0440

IMF WORKING PAPER

WP/91/89

INTERNATIONAL MONETARY FUND

Research Department

Market-Based Fiscal Discipline in Monetary Unions: Evidence from the U.S. Municipal Bond Market 1/

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September 1991

Abstract

The concept of market-based fiscal discipline posits that a government which runs persistent, excessive fiscal deficits will face an increased cost of borrowing and eventually, a reduced availability of credit, and that these market actions will provide an incentive to correct irresponsible fiscal behavior. This paper presents new empirical evidence on market-based fiscal discipline by estimating the relationship between the cost of borrowing and fiscal policy behavior across U.S. states. We find that U.S. states which have followed more prudent fiscal policies are perceived by the market as having lower default risk and are therefore able to reap the benefit of lower borrowing costs.

JEL Classification Number:
F3, G1

1/ *An earlier version of this paper was presented at a conference on* "Establishing a Central Bank," co-sponsored by Georgetown University's Center for German and European Studies, the Centre for Economic Policy Research, and the International Monetary Fund, held in Washington, D.C. on May 1-2, 1991. In addition to colleagues in the Research Department, the authors are grateful to Tom Barone, John Capeci, R.B. Davidson III, James Dearborn, Peter Garber, Mervyn King, Gilbert Metcalf, Lars Svensson, Thomas Swartz, Vito Tanzi, and Irene Walsh for helpful comments on an earlier draft. Ravina Malkani provided much appreciated research assistance. Professor Woglom was serving as a Visiting Scholar in the Research Department of the Fund when this paper was being prepared.

Table of Contents

Summary

It is widely accepted that participation in a monetary union is inconsistent with independence in the conduct of monetary policy. Less settled at this stage is the issue of what constraints, if any, should be placed on national fiscal policies in a monetary union.

One approach to encouraging greater fiscal policy discipline in a monetary union is to entrust private private financial markets with that role. Such market-based fiscal discipline would take the form of an initially rising default premium on the debt of a member country running excessive fiscal deficits. If those deficits persisted, the default premium would increase at an incremental rate, and eventually the offending country would be denied access to additional credit. This increase in the cost of borrowing, along with the threat of reduced availability of credit, would then provide the incentive to correct irresponsible fiscal behavior.

This paper provides empirical evidence on market-based fiscal discipline by estimating the relationship between the cost of borrowing and fiscal policy behavior across U.S. states. The analysis was aided by access to a set of survey data on yields of state general-obligation bonds that covers 39 U.S. states from 1973 to the present and that is superior in several respects to data that have been available heretofore.

The study finds evidence that states with larger stocks of debt, larger (current) fiscal deficits, and higher trend rates of growth of debt relative to income, pay more to borrow in the U.S. municipal bond market than do states with more conservative fiscal-policy track records. Moreover, it was also found that, ceteris paribus, states with more stringent, voluntary constitutional limits on borrowing face a lower cost of borrowing.

I. Introduction

It is widely accepted that participation in a currency union is inconsistent with independence in the conduct of monetary policy. Indeed, in the ongoing discussions about the path to economic and monetary union (EMU) in Europe, much attention is being devoted both to the establishment of a central monetary authority and to securing a mandate for that institution which would give primacy to the goal of price stability. In this sense, there would appear to be an emerging consensus about how to constrain or "discipline" monetary policy. 1/

Less settled at this stage is what constraints, if any, should be placed on national fiscal policies in a currency union. The debate is influenced by two observations. First, more than ten years of experience with the European Monetary System (EMS)--during which exchange rate commitments became progressively "harder"--does not suggest that the exchange rate regime itself will be sufficient to force a convergence around sound fiscal policies. In the words of the Delors Report (1989, paragraph 3):

> "...the EMS has not fulfilled its full potential. ...the lack of sufficient convergence of fiscal policies as reflected in large and persistent budget deficits in certain countries has remained a source of tensions and has put disproportionate burden on monetary policy."

Second, if fiscal policy discipline was not forthcoming, then some of the key objectives of monetary union itself could well be threatened. Specifically, if a member of the union accumulated so much debt that it eventually became unable or (unwilling) to service it, there would be (de facto) pressure on either the central monetary institution to monetize the debt or on other members to bail out the errant borrower; alternatively, if that pressure were resisted, the country might even threaten to withdraw from the union so as to have the freedom to either monetize the debt or devalue its exchange rate. None of these scenarios are comfortable ones: either the anti-inflationary credibility of the union's central bank would be damaged, or the bail out would impair the future disciplining effect of market forces, or the cohesion of the union would be questioned. Reflecting these concerns, there has, for example, been support for including in any EMU agreement, explicit provisions prohibiting monetary financing and bailing out of budget deficits, as well as an injunction against "excessive deficits" themselves. Still, debate continues on whether such provisions are all that is required to encourage fiscal discipline. At least three separate schools of thought have surfaced.

One view, echoed in the Delors Report (1989), is that binding fiscal rules represent the preferred solution to the problem. These rules would

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1/ For a discussion of monetary policy issues in an emerging European EMU, see Frenkel and Goldstein (1991).

impose effective upper limits on budget deficits and on debt stocks of individual member countries, as well as limit recourse to external borrowing in non-member currencies. 1/ In brief, the case against rigid fiscal rules is that they are incapable of taking adequate account of differences in the circumstances of members. For example, the same budget deficit (relative to GNP) is apt to be less cause for concern in a country with a high private saving rate, a low stock of debt, a temporarily high unemployment rate, and a good track record on inflation than in one with the opposite characteristics. Moreover, rigid fiscal rules on say, budget deficits could prevent automatic stabilizers in individual countries in a currency union from cushioning country-specific shocks. There are also questions of effectiveness. In this connection, von Hagen (1991) reports a greater tendency for U.S. states with debt limits and stringent balanced budget requirements to substitute unrestricted for restricted debt (by delegating functions and debt-raising power to off-budget entities and local governments).

A second approach, which finds expression in more recent EC Commission reports (see Economic and Monetary Union, August 1990, and One Market, One Money, October 1990), also calls for constraints on national fiscal policies, but adopts a more discretionary format. Specifically, it proposes that peer group, multilateral surveillance be reinforced to discourage errant fiscal policies of individual member countries. Suffice to say that this tack too is open to criticism. Multilateral surveillance exercises typically employ a broad set of economic indicators. This sets up the risk that different indicators will send conflicting signals for policy adjustment, thereby allowing an errant fiscal position to continue for too long. 2/ Moreover, without previously agreed upon rules available to settle disputes, there is a risk that negotiations, cum pressures for "solidarity" within the union, could delay unduly the needed fiscal adjustment.

Yet a third--albeit very different--route to fiscal discipline is to entrust private financial markets with that role. Such market-based fiscal discipline would take the form of an initially rising default premium on the debt of a member country running excessive deficits. If those deficits persisted, the default premium would increase at an increasing rate, and eventually the offending country would be denied access to additional credit. This increase in the cost of borrowing, along with the threat of reduced availability of credit, would then provide the incentive to correct irresponsible fiscal behavior. Advocates of the market approach (Bishop et al (1989)) recognize that it will work only if certain conditions are satisfied, namely: (i) capital must be able to move freely, (ii) full information must be available on the sovereign borrower, (iii) the market must be convinced both that there are no implicit or explicit outside

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1/ In some proposals, an additional fiscal rule would be that public borrowing would be permissible only to finance investment.

2/ For a fuller discussion of this conflicting-signals problem, see Frankel (1990).

guarantees on sovereign debt and that the borrower's debt will not be monetized, and (iv) the financial system must be strong enough to withstand the failure of a "large" borrower. They do not regard these conditions as unrealistically restrictive. Not surprisingly, those who favor the fiscal rules or surveillance options are less convinced, and point to the developing-country debt crisis of the early 1980s and to the New York City financial crisis of the mid-1970s, as graphic illustrations of the limitations of the market's disciplining process. 1/ Skeptics also note that high public debts often reflect political polarization or distributional conflicts over the sharing of the fiscal burden--factors that can make fiscal adjustment relatively insensitive to a rise in the cost of borrowing. 2/ Presumably, these doubts lie behind the assessments that "...the constraints imposed by market forces might either be too slow and weak or too sudden and disruptive" (Delors Report (1989, paragraph 30)), and that "...the effectiveness of market discipline cannot be taken for granted" (EC Commission (1990b, p. 100)).

In choosing among these alternative mechanisms for achieving greater fiscal discipline, it is natural to seek guidance from the experience of federal states. The experience of the United States is of particular interest for ongoing EMU discussions. For one thing, the viability of the United States as a common currency area is long since firmly established; in operational terms, this implies that one can legitimately disregard expectations of an exchange rate change as contributing to differences in borrowing costs paid by different fiscal jurisdictions. Second, state governments do not have access to central bank financing; as noted above, a similar provision is expected to be included in any EMU treaty. Third, with regard to creditors, U.S. states enjoy immunity from bankruptcy courts, much like a sovereign country does (see English (1991) and Orth (1987)). Fourth, while many U.S. states have voluntarily imposed their own statutory limits on their deficit-spending and/or borrowing, there are no federally-imposed borrowing limits; this provides enough autonomy at the state level to test the market-discipline hypothesis using a cross section of states, while also giving some scope to gauge the influence of fiscal rules on borrowing costs. Fifth, the U.S. capital market is probably closest to the kind of integrated, deep, informationally efficient financial area that Europe seeks to become after 1992. Finally, while individual state and local governments

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1/ In the case of the developing-country debt crisis, interest rate spreads on bank loans to developing countries were slow to rise in the mid-to-late 1970s, and the transition to highly restricted access (in the early 1980s) came abruptly,. One explanation for the relatively narrow loan spreads is the perception of a bail-out--either of the indebted countries themselves or of the deposit liabilities of the large international banks extending the loans; see Folkerts-Landau (1985). In the case of the New York City financial crisis, it apparently took some time for market participants to realize that New York City was diverting approved funds and pledging future receipts--both earmarked for other purposes--to meet current operating deficits; see Bishop et al. (1989).

