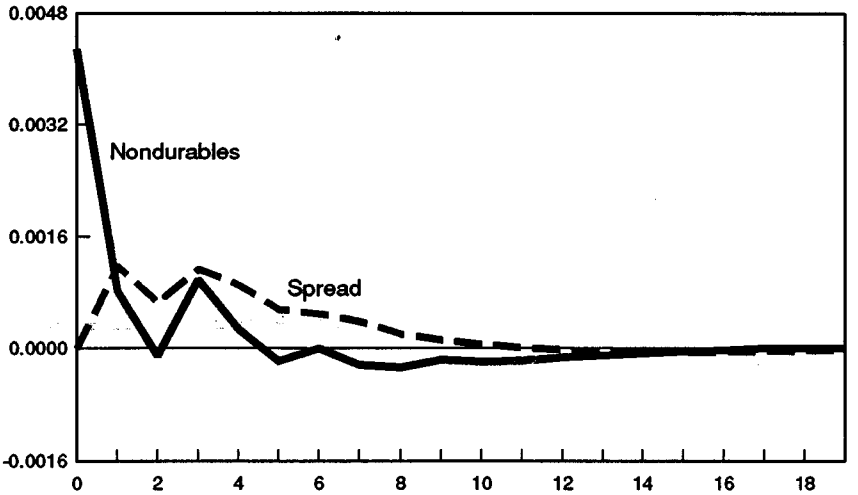
*The response to a one standard deviation shock in the labeled variable.

Figure 4
Plot of Responses of Durables*



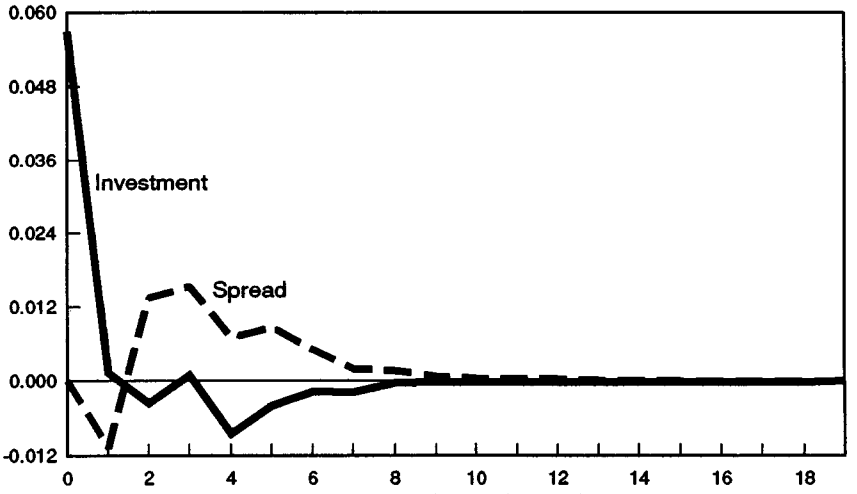
*The response to a one standard deviation shock in the labeled variable.

Figure 5
Plot of Responses of Nondurables*



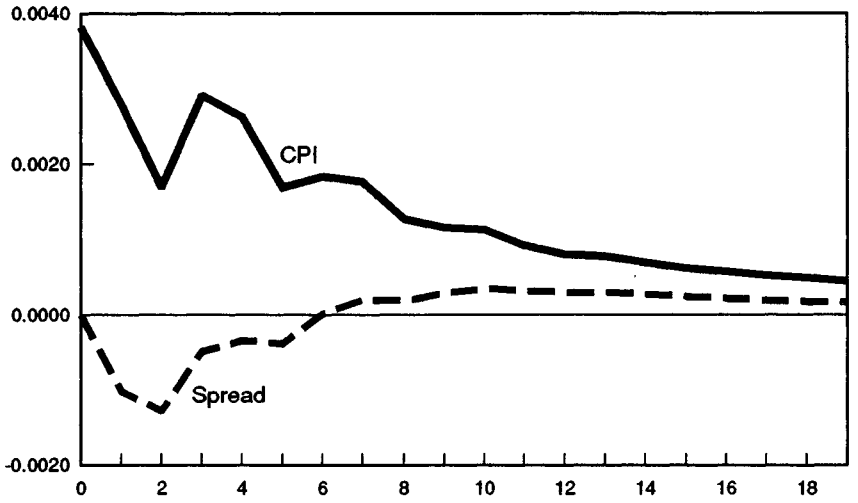
*The response to a one standard deviation shock in the labeled variable.