2/ EC Commission (1990b).

have at times run sizable fiscal deficits, there have been no state or municipal defaults on general obligation bonds during the post-World War II period (Davidson (1990) and Cohen (1988)); (state) fiscal discipline has therefore been more the rule than the exception.

To be sure, there are also significant differences between the United States and Europe that are worthy of explicit mention. As noted by Lamafalussy (1989) and others, in Europe there is a greater concentration of expenditures and, especially, borrowing needs in a few regions. This in turn may mean that a "no bail- out" pledge will carry less credibility in Europe than in the United States. Another difference is that ratios of debt to total product are much higher--by almost an order of magnitude--in European countries than in American states. Whereas the heavily indebted European countries have (total) debt-to-GNP ratios near and in some cases above 100 percent, their state counterparts in the New England and Pacific regions have ratios on the order of 10 to 20 percent; see Eichengreen (1990). 1/ Labor mobility is also much higher in the United States than in Europe 2/--a factor that should make it easier for Americans to discipline higher spending local authorities by fleeing jurisdictions where higher tax burdens are not offset by more generous provisions of public goods. 3/ Yet a fourth difference is that the involvement and relative size of the central fiscal authority is much greater in the United States than in Europe. The Community budget is presently about 1 percent of EC GNP and even after creation of the single market, it is not expected to exceed 3 percent; by way of contrast, the federal budget in the United States accounts for roughly a quarter of U.S. GNP. One implication of this difference is that American states do not have as much access (via tax collections) to their residents' incomes as do member countries of the EC; at the same time, the central fiscal authority plays a much larger role in cushioning (via variations in tax and transfer payments) region-specific income fluctuations in the United States than in Europe. 4/ More generally, much of what is done in the fiscal area by the federal government in the United States is done by national governments in Europe. 5/

1/ The state debt-to-GNP ratios used in this paper are much lower than the figures cited above because we employ a more restrictive measure of state debt that is more closely-linked to default risk; see Section III.

2/ Eichengreen (1990). The difference between Europe and United States on the degree of labor mobility is reduced if one only considers mobility across states, since much of US mobility is apparently within states.

3/ Obstfeld (1990).

4/ Sachs and Sala-i-Martin (1992). It should be noted, however, that estimates of the "cushioning effect" of the US federal tax and transfer system on region-specific shocks appears to be quite sensitive to the time dimension of the shock--and perhaps also to the level of disaggregation of regions. In this connection, von Hagen (1991) finds a much lower cushioning effect than Sachs and Sala-i-Martin, using a shorter-run definition of shocks and a more disaggregated definition of regions.

5/ Mussa (1991).

Taken together, these differences imply that the market for EC country debt after EMU may not generate the same default premium for any given risk of default as does the municipal bond market in the United States. But the size of the default premium is not as important as the broader issue of whether changes in the default premium accurately reflect changes in the probability of default, that is, whether interest rates move in response to those aspects of fiscal policy behavior that alter the probability of default. For if the bond markets do operate in such an informationally efficient manner, then the practical options for leaning more heavily on a "market-based" approach to fiscal discipline are enhanced.

Unfortunately, existing empirical literature on the relationship between default premia and fiscal policy behavior across U.S. states is quite limited; 1/ in addition, existing studies suffer from several data and methodological shortcomings. To begin with, most studies have had to settle for examining the relationship between municipal bond yields and state debt indicators at a given point in time; this absence of a consistent, panel data set has meant that regressions have typically been run on only 30 to 40 observations, with no opportunity to account for variations in default risk over time. 2/ Our results suggest that this is likely to be a serious handicap for finding statistically-significant estimates of default risk. Second, and again reflecting data limitations, several studies have measured the cost of borrowing in the municipal bond market by credit ratings alone. Clearly, relative to a situation where observations on market yields are directly available, credit ratings throw away potentially valuable information by transforming a continuous variable into a discrete one. A preferred option would be to use the information in credit ratings to help explain market yields. Third, there is often a tenuous link between fiscal policy variables and default probabilities. Some studies, for example, use Census data on state general obligation bonds as their measure of state debt. These data are not a good measure of a state's financial liabilities, however, because they include debt that is not serviced from state tax revenues and exclude debt not issued by the state, but which is serviced from state tax revenues. Similar considerations arise about the role of the current fiscal deficit in affecting default risk and about the right scaling variables (trend income versus current income) for the stock of debt.

A fourth difficulty is that most previous work has ignored a potentially serious simultaneity problem that could bias the estimated effect of debt on interest rates, particularly in cross-section studies.

1/ In a broad survey of the relevance of the U.S. currency union for European Economic and Monetary Union, Eichengreen (1990) estimates the effects of debt variables on yields. Liu and Thakor's (1984) paper is typical of the finance literature on state default risk and fiscal variables. Capeci (1990) provides a broad survey of the municipal bond literature related to default risk. Most of the studies reviewed, however, are of the local municipal bond market.

2/ See, for example, Eichengreen (1990).

The problem occurs because debt variables are not the sole determinants of default risk. For example, consider a state that has had an unstable political history, which leads credit markets accurately to view the state as a poor credit risk. This state will face a high cost of borrowing and, ceteris paribus, will borrow less. A state with a more stable political history and thus with a lower exogenous probability of default will have an incentive to borrow more because it faces a lower cost of borrowing. This negative relationship between state borrowing and borrowing costs sketched above reflects movements along the states' demand curve for borrowing. Market-based fiscal discipline, which depends on a positive relationship between debt variables and borrowing costs, however, is a hypothesis about the supply-curve for state borrowing. We thus have a classic identification problem that, if left unaddressed, could bias the hypothesized positive relationship between default risk and the interest rate.

Fifth, some studies do not allow states' own statutory or constitutional balanced-budget and borrowing provisions to affect the cost of borrowing. But to the extent that such provisions affect the future course of deficits and the stock of debt, they also affect default risk and thus, should be included as explanatory variables. The influence of these "constitutional" variables on fiscal discipline is of particular interest in the EMU context, since as noted above, there is some support for binding rules on fiscal deficits that are close relatives of the rules now extant in some U.S. states.

The primary purpose of this paper is to provide new empirical evidence on market-based fiscal discipline by estimating the relationship between the cost of borrowing and measures of default risk in the U.S. municipal bond market. Our efforts are aided by access to a set of survey data on yields of state general-obligation bonds that covers 39 states from 1973 to the present. 1/ We believe that this survey data, collected by the Chubb Corporation, offers a richer medium for testing the market discipline hypothesis than has been available heretofore; not only is there a much larger sample of observations, but problems of comparability across bonds with different maturities, call provisions, and coupon yields are effectively eliminated by the survey design.

In addition to testing the market discipline hypothesis, the U.S. state data have implications for the rules approach to fiscal discipline. The state data contain a variety of self-imposed fiscal rules. Thus we can test whether financial markets perceive these rules to be effective in limiting default risk. While there may be important differences between voluntarily and involuntarily imposed fiscal rules, the state data allow us to test whether it is possible to credibly "tie one's own hands."

The rest of the paper is organized along the following lines. Section II reviews the theory of default risk in the context of the supply

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1/ While the municipal bond market includes obligations of cities as well as of states, we consider only the latter in this paper.

and demand for state borrowing. Section III describes in detail the (Chubb) survey data and the other data used, and reviews the specification issues raised by the theory of default risk. The econometric results are presented in Section IV. Anticipating what follows, we do find evidence that states with larger stocks of debt, larger (current) fiscal deficits, and higher trend rates of growth of debt relative to income, pay more to borrow in the municipal bond market than do states with more conservative fiscal-policy track records. Moreover, we also find that, ceteris paribus, states with more stringent, voluntary, constitutional limits on borrowing face a lower cost of borrowing. Concluding remarks are contained in Section V.

II. The Market for State Borrowing

A. The supply of funds to state borrowers

Theories of the supply of funds to states typically assume that any state's borrowing is a small fraction of total borrowing in the capital markets. 1/ Consequently, the market interest rate is assumed to be unaffected by any individual state borrowing. Put another way, states are price takers (with respect to the expected, risk-adjusted interest rate) on credit markets. This does not, however, imply that all states face the same promised interest rate (equivalently, yield to maturity). In fact, the promised interest rates on state bonds show considerable variability. It is not atypical for the spread between the lowest and highest yields to be over 100 basis points. This section looks at the theoretical reasons used to explain these spreads in spite of a common, market-determined interest rate. The explanations can be separated into two factors: (i) default risk; (ii) risk premia.

Default risk

Modern capital theory is a theory of the determinants of expected returns. In the case of securities subject to default, the expected return is determined by the stated or promised interest rate and the probability and consequences of default. For example, in the case of a one-period bond on which there is a positive probability of complete default, (1-P), the relationship between the promised interest rate, R, and the expected interest rate, E, is given by:

$$E = (1 + R)P - 1 \qquad (1)$$

1/ In credit markets, it is arbitrary on which side of the market the borrowers and lenders are placed. One can talk about the supply and demand for credit, in which case borrowers are on the demand side and lenders on the supply side, or alternatively the supply and demand for debt, which reverses the sides. In this paper, we use the former categories so that lenders supply funds to states and state borrowing leads to a demand for funds.