Figure 6
Plot of Responses of Investment*



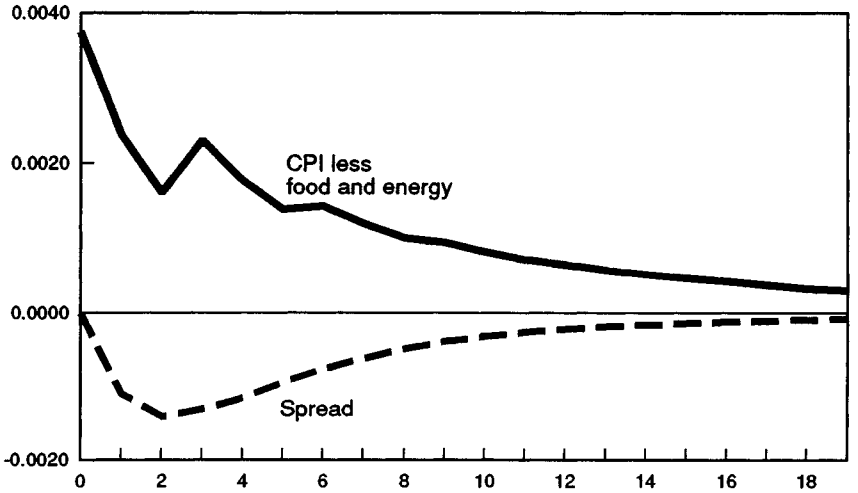
*The response to a one standard deviation shock in the labeled variable.

Figure 7
Plot of Responses of CPI*



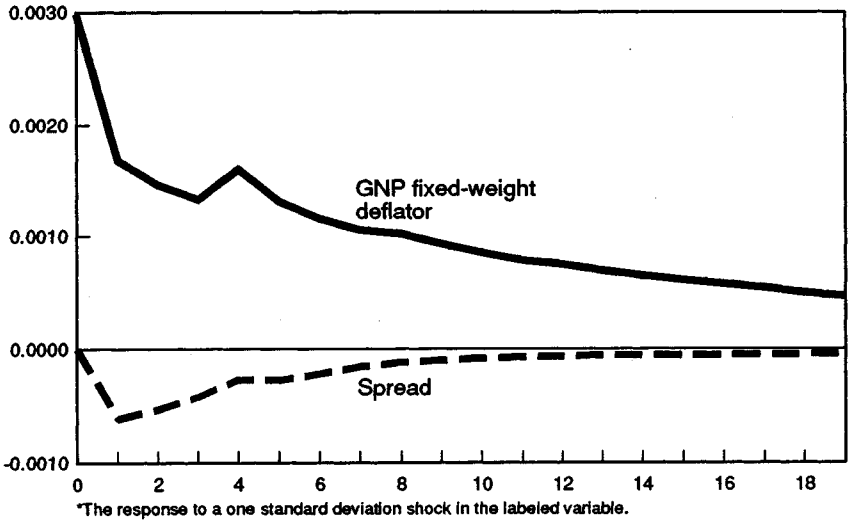
*The response to a one standard deviation shock in the labeled variable.

Figure 8
Plot of Responses of CPI Less Food and Energy*



*The response to a one standard deviation shock in the labeled variable.

Figure 9
Plot of Responses of GNP Fixed-Weight Deflator*



*The response to a one standard deviation shock in the labeled variable.

The weakness of the inflation forecasts are striking. The term-spread seems to have much less to do with inflation than standard discussions would suggest although these results are quite consistent with the literature which has had some difficulty in pinning down the relationship between interest rates and inflation. On the other hand, it is only in the price equations that any evidence of reverse or contemporaneous causation shows up. It would seem that the Federal Reserve responds to inflation especially to inflation once food and energy prices have been removed and does so in a manner to control output. The results are not inconsistent with the Fisher effect, they simply indicate that the bulk of the variance in the term-spread lies in the real cost of funds.

The results are stable with respect to lag lengths. In fact, the results are even sharper if the lag length is reduced, but the 4 lag models were presented so that the more diffuse relationships with prices and investment would also show through.

Table 1
Bivariate VAR Results

Y	Granger F tests: Spread -> Y	Granger F tests: Y -> Spread	Y's R^2	Term-spread's Decomposition of Y's forecast variance: Lag 4	Term-spread's Decomposition of Y's forecast variance: Lag 20	Contemporaneous correlation Y, spread
Δ GNP	8.5 (0.0000)	1.3 (0.2741)	.34	20.62	29.71	-.11
Δ Consumption	12.3 (0.0000)	1.5 (0.2211)	.45	37.31	42.32	.03
Δ Durables	12.9 (0.0000)	2.16 (0.0786)	.40	33.88	36.83	-.00
Δ Non-durables	4.0 (0.0048)	2.5 (1.2)	.27	13.70	19.23	.00
Δ Investment	5.2 (0.0007)	0.26 (0.90)	.20	14.53	17.95	-.19
Δ CPI	2.9 (0.0299)	1.7 (0.1644)	.78	9.65	7.38	-.31
Δ CPI Less Food & Energy	3.2 (0.0148)	2.2 (0.0733)	.74	22.39	27.28	-.43
Δ FW Deflator	1.3 (0.2626)	2.3 (0.0630)	.75	5.57	3.96	-.25

Note: P-value in parentheses

Results on individual sectors and other break-downs of the national income accounts are consistent, but not presented for brevity's shake.

Thus, it would appear that at least from the bivariate results that monetary distortions of some type are significant in the determination of the yield spread.

III. Some other tests

The above results, if interpreted as indicating that we are observing a monetary policy transmission process, suggest a number of simple trivariate tests to explore the nature and usefulness of the term-spread as a measure of monetary policy.

First, is whether this is purely a consumption based channel. In the above results, while the investment response was weaker and delayed it is still significant. However, the investment relationship might be the product of consumption producing higher cash flows for corporations (Petersen and Strauss, 1989, Fazzari, Hubbard and Petersen, 1988). If this is the case then a three variable VAR with consumption, investment and the term-spread would show that the term-spread has no direct relationship with investment. Table 2 shows the Granger tests and they are consistent with the term-spread acting entirely through consumption.

The other set of obvious tests is to include money growth and examine if the term-spread might have any advantages over money as a measure of policy. These tests are not meant to be complete, but simply to explore if the term-spread deserves serious consideration as a measure of monetary policy.

Table 2
Trivariate VAR Results

	Granger F tests			Term-spread's Decomposition of Y's forecast variance		Contemporaneous correlation
Y	Spread -> Y	C -> Y	Y's R^2	Lag 4	Lag 20	Y, spread
Δ Consumption	13.3 (0.0000)	NA NA	.46	32.23	37.66	.02
Δ Investment	1.1 (0.3467)	4.71 (0.0040)	.28	11.08	15.16	−.19

Note: P-value in parentheses

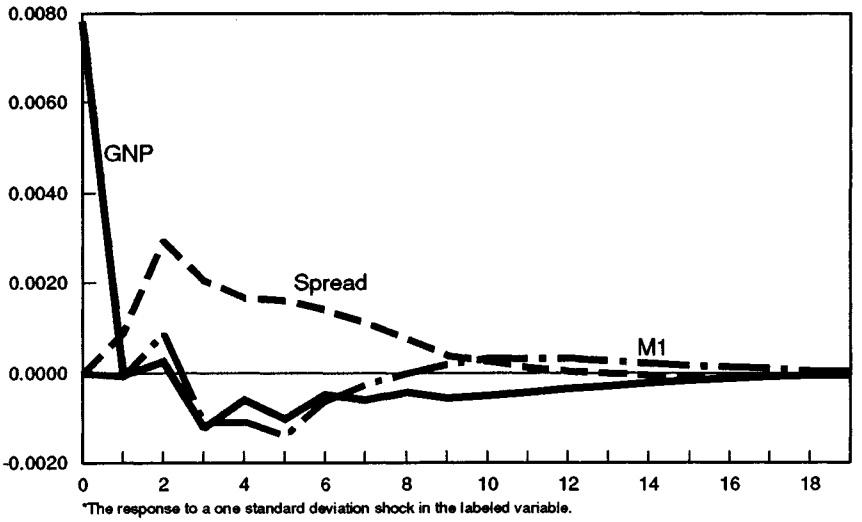
Table 3 shows the results for three variable VARs with M1 and M2 paired with either output or consumption. Graph 10 shows GNP's impulse responses for the M1 model, other models are largely the same. The results indicate that the term-spread appears to strongly dominate money in forecasting real activity. The term-spread retains virtually all of its explanatory power and its impulse response function is largely unaffected even when placed last in the orthogonalization. Second, the large difference between contemporaneous correlations for money and the term-spread in the consumption VARs indicates that the term-spread may be subject to fewer contemporaneous correlation problems than money and thus serve as a cleaner policy instrument. At the very least this suggests that with the data for the 1980s and new functional forms for interest rates, the Sims (1980) and Litterman and Wiess (1985) debate may need re-examination.