$= R - (1-P)(1+R) < R$

Because of the probability of default, the expected interest rate is less than the promised rate. Therefore, the promised interest rate on these bonds has to be higher than the interest rate on safe assets, which bear the (after-tax equivalent) risk-free rate, R_T. There are two reasons why the interest rate on loans with the possibility of default are higher than the risk-free rate: default premia and risk premia. Default premia compensate a lender for the expected losses from default. Risk premia compensate a lender for the possible increased riskiness of the total portfolio that results from the possibility of default. Unfortunately, many authors use the terms risk premia and default premia interchangeably in this framework.

Finance theory implies that default premia must be positive for assets *subject to default risk, but risk premia may be zero even with default risk.* The possibility of a zero risk premium on a loan with default risk occurs when the default risk can be diversified away (i.e., when the default risk is unsystematic). In this case, the lending to one risky borrower does not increase the risk of the total portfolio because of diversification. With diversification, the default risk from one loan is combined with offsetting risks on other loans. To focus initially on the determinants of default risk, we start with the case of no risk premia.
With no risk premia, the expected interest rate on a bond with default risk must equal the risk-free rate, or

$$E = (1 + R)P - 1 = R_T. \tag{2}$$

Adding one to both sides of (2) yields:

$$1 + E = (1 + R)P = 1 + R_T. \tag{2'}$$

Written in this way, the equality of the expected interest rates implies that the expected repayment of principal and interest on the risky and risk-free securities must be the same. The theory of the promised interest rate on risky debt in this case becomes a theory of the determinants of the risk of default, or, in terms of equation (2), the theory of the determinants of P. The relationship between default risk and the rate on risky state debt can be written explicitly by rearranging (2) to yield:

$$R - R_T = (1 + R_T)(1 - P)/P. \tag{3}$$

This equation shows that as the default probability increases, the spread between the interest rate on risky state debt and the after-tax, equivalent risk-free rate also increases.

For our purposes, the most interesting determinants of the probability of default are debt variables and current borrowing. In many different contexts, (e.g., Stiglitz and Weiss (1981), Eaton and Gersovitz (1981), Metcalf (1990), and Capeci (1990)), it has been shown that when current borrowing affects the probability of default, the supply curve can be backward bending, as in Figure 1 (a more technical derivation is detailed in the Appendix). At low levels of debt, an increase in borrowing, B, causes the promised rate to rise in order to compensate the lender for the increased probability of default. Notice, however, that the increase in the promised rate, R, also worsens the borrower's financial position by raising the interest expense on new borrowing. Thus, increasing the promised rate, by itself, increases the probability of default.

At some critical interest rate (R_C) and level of borrowing (B_C), the supply curve becomes vertical. At this point with $B = B_C$, any increase in the interest rate would cause the expected rate to fall because of the increased probability of default. The only way the promised rate could rise above R_C while fulfilling (2), would be if the level of borrowing fell below B_C; hence the backward bend to the supply curve. Promised rates above R_C, however, are unlikely to be observed in the market for reasons discussed below.

While the supply curve, at least initially, has the normal upward slope, lenders are not being induced by higher expected rates to increase their supply of credit. Recall that we began the analysis by assuming that the supply of credit to a state was infinitely elastic because any state's borrowing is a small fraction of total borrowing. That assumption is fulfilled in Figure 1, in spite of the shape of the supply curve. While the promised rate in Figure 1 varies with state borrowing, the expected rate is constant throughout. The slope of the supply curve solely reflects the change in the promised interest rate needed to keep the expected rate constant as the probability of default varies.

While the analysis so far has been very simple, the qualitative results on default risk are more general. For example, while the analysis was done for one-period bonds with the possibility of total default, it generalizes fairly easily for multiperiod bonds and partial defaults. In fact, if the probability of default is constant over time, the analysis immediately generalizes for the case of longer maturity bonds (see Yawitz, Maloney, and Edderington (1985)). In this case, however, one must take account of the fact that only the current deficit must be financed at the current promised rate. As is shown in the Appendix, this complication suggests that the slope of the supply curve increases at an increasing rate the larger the fraction of new borrowing in total borrowing. Thus, positively-valued current deficits may have a strong effect on the cost of state borrowing.

Risk premia

Risk premia complicate the relationship in equation (2) between the interest rate on risky debt, the risk free rate, and the probability of default. Most theories of risk premia, however, suggest that premia should either be proportional to default risk, or more than proportional to default risk. Thus while equation (3) no longer holds, the interest spread in (3) provides an upward biased measure of default probabilities, where this bias increases with the probability of default.

Specifying the risk premia associated with state debt requires a specification of planned holding periods. For example, if most lenders are planning to hold state debt to maturity, the only nominal risk is related to the probability of default. Risk premia arise when this default risk cannot be eliminated through diversification (when default risk has a systematic component). In this case, buying risky state bonds would increase the risk on the total portfolio and financial investors would seek to be compensated for their greater exposure to risk by a higher promised yield. While equation (2) no longer holds, the promised yield would still be a positive function of default probabilities. 1/

Many investors, however, either have shorter holding periods, or are concerned for other reasons with the current market value of risky bonds throughout the holding period. A good example of the latter type of investor is a municipal bond, mutual fund, which must "mark to market" each day. In either case, these financial investors are concerned with the volatility of the market value of the state bond throughout its maturity. This volatility will depend on changes in the current interest rate on the bond (i.e., the secondary market yield). Volatility of secondary market yields can result from two causes: (i) cyclical changes in the risk of default, which are independent of debt variables; and (ii) changes in credit ratings. In both cases, these risk premia are likely to be positively related to default risk.

The relationship between debt variables and promised yields is non-linear. As discussed above, as debt variables increase, the promised rate is likely to rise at an increasing rate. This suggests that an exogenous increase in default risk caused by a major recession is likely to have a larger impact on heavily indebted states. Thus, the volatility of yields and the associated risk premia are likely to be increasing functions of default risk. Davidson (1990) presents evidence showing that the spread between municipal bond rated by Moody's as Baa and Aaa is more volatile over time than the spread between the Aa and Aaa rates. 2/ This evidence is

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1/ The question of risk premia on sovereign debt is tested empirically in Stone (1990) and Cottarelli and Mecagni (1990).

2/ U.S. bonds are given credit ratings principally by Moody's Investor Service and Standard & Poor's. The qualitative description of the Moody's Ratings categories are: Aaa - Best quality; Aa - High quality; A - Upper medium grade; Baa - Medium grade; Ba - Possess speculative elements; B - Generally lack characteristics of desirable investment; Caa - Poor Standing; may be in default; Ca - Speculative in a high degree; often in default; C - Lowest grade; very poor prospects. In addition to each broad category, a 1,2, or 3 can be added to the letters to indicate whether the security is in the high, middle, or low end of the ratings category. See Van Horne (1990) for a discussion of the relationship between credit ratings and default risk.

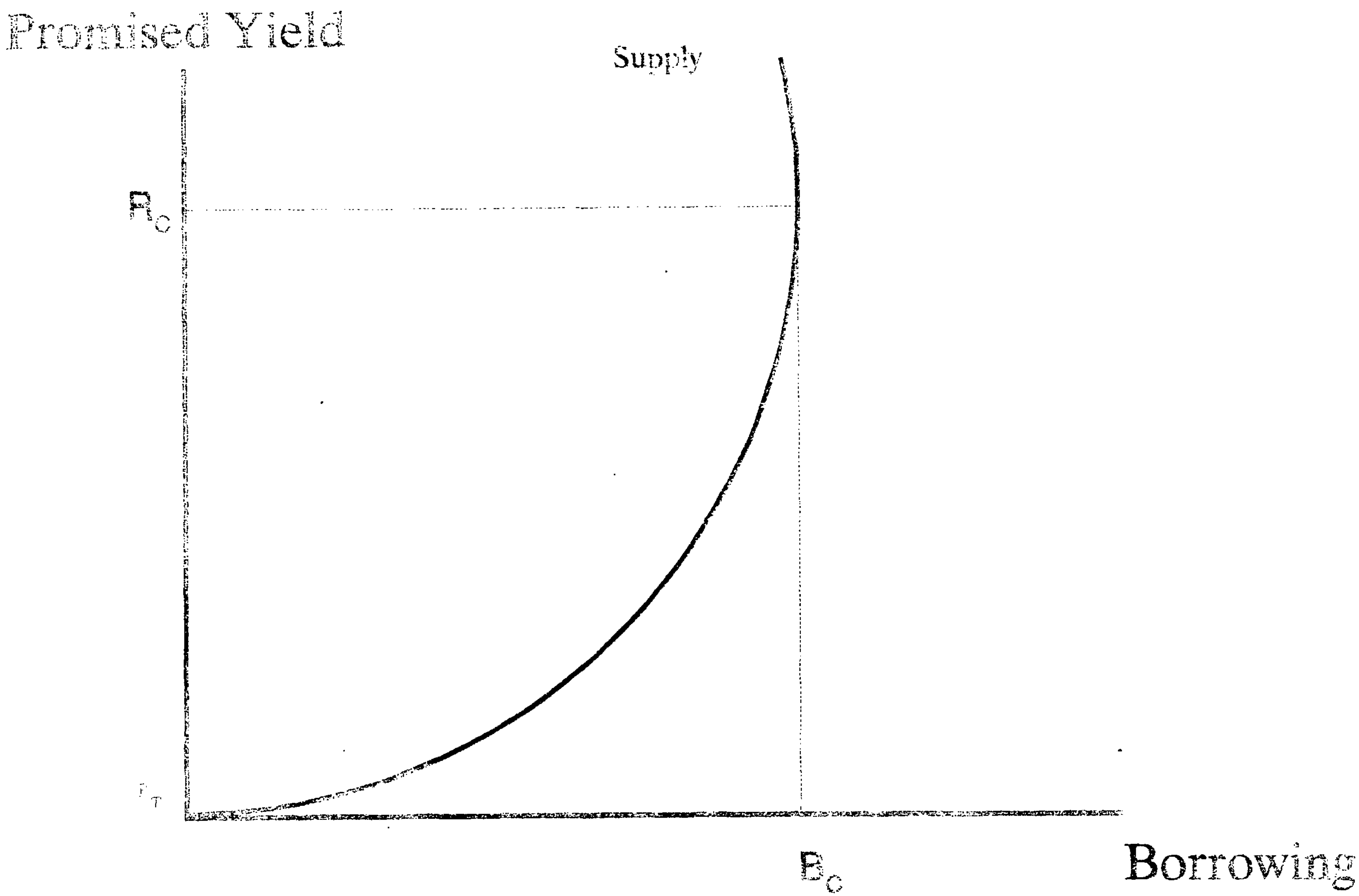

Figure 1
The Supply Curve of Borrowing

consistent with the hypothesis that risk premia due to cyclical volatility increases with default risk.