Table 3
Trivariate VAR Results with Money

	VAR Specification			
Test	**GNP, M1**	**GNP, M2**	**C, M1**	**C, M2**
Granger F-test				
M -> Y	0.6	0.2	2.47	1.0
	(0.6128)	(0.92)	(0.0497)	(0.38)
Spread -> Y	6.9	6.0	12.7	9.4
	(0.0001)	(0.0002)	(0.0000)	(0.0000)
R^2	.35	.34	.50	.48
Decomposition of Variance for Y				
Lag 4, money	2.6	1.4	5.7	3.4
Lag 20, money	7.7	2.0	13.6	5.0
Lag 4, spread	18.0	20.6	33.9	35.2
Lag 20, spread	25.0	30.7	35.2	41.2
Contemporaneous correlations				
Money, Y	0.00	-0.01	0.33	0.26
Spread, Y	-0.14	-0.11	0.00	0.04

Note: P-value in parentheses

Figure 10
Plot of Responses of GNP*



*The response to a one standard deviation shock in the labeled variable.

IV. Testing robustness

Taken as a pure exercise, it is actually unnecessary to test the robustness of the bivariate results. The models indicate that there should be a bivariate relationship between the term-spread and other variables and do not in fact suggest anything about the stability of the relationship or robustness to the inclusion of other variables. However, given the strength of the bivariate and trivariate results and the current use of the term-spread in various forecasting and policy applications it would seem to be useful to examine a few more systems and sub-sample stability to get a sense of how robust these results are.

Primarily the worry would be that the term-spread is capturing some type of market forecast about risk, i.e. it is conceivable that a positive spread means the current environment is less risky that the future therefore agents might concentrate activity in the current period. Thus some control for risk assessment may be in order. Recently, Friedman and Kuttner (1989) have suggested just such a measure the Public-Private spread which is defined as the difference between the 6 month commercial paper rate and three month treasury bill rate.

The Public-Private spread provides an especially nice test in the current context because it is also a market spread, but one focused on the market's assessment of risk as opposed to distortions in the term structure, thus if the term-spread is somehow picking up some kind of market forecast about future risk instead of a monetary policy induced distortions then the Public-Private spread should generate substantial instability in the impulse response functions and reduce the overall explanatory power of the term-spread considerably. In fact in Bernanke (1990) the Public-Private spreads seems to dominate the term-spread to which Bernanke gives the interpretation that the Public-Private spread is a superior measure of monetary policy.

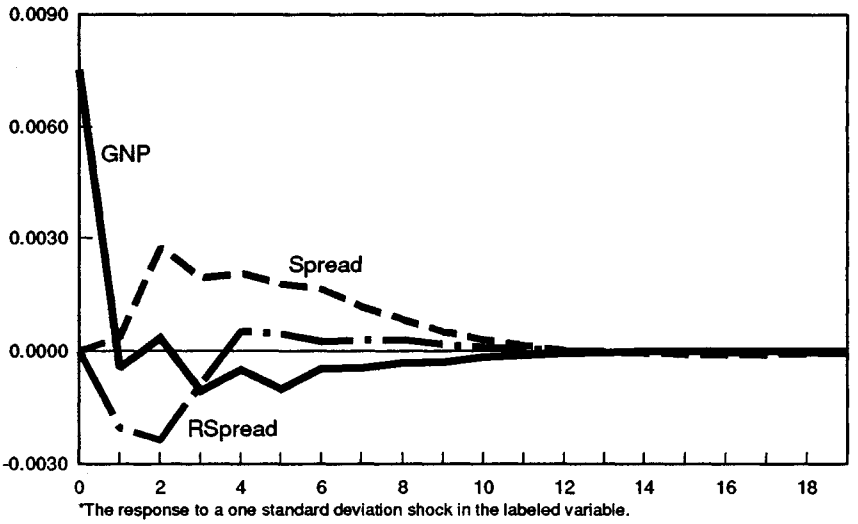
Table 4 shows the Granger tests and decomposition of variance for systems where the Public-Private spread is added to the VAR specification and when it is not. Both the Public-Private spread and the term-spread fair well, although the term-spread clearly dominates. This would seem to strongly contradict Bernanke's (1990) result although he did not examine their joint performance. The impulse response function from the term-spread to output and consumption is unaffected by the Public-Private spread or money and the impulse response graphs look just like the previous graphs as is shown in Graph 11. Additional tests on larger systems were done and provide consistent evidence but with reduced power.