Credit-rating changes are also associated with changes in yields. Rating changes are generally regarded as primarily reflecting unanticipated changes in a state's fiscal position. 1/ While one can argue that a Aa state is just as likely to experience either a deterioration or improvement in its fiscal position as a Baa state, risk premia from rating changes still increase with default risk. This relationship results from an important nonlinearity between ratings and yields. Many financial intermediaries are prohibited from holding securities rated below investment grade quality (below the Moody's rating Baa, or the S&P rating BBB). With the removal of these large holders, yields would have to rise dramatically to induce the remaining holders to absorb the total supply of debt. Thus, while changes in ratings may be equally likely, the consequences of a rating downgrade for a Baa state are more severe. An A state, however, faces a greater likelihood of a downgrade below Baa than does a Aaa state. Thus one would expect the risk premia associated with ratings changes to rise with the probability of default.

Conclusion

There are additional factors that affect the interest rates on specific issues of state debt, namely (i) maturity, (ii) callability, (iii) the coupon yield, and (iv) insurance. 2/ The complication of these factors,

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1/ The rating agencies, however, try to measure default risk independently of the business cycle. Thus for example, the Baa - Aaa spread widens during a recession instead of the spread remaining constant with fewer Aaa states and more Baa.

2/ In principle, the yield on state debt can vary because of taxes. To a state resident, neither federal nor one's own state's securities are subject to state and local taxation. State, general obligation debt, however, is also free of federal taxation, so that the marginal rate of federal taxation for the marginal investor who is indifferent between Treasuries and state debt with appropriate default and risk premia. Various competing theories (summarized in Poterba (1989)) have identified the relevant marginal investor as banks, insurance companies, corporations, or individuals. Poterba (1989) presents empirical evidence in support of the hypothesis that individuals are the indifferent investors during the 1960-1988 period, particularly for the case of long-term municipal debt.

In fact, such differences in marginal tax rates are frequently cited for what would otherwise be anomalies in yields across states. For example, Swartz (1989) refers to "tax related demand" to explain why the yields on Connecticut and California state bonds were consistently among the six lowest during the late 1980s in spite of credit ratings below Aaa. During the same time period, the bonds of at least 5 other Aaa states traded with higher yields. We tested for differences in yields due to differences in average, marginal rates of federal taxation across states, but found anomalous results.

however, can be avoided if interest rates on bonds with identical characteristics with respect to these factors are compared across states. After controlling for these factors, the expected interest rates for all state bonds, after adjusting for risk premia, should be equal to the equivalent after-tax interest rate on Treasuries. The equality of expected interest rates, however, implies that the promised rates, the rates observed directly on financial markets, will differ because of differences in default and credit risk across states. Default and credit risk should be an increasing function of state borrowing.

B. The demand for funds by state borrowers

The key issue in the states' demand for funds is whether the quantity demanded is sensitive to the cost of borrowing. If it is, the promised yield could never reach R_C in Figure 1. Metcalf (1990) estimates a model of the demand for state borrowing, where states choose between borrowing and tax finance based on demographic factors and the after-tax cost of borrowing. He finds that states do vary their borrowing based on the after-tax cost of borrowing.

This model of the demand for borrowing is important because while states must be price takers with regard to the expected risk-adjusted interest rate, it is implausible to assume that they would be price takers with regard to the promised interest rate. The state must recognize that by borrowing more, the promised rate on all new borrowing increases. Specifically, the marginal cost of borrowing one more dollar exceeds the promised rate on this borrowing, and is equal to the promised rate plus the change in the promised rate (which depends on the slope in Figure 1) times the volume of new borrowing. But as borrowing approaches B_C, the change in the promised rate is large for small changes in borrowing (i.e., the slope in Figure 1 goes to infinity). As a result, the marginal cost of borrowing increases without limit as B approaches B_C, and the state has a strong incentive to keep total borrowing below B_C.

While this model is plausible and receives empirical support, it is not consistent with the credit rationing part of the market approach to fiscal discipline. The credit rationing story can be resurrected, however from different models of state borrowing. For example, Eaton and Gersovitz (1981) develop a model for sovereign country borrowing where a country borrows to smooth its consumption stream. In this model, if the state of nature is adverse enough, a country might wish to borrow above B_C. In this case, the credit markets would limit borrowing to B_C at the promised interest rate R_C. The country is credit constrained because it would be willing to pay a higher promised rate in order to borrow more, but no lender will lend more. In this model, credit constraints arise out of unforeseen, large shifts in the demand curve.

These two models need not be viewed as mutually exclusive. For example, trend borrowing may be determined by Metcalf's interest-sensitive model, with unanticipated variations around trend being explained by the Eaton and Gersovitz model. The data certainly suggest that there can be unanticipated increases in borrowing. Louisiana's experience during the 1980s provides a dramatic example. In December of 1982, Louisiana was a Aa-rated state with promised yields below those of Aaa-rated New Jersey. Five years later, Louisiana was Baa1-rated, with yields over 100 basis points higher than New Jersey's. During this time period, deficits in excess of 18 percent of state expenditures were incurred by Louisiana. This suggests that while the trend demand for debt is interest sensitive, unanticipated increases in demand also occur.

In this paper, we are primarily concerned about estimating the supply curve of funds to risky state borrowers. Market-based fiscal discipline can work even with interest insensitive borrowers via credit rationing. In addition, the simultaneity issues, described below, make estimating the demand curve problematic. For estimating the supply curve, the determinants of the demand for state borrowing are important chiefly because of the identification problem.

III. Data and Issues of Econometric Specification

A. Data on market yields

The primary data needed to test for the existence of default premia on state debt are market yields on the obligations of the various state governments. States, however, issue two basic types of bonds: revenue bonds and general obligation bonds. General obligation bonds (GOs) are "full faith and credit" obligations of the state, whereas revenue bonds are only backed by the revenues of the specific project being financed by the bond. For example, the repayment of interest and principal on a Florida Department of Transportation Bond, a revenue bond, could come from toll revenues. Florida State Board of Education bonds, on the other hand, are financed from the general tax revenues of the state. Given our interest in the fiscal position of state governments, we need yield data on general obligation bonds.

The need for market price data on general obligation bonds, however, raises immediate problems because these bonds are not actively traded. For example, JP Morgan tracks the yields on over 75 actively-traded tax exempt bonds in their Municipal Market Monitor. Of these bonds, only 5 are state GOs. Surprising as it may seem, information is not widely available on the market prices of individual state debt.

As previously noted, however, financial market participants, particularly mutual funds, have a need for current market values. This need is met by brokerage firms (e.g., JJ Kenny) that place values on bonds issues for a fee. These bond values, however, are typically not transactions prices. Instead, the relationships between the prices on particular issues are specified in what is called a "pricing matrix." This matrix uses a relatively small number of transactions prices to infer the values of all the other securities being evaluated. The information that goes into the specification of the pricing matrix is proprietary and not generally available. While it is difficult for an outsider to determine the validity of these matrix prices, it is noteworthy that these pricing services are widely used. In fact, one of the widely-reported municipal bond indices, the Bond Buyer 40, is based on municipal bond "prices" from these services. Thus, the financial markets' own needs for current market values are not met solely with transactions prices.

Transaction price data and matrix prices suffer from another problem. In addition to default risk, risk premia, and tax effects, municipal bond prices and yields are affected by other features that vary by issue. Unless one compares identical securities across states, these other features can have a significant impact on yield spreads. For example, a randomly selected issue of JP Morgan's Municipal Market Monitor (1989) lists the market yields on two Florida State Board of Education Bonds. These market yields are based on the closing bid price at Morgan. On August 24, 1989, the two market yields were 7.05 and 7.27 percent. The bonds were identical, except that the lower yielding bond matured in 2013 as opposed to 2010, was callable at 100 in 1996 as opposed to 102, and bore a coupon of 5 percent instead of 7.25 percent. During the same week, the yield spread between AA and AAA 20 year municipal bonds was reported by Delphis Hanover as 20 basis points. Thus, the yield spread caused by the special features on the two Florida State GOs was wider than the yield spread between two credit-rating categories.

Fortunately, there is a data source that allows us to avoid the problem of comparability on GO bonds, The Chubb Relative Value Study. The Chubb Corporation, an insurance company, has conducted since 1973 a semi-annual survey of 20-25 (sell-side) municipal bond traders. The traders are asked to give the yields on 5, 10 and 20 year maturity GOs for 39 states and Puerto Rico, relative to the yield on a comparable New Jersey state GO. The survey results for December 1989 are reproduced in Table 1. This survey implies that, on average, traders felt that a comparable California 20 year GO should have a market yield 14.04 basis points below New Jersey's market yield, while a comparable Louisiana 20 year GO should bear a yield 70 basis points higher than New Jersey's. Most important, for our purposes, the Relative Value Study implies that the yield spreads between comparable California and Louisiana 20 year GOs should be 84.04 basis points. 1/ Since the bonds being evaluated are comparable across states, the differences in yield spreads can only reflect default risk, risk premia, and tax effects. Thus while the data are not based on transactions prices, they do solve the problem of special features such as call provisions. 2/

1/ The 10 excluded states include the 9 states who have no outstanding GO debt and Arkansas. In addition, we excluded New Jersey, Alaska and Hawaii. The latter 2 states were excluded because of their unique fiscal status.

2/ The Chubb Relative Value Survey does not include explicit instructions to evaluate comparable bonds. Tom Swartz of Chubb, however, reports that these instructions are implicit, and that whenever a survey respondent asks they are instructed to evaluate comparable bonds.

Table 1. Chubb Relative Value Study, December 1989
(Basis point spread for 20 yr. state GO,
relative to a New Jersey 20 yr. GO)

Ranking:	Moody's Rating	Avg. Response	Std. Dev.
1 California	Aaa	-14.04	3.84
2 North Carolina	Aaa	-11.91	4.32
3 Virginia	Aaa	-10.65	4.76
4 Connecticut	Aa1	-9.96	5.09
5 Missouri	Aaa	-8.30	5.28
6 South Carolina	Aaa	-6.74	5.58
7 Georgia	Aaa	-6.39	2.58
8 Maryland	Aaa	-4.65	3.51
9 Tennessee	Aaa	-4.09	5.80
10 New Jersey	Aaa	0.00	0.00
11 Ohio	Aa	1.39	3.41
12 Utah	Aaa	5.57	4.84
13 Maine	Aa1	7.00	4.95
14 Minnesota	Aa	8.13	3.79
15 Montana	Aa	8.39	5.25
16 Delaware	Aa	8.61	4.51
17 Kentucky	Aa	8.70	5.31
18 New Hampshire	Aa1	9.52	3.84
19 Rhode Island	Aa	10.26	3.58
20 Vermont	Aa	11.17	3.56
21 Alabama	Aa	12.09	3.83
22 Wisconsin	Aa	12.13	3.93
23 Pennsylvania	A1	12.91	4.83
24 Mississippi	Aa	13.39	4.49
25 Hawaii	Aa	13.87	3.83
26 Michigan	A1	14.04	4.84
27 New Mexico	Aa	14.48	3.59
28 Illinois	Aaa	14.48	4.67
29 Oregon	A1	16.57	3.59
30 Florida	Aa	17.26	4.11
31 Nevada	Aa	18.74	4.00
32 New York	A1	20.39	4.75
33 Oklahoma	Aa	21.61	7.29
34 Texas	Aa	22.74	5.93
35 North Dakota	Aa	22.83	10.11
36 Washington	A1	24.48	3.05
37 Alaska	Aa	27.39	7.49
38 West Virginia	A1	28.22	5.34
39 Puerto Rico	Baa1	48.09	6.99
40 Massachusetts	Baa1	62.39	11.50
41 Louisiana	Baa1	70.00	12.07

As one would expect, these yield spreads vary over the course of the business cycle: over time, the spread for a particular state can vary considerably. For example, during the recession year of 1982, the spread between the highest and lowest rated states of Oklahoma and Michigan was over 170 basis points: in contrast by 1989, the high-low spread fell by a factor of 2 and Michigan was a higher-rated state than Oklahoma (see Table 1). These yields spread behave as one might expect if they, in fact, reflect changes over time in default risk.

B. Other data

To measure state debt, we used data on net, tax-supported debt as reported by Moody's. This debt figure is calculated each time Moody's issues a Credit Report on a new issue. Net tax supported debt includes all debt serviced from state tax revenues even when the state itself was not the issuer (e.g., Massachusetts Bay Transportation Authority bonds in Massachusetts), and deducts from gross debt, obligations that are serviced from nontax revenues (e.g., Oregon general obligation debt that is backed by mortgage lending). Moody's publishes the latest available numbers for each state annually. These data reflect the most accurate picture of state's fiscal position from the perspective of one of the two major credit rating agencies. Unfortunately, the numbers are not updated at a uniform time during the year. These data are available from 1981 through 1990. To derive measures of the relative size of debt, the nominal debt numbers were deflated by the implicit GNP deflator for the year and divided by trend Gross State Product (based on Department of Commerce, real Gross State Product data). Bond ratings are the Moody's ratings.

Finally, state "constitutional" debt limitations were measured by an index devised by the Advisory Commission on Intergovernmental Relations (ACIR 1987). These limitations can vary from a requirement for the governor to submit a balanced budget to a prohibition on the issuance of general obligation debt. The ACIR index tries to measure in one number the restrictiveness of the various provisions adopted by a particular state. The index varies from 0 in Vermont, a Aa-rated state with no restrictions, to the maximum of 10 in 26 states. These 26 states include 8 of the 9 states with no general obligation debt, 7 of the 11 Aaa-rated states, 10 of the 23 Aa-rated states, and West Virginia an A1 state. For the 5 states (other than West Virginia) rated below Aa, the index ranges from 6 to 3.

The summary statistics for all of our variables are given in Table 2. At first glance the data in Table 2 seem to indicate that debt levels among the U.S. states are orders of magnitude lower than among the European countries. This conclusion is unwarranted, however, because the Federal government is much larger in the United States than it will be in Europe, at least for the immediate future. As a result, states have less access to the incomes of their residents than do the European countries. Thus it is inappropriate to compare relative debt levels of the U.S. states to the relative debt levels of the European countries. A better comparison of the relative importance of government debt between the U.S. states and the European countries is provided by the fraction of total government expenditures accounted for by interest on the debt. During the 1989 fiscal year, interest as a fraction of total expenditures ranged between 1.5 and 10 percent (U.S. Census (1990)) for the 50 states. Bishop (1991) reports statistics that suggest the comparable numbers for the European countries range between 5 and 25 percent. Thus, while debt levels are higher in Europe than among the U.S. states, these differences are not as large as the numbers in Table 2 might suggest.

C. Specification issues

As outlined earlier, our basic aim is to estimate the relationship between the promised interest rate and default risk, where default risk in turn is related, inter alia, to the quantity of debt -- or more generally, to a state's past and prospective fiscal policy behavior. Put in other words, we hope to be able to trace out the supply curve illustrated in Figure 1.

The dependent variable in all our regressions is the yield spread on a 20 year state, general obligation bond relative to the yield on a 20 year New Jersey general obligation bond. In a cross-section regression, this implies that the constant term can be thought of as capturing New Jersey's yield.

Table 2. Summary Statistics for Major Variables

	Mean	Minimum	Maximum	Std. Dev.
Yield spread	16.5	-28.4	143.5	23.5
Debt	2.3	0.2	7.1	1.4
"Deficit"	0.2	0.0	2.3	0.3
Trend growth in debt	1.5	-11.9	20.6	6.7
ACIR index of debt limitations	7.6	0.0	10.0	2.8

The yield spread is measured in basis points; debt and deficit are in percentage points of trend gross state product, and trend growth in debt is percentage points per year.

In contrast to earlier empirical studies, we see four aspects of fiscal policy behavior as potentially impacting on the probability of default. The first of these is the existing stock of debt (relative to income), which summarizes the scale of the state's past borrowing; ceteris paribus, the higher this ratio, the higher the default probability. Our second fiscal policy indicator is the expected growth of relative debt. This is captured in our regressions by the difference for each state between the trend rate of growth in real debt and trend growth in real state product. A state for which this trend variable is positive will have, on average, a rising relative debt, and thus a larger risk of default over the life of a 20 year general obligation bond.

Recall from Section II that the theory of default premia suggests that the slope of the supply curve should increase more rapidly the greater the proportion of new borrowing that must be financed at the current interest rate. If new borrowing causes an increase in the promised yield, then a deficit should affect the yield independently of its effect on total debt outstanding. This provides the rationale for our third fiscal policy variable, namely the increase in debt over the preceding year. We give this variable a value of zero if debt falls and a value equal to the deficit when it is a positive number. The expectation is that the deficit will carry a positive sign in the regressions. Last but not least, we have included the stringency of the state's constitutional debt limitations as also affecting default risk. Here, the argument is that stringent constitutional limitations make it more likely that any deviation from responsible fiscal policy will be corrected before it reaches crisis proportions; as such, we expect the constitutional stringency index to appear in the regressions with a negative sign.

So much for the fiscal variables. Next, we need to consider the likelihood that there are additional factors, particular to each state, that should help to explain default risk. Bond ratings are a discrete measure of all the factors (including fiscal variables) in each state that affect default probabilities. Liu and Thakor (1984) have proposed a two-step regression procedure designed to use the information in these, otherwise omitted state-specific factors. For each year, the rating categories are replaced with the average yield spread for the states in that category. A regression is then run for each year that estimates the numerical value of each state's rating category based on the included fiscal variables (i.e., debt, deficit, trend of the debt-to-income ratio, index of constitutional debt limitations). The <u>residuals</u> from these regressions, which we will call the ratings residuals, are an estimate of the quantitative importance of the factors that have <u>not</u> been captured by the included fiscal variables. In the second stage, the yield spread is regressed on all the variables employed in stage one plus the ratings residual. This procedure allows one to capture the information that is embedded in bond ratings and that is not already accounted for by the fiscal variables. 1/

1/ Cranford and Stover (1988) criticize Liu and Thakor by noting that because the error from the first stage regression is orthogonal to the fiscal variables, the point estimates of the fiscal coefficients in the second stage regression will be identical to an OLS regression of yield on the fiscal variables, omitting the ratings variable. In response, Liu and (continued...)