Table 4
Trivariate VAR Results with Public-Private Spread

Test	GNP wo P-P	GNP w P-P	C wo P-P	C w P-P
Granger F-test				
P-P -> Y	NA	2.8	NA	2.8
	NA	(0.03)	NA	(0.0311)
T-Spread -> Y	8.5	4.9	12.33	9.4
	(0.0000)	(0.0013)	(0.0000)	(0.0000)
R^2	.34	.40	.45	.51
Decomposition of Variance for Y				
Lag 4 P-P	NA	8.5	NA	3.4
Lag 20 P-P	NA	10.5	NA	5.0
Lag 4 T-spread	20.6	16.2	37.3	30.8
Lag 20 T-spread	29.7	27.6	42.3	34.6
Contemporaneous correlations				
P-P, Y	NA	-0.13	NA	-0.15
T-Spread, Y	-0.11	-0.07	0.04	0.07
T-Spread, P-P	NA	-0.23	NA	-0.25

Note: P-value in parentheses

Figure 11
Plot of Responses of GNP*



*The response to a one standard deviation shock in the labeled variable.

Sub-sample tests on parameter stability are presented in Table 5 and show no evidence of instability. The test are joint F-tests on whether the parameters on the term-spread would vary in the bivariate case if the sample was broken in the first quarter of 1976, other break points offer similar evidence of stability. No formal tests were done on the more complicated VARs, since there are some well known instabilities in the money-income relationship. A few sub-sample VARs were performed and showed substantial instability, although this has very little bearing on the present question. There is also some instability in sub-sample R^2s with the later periods showing higher explanatory power, but this may simply reflect changes in activity of monetary policy.

Table 5
Stability Tests on Term-Spread
Break at 76 q1

Y	F-test on Term-spread parameter stability
Δ GNP	1.35
	(0.2558)
Δ Consumption	1.32
	(0.2665)
Δ Durables	0.89
	(0.4724)

Note: P-value in parentheses

I should note that the inclusion of an interest rate in levels will have significant impact, but this really does not provide any information, as it primarily goes to the issue of functional form, which, at this point, without substantial theory work directed at the term-spread is difficult to assess.

V. Conclusions

The results in this paper would point strongly to the fact that monetary policy or some other aspect of supply function of credit needs to be taken seriously as a determinate of the term structure. Further evidence is developed which suggests that research into the term-spread as a measure of monetary policy is not without merit. Lastly, since the goods markets seems to be paying an important role in arbitraging these distortions it would appear that pure financial models will have some difficulty accounting for the variance in the term structure. It is unlikely that agents ability to arbitrage in the goods market is constant through time.

Notes

[1]In some ISLM models investment is the primary respondent to interest rate movements. Although due to the ad hoc nature of such models, it is not easy to assess the rationale for this. I would argue that in light of recent work on investment such models are unlikely to be of any practical import.

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Appendix

Using the Euler equation for time separable utility

$$U'(C_t)/\ \beta E\{U'(C_{t+1})\} = 1+r_t \qquad (1)$$

Taking logs and using the approximation that $\log(1+r_t)=r_t$

$$log(U'(C_t))-log(\beta)-log(E\{U'(C_{t+1})\}) = r_t$$

$$\text{or } -\Delta u'(C_{t+1})- log(b) = r_t \qquad (2)$$

where $\Delta u'(C_{t+1})$ is the expected change in the log of expected utility.

This implies that r_{Nt}, the n period rate can be expressed

$$r_{Nt} = -1/N \left\{\Sigma_i\ \Delta u'(C_{t+i})\right\} - log(\beta) \qquad (3)$$

which implies that

$$r_{Nt} - r_{1t} = -1/N\ \Sigma_i\ \Delta u'(C_{t+i}) + \Delta u'(C_{t+1}) \qquad (4)$$

Thus, if the marginal utility of consumption is expected to fall more in the next period then in the average of future periods, the term spread will be negative. It follows that if there is declining marginal utility of consumption that a high growth quarter will follow a negative spread.

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