Two related specification issues are the nonlinearity of the relationship between fiscal variables and promised yields and variations in the risk of default over the business cycle. With regard to the first issue, we assumed that the non-linear supply curve in Figure 1 can be approximated by a quadratic function in the debt variables. The problem of the variation in the risk of default with the business cycle was handled with dummy variables. Because the risk of default is higher during a recession year (even with the same debt stock), we included dummies in our regressions to allow the constant term to vary by year. In addition, the nonlinearity of the supply curve suggests that the slope may also vary by year. A higher risk of default is likely to change both the location of the supply curve in Figure 1 as well as the slope for any value of borrowing. Thus we included slope dummies in our regressions to allow the effect of an increase in the debt variables on yields to vary by year. 1/

The final specification issue is to account for the simultaneity between the promised interest rate and the debt variables. Recall that the issue of simultaneity arises when the states' demand for borrowing is interest sensitive. The simultaneity problem is therefore likely to be most severe for cross sectional differences in trend levels of debt. To account for this possibility, we tested our basic pooled equation against a panel model with fixed effects. The fixed effects model, however, uses deviations from state sample means to estimate the supply equation. As a result, the time-invariant state variables (viz., trend debt growth and debt limitations) must be dropped from this specification.

The fixed effects model has the advantage of controlling for state specific omitted variables that we cannot measure quantitatively, but which market participants report are important. For example, Delaware is a Aa-rated state, with GO bond yields typically below the average for all Aa-rated states. Yet, Delaware is one of the 4 states with the largest relative debt. Oregon, on the other hand, is an A1-rated state with a well-below average value for its relative debt, about one-fifth the size of Delaware's relative debt. The larger relative debt in Delaware primarily reflects the fact that the municipal government system is much less well developed in Delaware because of its small size. Therefore, the Delaware

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1/ (...continued)
Thakor point out that while the point estimates will be the same, the standard errors will be lower in the second stage regression. The question then becomes which are the appropriate standard errors. We believe that the standard errors from Liu and Thakor's procedure are more appropriate for our test. The ratings residual allows us to capture the effects of omitted factors, which if not accounted for would mask the statistical significance of the relationship between fiscal variables and yields.

1/ Notice that the ratings variable is also capturing variations in the risk of default over the business cycle. For example, the spread between the numerical values assigned to Baa and Aaa ratings in the recession year of 1982 was 153.6 basis points, whereas the same spread during 1989 was less than half as much at 70.9 basis points.

relative state debt is closer to a measure of the relative size of the state and local debt for other states.

These unobserved, fixed effects may impart a downward bias to our estimates for the effects of debt on yields. For example, because financial markets know about Delaware's unique state and municipal system, Delaware is able to borrow at relatively low yields (i.e., the supply curve in Figure 1 is shifted to the left for Delaware). But given these relatively low yields and an interest sensitive demand, Delaware has a incentive to borrow more. Our supply curve expects to find a positive relationship between cross-section differences in relative debt and yields, but the unobserved, fixed effects impart a negative relationship between promised yields and relative debt.

With the fixed effects model, we avoid having to explain why Delaware has a lower yield than Oregon in spite of the higher relative debt. Instead, we must explain how deviations from the mean in the yields of Oregon and Delaware are related to deviations from the mean in debt. The disadvantage of this approach is that we can only include variables that change over time. Therefore, with this approach, we cannot test for the importance of debt limitations, or for importance of the growth in trend debt.

The fixed effects model solves the simultaneity problem if mean debt levels are interest sensitive, while the deviations from the means are not (Hsiao (1986)). It is, of course, possible that deviations from the mean in debt and yield variables are simultaneously determined. Therefore, we also estimated the fixed effects model with two stage least squares. The problem here, however, is to find appropriate instruments, that is, variables that affect the demand for borrowing, but are unrelated to supply. Finding appropriate instruments presents a problem because virtually all of the instruments that affect demand also affect the probability of default, and thereby also affect supply. Metcalf (1990), for example, argues that demographic factors, such as the percentage of elderly, and current economic conditions are important exogenous factors in the demand for state borrowing. These same factors, however, are also likely to affect the probability of default. Take Metcalf's argument that a large population of elderly in a state can lead to a reliance on debt finance. It seems to us that the same argument implies that that state will have a higher probability of default for any level of borrowing. Default places a heavy burden on a state's residents. Defaulting on a newly issued 20 year state GO, when the bond approaches maturity, however, will not adversely affect the current generation of the elderly. While it is not clear how to solve this simultaneity problem, we experimented with lagged values of debt and economic conditions as instruments.

Table 3 presents the basic equation of our pooled regressions along with a priori implications from the discussion of theory and specification issues.

Table 3. Specification of Full Model and Definition of Variables

Yield Spread = $\alpha_0 + \alpha_1$ Debt + α_2 Deficit + α_3 Debt^2 + α_4 Deficit^2

+ α_5 Trend Growth in Relative Debt + α_6 Debt Limit

+ α_7 Ratings Residual + α_8 - α_{14} Year Dummies

+ α_{15-22} (Year Dummies) Debt + α_{23-30} (Year Dummies) Deficit

Yield Spread is the basis point value of the spread between the yield on a given state's 20 year GO debt and New Jersey's yield.

Debt is Moody's real net tax supported debt as a fraction of the trend value of real Gross State Product; $\alpha_1 > 0$, $\alpha_3 > 0$.

Deficit is the change in debt when positive, or zero; $\alpha_2 > 0$, $\alpha_4 > 0$.

Trend Debt Growth is the difference between trend growth in real tax supported debt and real Gross State Product; $\alpha_5 > 0$.

Debt Limit is the ACIR index of the restrictiveness of a state's constitutional limitations on debt; $\alpha_6 < 0$.

Ratings Residual is the residual from a regression of the Moody's rating for each state regressed against the preceding fiscal variables. The rating category is assigned the average value of the yield spreads for the states in that category; $\alpha_7 = 1$

Year Dummies take on the value of 1 for one year between 1983-1989, and zero otherwise; α_{15-22} and α_{23-30} should be larger the greater the default risk in that year (i.e., during a recession).

IV. Empirical Results

Our basic regression results for the yield spread are presented in Table 4. These regressions use the largest sample period available with both the Chubb data and the Moody's debt data (i.e., 333 observations). 1/ Two versions of our theoretical model are shown. The first one, which we call the full model, includes the current deficit and its squared value, along with all the other determinants of default risk outlined earlier. The second version, which we label the abbreviated model, is identical except that it excludes the deficit variables.

The results in Table 4 offer broad support for our theoretical model. The coefficient on relative debt (the ratio of debt to trend state product) is significant with the expected positive sign, suggesting that debt stocks have a significant influence on borrowing costs. This is a robust finding for our pooled samples, and contradicts Eichengreen's (1990, p.151) conclusion--based on yield spreads for a single year and on measures of gross state debt--that "there is weak evidence that higher debt burdens increase the cost of borrowing." The full model also indicates a significant effect for the current fiscal deficit in increasing a state's promised interest rate. Also, as is suggested by theory, the higher the trend rate of growth of the relative debt, the higher both the default risk and the cost of borrowing. Taken together, these estimates for the debt variables suggest that states which have implemented relatively conservative fiscal policies are perceived by the market as having a lower default probability and thereby reap a market dividend in the form of a lower borrowing cost.

Interestingly enough, the estimated coefficient on our "constitutional, fiscal rule" variable is also significant and with the expected negative sign. Indeed, and somewhat to our surprise, this constitutional debt limitation variable (measured by the ACIR index of fiscal stringency) was the most consistent performer among all the fiscal policy variables, typically emerging as significant with the expected sign not only in the pooled, time-series results but also in the single-year cross-sections. (We also estimated several pooled regressions where the constitutional debt limitation variable entered interactively with the debt and deficit variables but the results showed little pattern or reason.) 2/

The implication, for what it is worth, is that states which have voluntarily imposed limitations on their borrowing and debt accumulation are seen by the market as having lower default risk, even after controlling for their past fiscal-policy track records. Using the point estimate in column

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1/ The 333 observations derive from observations on 37 states over the 1982-90 period (9 years).

2/ There may well be a problem of multicollinearity here given the preponderance of high values for the debt limitation index.

Table 4. OLS Estimates for the Abbreviated and Full Models

	Full Model (1)	Abbreviated Model (2)
Debt	8.26 (3.51)	9.98 (4.92)
Deficit	23.26 (2.37)	
$Debt^2$	-0.25 (0.86)	-0.40 (1.55)
$Deficit^2$	-11.40 (2.55)	--
Trend Debt Growth	0.28 (2.51)	0.35 (3.47)
Debt Limits	-1.99 (7.31)	-2.01 (8.18)
Ratings Residual	0.98 (24.0)	0.99 (26.7)
Std. Error of Est.	12.77	11.94
$\bar{R}2$	0.70	0.74
Number of observations	333	333

Sample Period 1982-1990; "t" statistics in parentheses. In addition, each regression contained a constant term, year dummies for 1983-1990,—and slope dummies for the debt variable for 1983-1990. Thus the coefficients on debt and the deficit refer to the 1982 coefficients for these variables. The variables are as described in Table 3.

(1) of Table 4, a state with an "average" set of constitutional limitations (an index value of 7.6) pays 5 basis points more than a state with the most restrictive set of limitations. Presumably, market participants view these fiscal rules as constraining future fiscal adventurism. Because the ACIR index combines a group of rather diverse restrictions (ranging from the requirement that the governor must submit a balanced budget to an absolute dollar ceiling on the amount of general obligation debt), it would be unwise to read too much into this finding. But it does suggest that the benefits of "tying one's hands"--so emphasized in the literature on the credibility of monetary policy--may be applicable to certain aspects of fiscal policy as well.

This brings us to the ratings residual, which is highly statistically significant with the expected positive sign and with a coefficient that is not significantly different from its expected value of one. Our results do therefore support the notion that credit rating categories contain important information about default risk that is <u>not</u> captured by the fiscal variables. It also shows why trying to infer the presence of market discipline from eyeball observations of yield spreads and fiscal policy differences, without attempting to hold "other things equal," is apt to be misleading. The first-stage regressions that attempt to explain the ratings are not presented, but are qualitatively similar to those estimated in earlier studies.

It would of course be desirable to show not just that default premia increase with looser fiscal policy, but also by how much. This can be calculated--and we in fact do so below--but the estimates, we're afraid, are subject to considerable margins of error. To reflect the theoretically appealing notion that default risk should rise at an increasing rate with higher levels of debt, we attempted to capture the non-linear nature of the supply curve with a quadratic in debt (and in the deficit). Most typically, however, the squared terms appeared in the regressions with the wrong sign and in some cases with a "t" value above 2. This is the case with the estimates for the full model shown in column (1) of Table 4: the estimated coefficient on the squared debt stock is negative but insignificant, while that on the squared deficit term is negative with a "t" value in excess of 2. Nevertheless, this imprecision should not overshadow the strong qualitative conclusion implied by our estimates that promised yields increase with the stock of debt.

Earlier on, we also speculated that default risk could vary over time, perhaps on account of the business cycle. Because we have included year-by-year shift and slope dummy variables, the estimated slope coefficients on debt and the deficit refer to 1982. Because 1982 was a recession year, it is not unreasonable to posit that default risk was then at a peak. In fact, the spread between Baa-Aaa municipal bonds was widest for any year in our sample during December of 1982. Thus it is reassuring that the point estimates (the results for the abbreviated model are shown in Table 5) for all of the slope dummies on debt are negative and 6 out of the eight are statistically significant. The constant term dummies are primarily positive, but none are statistically significant.

Table 5. Time Dummies for the Abbreviated Model

(Results for regression in of column 2 Table 4)

	83	84	85	86	87	88	89	90
Constant Term Dummy:	4.30 (0.84)	8.54 (1.69)	4.44 (0.85)	7.40 (1.43)	3.63 (0.68)	0.67 (0.13)	-1.40 (0.28)	-5.50 (1.11)
Coefficient on Debt Dummy:	-2.58 (1.36)	-3.88 (2.05)	-4.53 (2.27)	-5.97 (3.04)	-4.23 (2.09)	-4.12 (2.09)	-3.97 (2.11)	-1.19 (0.66)

While there is broad support for the theoretical model, our attempt to test for the additional effect of new borrowing was not successful, as is shown by a comparison of the estimates for the full and abbreviated models in Table 4. In the results for the abbreviated model in column (2), the relative debt stock, the trend growth of the debt stock, the constitutional debt limitation index, and the ratings residual all appear as statistically significant with the theoretically expected signs. The squared value of the debt stock carries the wrong (negative) sign but has a high standard error. 1/ In short, all the same qualitative conclusions apply. It is worth noting that the explanatory power of the abbreviated model (as measured by both the unadjusted and adjusted R-squared) is actually superior to that of the full model. 2/ From this, we conclude that our attempts to capture with our deficit variable the additional effects on default risk stemming from new borrowing were unsuccessful (despite the significance of the deficit variable in the regressions for the full model).

Using the estimated coefficients in the abbreviated model, it is possible to calculate some suggestive statistics about the quantitative effect of relative debt on borrowing costs. For example, during the recession year of 1982, relative debt had a mean value of 2.2 percent. An increase in relative debt of one percentage point would have led to an increase in borrowing costs by more than 8 basis points, and the promised yields rise with the relative debt as long as debt was less than 12.3 percent of Gross

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1/ In addition to problems of simultaneity (discussed later in this section), there may also be a multicollinearity problem at work as between the debt and squared-debt variables. In this connection, it is worth noting that when the abbreviated model was re-estimated using <u>either</u> the level or the squared value of debt-to-income, the estimated coefficients were significant with the expected positive sign.

2/ Note that the ratings residual variable is not the same between the two regressions. In the abbreviated model, whatever information there is in the deficit variable is captured by the ratings variable. This adds to our suspicion that the deficit variable is capturing the increased probability of default from new borrowing.

State Product. The lowest estimates of the effect of debt on yields occurs for 1986, when the slope dummy on debt takes on the largest negative value of -5.97 (from Table 5) with a statistically significant "t" value of 3.0. For this year, our estimates imply that an increase in the relative debt by one percentage point (from the mean value of 2.2 percent) would raise borrowing costs by over 2 basis points and promised yields rise with relative debt as long as relative debt is less than 5.0 percent of Gross State Product. We also estimated full and abbreviated models on a cross-section of States for single years.

We also estimated the full and abbreviated models on a cross-section of states for single years. Not unexpectedly, estimated coefficients on the fiscal policy variables were typically much less well determined than in the pooled samples, and the sizes--and sometimes even the signs--of the coefficients often changed quite markedly from period to period. For illustrative purposes, we show in Table 6, estimates of the abbreviated model for the years 1982, 1987, and 1990. Note in particular how the estimated coefficient on the debt-to-income variable, as well as that on its squared value, differ across the three years. For example, if one had only the estimates for 1982, it would be concluded that promised yields increased--albeit at a decreasing rate--with the stock of debt, whereas a dramatically different conclusion would emerge from the 1990 results. And if reliance had to be placed on the 1987 estimates, the conclusion would be that there was no significant association between promised yields and the stock of debt. In our view, these single period, cross-section results indicate how constraining it can be to ignore time-series variation in default risk-and even more so--how hazardous it can be to draw conclusions on the market discipline hypothesis from estimates based on a small sample of observations taken at one point in time.

As discussed in Section III, theory suggests that debt stocks and interest rates should be simultaneously determined. The results discussed so far do not, however, take account of this possible bias. Table 7 presents our attempts to account for this simultaneity. The pooled regression of the abbreviated model (from column (2) of Table 4) is reproduced in column (1) for comparison. The second column gives OLS estimates of the fixed effects version of the abbreviated model, which are unbiased in the case where mean levels of debt are interest sensitive, but deviations from the mean are not. The third column gives a two-stage, least squares estimate of the fixed effects model, where lagged values of debt, debt squared, and the unemployment rate are used as instruments.

The results in Table 7 indicate that simultaneity is important, which is what we would expect for interest-sensitive state borrowers. Notice that in the second column, the squared debt term is still insignificant, but the point estimate is no longer negative. Given the small size of the squared term in the first two columns of Table 7, however, the quantitative effects of increases in debt on yields are very similar. The first "F" test reported at the bottom of Table 7 shows that the introduction of 34 extra coefficients in the fixed effects model does significantly lower the

Table 6. OLS Estimates of the Abbreviated Model for Single Years

	1982	1987	1990
Debt	17.12 (2.65)	3.49 (0.59)	-3.45 (1.84)
$Debt^2$	-1.63 (1.63)	0.06 (0.05)	1.40 (5.31)
Trend debt growth	0.88 (1.87)	0.32 (1.22)	0.16 (1.21)
Debt limits	-3.83 (3.59)	-1.58 (2.39)	-2.23 (6.72)
Ratings residual	0.95 (9.98)	1.03 (10.13)	0.96 (14.95)
Standard error of estimate	16.96	10.85	5.26
$\bar{R}^2$	.791	.762	.930
Number of observations	37	37	37

The variables are as described in Table 3.

standard error of the regression over the pooled model of column (1). 1/ This result suggests that we must interpret the coefficients on debt limitations and trend debt growth in the pooled sample with care. The significance of these variables in the first column indicates that these variables capture significant information about the cross-state variation in default risk. The rejection of the pooled model in favor of the fixed-effects model, however, indicates (not surprisingly) that there are other cross-state factors that are also relevant. To the extent that debt limitations and trend debt growth are correlated with omitted cross-state factors, the causal effect of these two variables on promised yields may be overstated in column (1).

In the third column of Table 7, we employ a two-stage, least squares estimation to account for possible simultaneity between deviations from state mean debt levels and deviations from state mean yields; again, there are significant changes in our estimates. In this case, the squared debt term reverts to negative, but there is a substantial increase in the size of the positive coefficient on debt. The two-stage, least squares estimates of the fixed effects model imply that during 1982, a 1 percentage point increase in relative debt above its mean value (of 2.2 percent) would lead to an increase in <u>over</u> 12 basis points in the promised yield on that state's debt (as opposed to the 8 basis points implied by the OLS estimates in column (1)). Even in 1986 when the slope dummy for debt again takes on its largest negative value, a one percentage point increase in the relative debt would increase the promised yield by almost 7 basis points. Thus, while our attempts to deal with simultaneity have not resolved the anomaly of negative signs on the squared debt terms, they do point to a much larger effects of increases in debt on promised yields.

V. Concluding Remarks

In the ongoing debate on the need for constraints on national fiscal policies in a monetary union, it is perhaps not surprising that <u>both</u> sides have claimed the U.S. experience as supporting their position. Proponents of binding fiscal rules are able, for example, to point to the existence of states' own voluntary constitutional limitations on borrowing as demonstrating their usefulness, as well as to alleged lags, overreactions, and inconsistencies in yield spreads across states as arguing against heavy reliance on market forces. Likewise, opponents of fiscal rules can highlight the joint absence of (postwar) defaults by state governments and of federally-imposed fiscal rules; they also regard the observed differences in market yields across states with different fiscal stances as illustrating the sufficiency of "market-based" discipline. Suffice to say that without some empirical evidence on the link between state fiscal policy and state

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1/ The dependent variables for the regressions in columns (1) and (2) are the yields and deviations from state mean yields, respectively. The latter variable has a smaller variance, which accounts for the lower R^2 reported in column (2) in addition to the lower standard error.

Table 7. Accounting for Simultaneity in the Abbreviated Model

	Pooled OLS (1)	Fixed Effects OLS (2)	Fixed Effects 2SLS (3)
Debt	9.98 (4.92)	8.53 (2.44)	19.7 (3.68)
$Debt^2$	-0.40 (1.55)	0.11 (0.24)	-1.54 (1.76)
Trend debt growth	0.35 (3.47)	--	--
Debt limits	-2.01 (8.18)	--	--
Ratings residual	0.99 (26.7)	0.99 (24.3)	1.02 (22.5)
Std. error of est.	11.94	8.42	8.61
$\bar{R}2$	0.74	0.68	0.67
Number of obs.	333	333	333

Tests of restrictions:

Test of col. (2) over col. (1):	F(34,277) = 8.11
Test of fixed effects in col. (2):	F(36,277) = 6.88
Test of time dummies in col. (2):	F(16,277) = 4.61
Test of fixed effects and time dummies in col. (2):	F(52,277) = 6.30

Sample Period 1982-1990; "t" statistics in parentheses. The regression in column (1) contained a constant term, and each regression also contained year dummies for 1983-1990,—and slope dummies for the debt variable for 1983-1990. Thus the coefficients on debt and the deficit refer to the 1982 coefficients for these variables. The variables are as described in Table 3.

borrowing costs--while holding other factors constant--it is difficult to choose between these competing claims.

In this paper, we have used survey data on yield spreads for general obligation municipal bonds to get a first fix on the empirical regularities involved. On the whole, we see our empirical results as lending qualified support to the "first half" of the market-discipline hypothesis. Specifically, we do find evidence that U.S. states which have followed "more prudent" fiscal policies are perceived by market participants as having lower default risk and therefore are able to reap the benefit of lower borrowing costs. In this context, "more prudent" fiscal policies encompass not only a lower stock and trend rate of growth of debt relative to income, but also relatively stringent (albeit voluntarily imposed) constitutional limitations on the state's borrowing authority. In this latter connection, however, it remains to be shown whether a fiscal policy rule imposed by a higher level of government would carry the same credibility with the market as one initiated voluntarily by the lower-level borrowing authority itself.

On the basis of our point estimates from the abbreviated model in Table 4, we calculate that a (hypothetical) state which has fiscal-policy characteristics that are one standard deviation "looser" than the mean of our sample would pay roughly 15-20 basis points more on its general obligation bonds than another (hypothetical) state with fiscal policy characteristics one standard deviation "tighter" than our sample mean. 1/ This is in the same ballpark as Capeci's (1990) estimate (for local municipalities in New Jersey) that a one standard-deviation loosening of fiscal policy is associated with an increase in borrowing costs of 22 basis points. In evaluating the size of our fiscal-policy-related default premium, one should keep in mind at least four points. First, there have been no defaults on general obligation bonds in the postwar period--a factor that suggests a low probability of default. Second, even if a default did occur, the consequences for borrowers may be much larger than those for creditors. Third, if a state pays say, a 6 percent promised yield on its general obligation bonds, a default premium of say, 20 basis points represents an increase of 3 percent in its nominal cost of borrowing--not necessarily a trivial additional expense. And, as a fraction of its real borrowing costs, the 20 basis point increase would be substantially higher. Fourth, it is possible to conceive of (non-market) mechanisms that would magnify the market signal in yield spreads to increase the incentive to discipline errant fiscal policy. But this takes us beyond the scope of this paper and toward the "second half" of the market-discipline hypothesis, namely, the proposition that authorities faced with increased borrowing costs will rein-in their errant fiscal policy behavior.

1/ The fiscal-policy characteristics included in this calculation are debt, debt, the trend of the debt to income ratio, and the constitutional debt limitation index.

To illustrate the possibility of a backward bending supply curve in the simplest context, assume no risk premia and that the probability, P, of no default is:

$$P = P(Z), \tag{A.1}$$

where $Z = B(1 + R)$; $P(0) = 1$; $P'(0) = 0$; $P' \geq 0$; and P is zero for some large, but finite value of Z.

In this case, equation (2) in the text holds for all risky state borrowers, and the variation in interest rates on risky debt can be determined by totally differentiating (2) by B, and R (using (A.1)):

$$(1 + R)P'[dB(1 + R) + BdR] + dRP = 0, \tag{A.2}$$

which upon rearranging yields:

$$dR/dB = -(1 + R)^2P'/[P + (1 + R)P'B]. \tag{A.3}$$

While the exact, detailed relationship between borrowing and the promised rate depends on higher order derivatives, two key result follows from (A.3): first, the denominator in (A.3) is initially positive, since $P(0) = 1$ when $B = 0$; second, since P becomes zero for some finite Z, the denominator eventually is nonpositive. The convexity of the supply curve in Figure 1, however, does not follow from (A.3) but depends in a complicated way on the second derivative of P.

To illustrate the qualitative nature of the complication of existing debt, consider the case where borrowers have issued some long-term bonds, B, at the rate $\bar{R}$, and only the current (positive valued) deficit, D, is issued at the current rate R. In this case, the end-of-period financial obligations of the borrower are given by:

$$Z = B(1 + \bar{R}) + D(1 + R), \tag{A.4}$$

for $D \geq 0$.

In this case, the analogues to (A.3) are given by:

$$dR/dB = -(1 + R)(1 + \bar{R})P'/[P + (1 + R)P'D]; \tag{A.5}$$

$$dR/dD = -(1 + R)^2P'/[P + (1 + R)P'D].$$

Consequently, the effect of higher debt on the yield differs from the effect of a higher positively valued deficit only to the extent that the current interest rate differs from past interest rates.

While the signs of the second derivatives still depend on P", one interesting result does follow from (A.5):

$$d^2R/dB^2 = -\{(1 + \bar{R})P'/[P + (1 + R)P'D]\}dR/dB$$

$$+ \text{ other terms proportional to } dR/dB; \qquad (A.6)$$

$$d^2R/dD^2 = -\ 2\{(1 + \bar{R})P'/[P + (1 + R)P'D]\}dR/dD$$

$$+ \text{ same other terms but proportional to } dR/dD.$$

The first-terms on the right-hand sides of (A.6) are both positive and the first term for d^2R/dD^2 is larger, as long as $2(1 + R) > (1 + \bar{R})^2$. The remaining terms will be nearly equal as long as R is nearly equal to $\bar{R}$. All this analysis suggests that $d^2R/dD^2 > d^2R/dB^2$.

Bibliography

Bishop, Graham, Dirk Damrau, and Michelle Miller, "1992 and Beyond: Market Discipline CAN Work in the EC Monetary Union," Salomon Brothers (London: November 1989).

Capeci, John, "Local Fiscal Policies, Default Risk and Municipal Borrowing Costs," Brandeis University, Department of Economics, No.259 (1990).

Cohen, Natalie R., "Municipal Default Patterns," Enhance Reinsurance Co. (1988).

Davidson, R.B., "Municipal Market Analysis: A Framework for Analyzing Quality Spreads," J.P. Morgan (March 29, 1990).

Delors' Report, Report on Economic and Monetary Union in the European Community, Committee for the Study of Economic and Monetary Union (June 1989).

Eaton, Jonathan, and Mark Gersovitz, "Debt with Potential Repudiation: A Theoretical and Empirical Analysis," Review of Economic Studies, 49 (April 1981), pp. 289-309.

EC Commission, "Economic and Monetary Union: The Economic Rationale and Design of the System" (March 1990).

EC Commission, "One Market, One Money--An Evaluation of the Potential Benefits and Costs of Forming an Economic and Monetary Union" (October 1990).

Eichengreen, Barry, "One Money for Europe? Lessons from the US Currency Union," Economic Policy (April 1990), pp. 119-86.

Frankel, Jeffrey, "Obstacles to Coordination, and a Consideration of Two Proposals to Overcome Them," in William Branson, Jacob A. Frenkel, and Morris Goldstein (eds.), International Policy Coordination and Exchange Rate Fluctuations (University of Chicago Press for the National Bureau of Economic Research, Chicago: 1990), pp. 109-145.

Frenkel, Jacob A. and Morris Goldstein, "Monetary Policy in an Emerging European Economic and Monetary Union," IMF Staff Papers (June 1991), pp. 356-398.

Hsiao, Cheng, Analysis of Panel Data (Cambridge University Press: Cambridge, 1986).

Lamafalussy, Alexandre, "Macro-coordination of Fiscal Policies in an Economic and Monetary Union in Europe," Supplement to Delors' Report (1989).

Liu, Pu and Anjan Thakor, "Interest Yields, Credit Ratings, and Economic Characteristics of State Bonds: An Empirical Analysis," Journal of Money, Credit and Banking, Vol. 16, No.3 (August 1984), pp. 345-50.

Metcalf, Gilbert, "Federal Taxation and the Supply of State Debt," National Bureau of Economic Research Working Paper No. 3255 (1990).

Mussa, Michael, "Monetary and Fiscal Policy in an Economically Unified Europe," paper presented at Cargenie-Rochester Conference on Public Policy, Revised, January 1991.

Orth, John V., The Judicial Power of the United States: The Eleventh Amendment in American History (New York: Oxford, 1987).

Poterba, James, "Tax Reform and the Market for Tax Exempt Debt," National Bureau of Economic Research Working Paper No. 2900 (1989).

Swartz, Thomas, "State General Obligation Trading Values--Back to the Future," Municipal Analysts Forum (August 1989), pp. 7-10.

Stiglitz, Joseph and Weiss, Andrew, "Credit Rationing in Markets with Imperfect Information," American Economic Review, Vol. 73, No. 3 (June 1981), pp. 393-410.

United States Census, State Government Finances in 1989, Washington: Department of Commerce (1990).

Yawitz, Jess, Kevin Maloney, and Louis Edderington, "Texas, Default Risk, and Yield Spreads," Journal of Finance, Vol. XL, No. 4 (September 1985), pp. 1127-40.