times ahead in the long run. As a reflection of this pattern, for U.S. quarterly data from 1957 to 1994, the contemporaneous correlation of a measure of unexpected inflation with the real return on the stock market is negative and surprisingly large in magnitude, -0.4.\textsuperscript{12} In contrast, the short-term relation between the inflation rate and real GDP tends to be positive; that is, inflation is mildly procyclical.\textsuperscript{13}

An additional feature of inflation is its positive correlation with wartime spending, especially for such large conflicts as World Wars I and II and the Napoleonic Wars (see Barro [1987]). However, for the moderate fluctuations of government spending that show up in the U.S. data since World War II, there is no significant relation between innovations to inflation and movements in government expenditure.

In the model set out at the outset, where \(G\)-contingent and indexed debt instruments were available, the issue of nominal public debt would be a mistake. The resulting fluctuations in financing costs, because of unanticipated inflation and unanticipated changes in the future prices of nominal debt, would create

\textsuperscript{12}The series on expected inflation is an updated version of the one constructed in Barro (1992). These values come from an ARMA process with deterministic seasonals for CPI inflation, with the estimated coefficients updated each quarter to use only lagged data. The inflation rate is computed from monthly, seasonally unadjusted values of the CPI for January, April, July, and October. Real stock returns are the growth rate of the S&P 500 index less CPI inflation plus the S&P 500 dividend yield.

\textsuperscript{13}The departure of the price level from its trend tends, however, to be countercyclical. See Kydland and Prescott (1990) and Barro and Grilli (1994, pp. 14, 15).
unnecessary variations in taxes and thereby generate some departure from perfect tax smoothing in the sense of the objective in equation (1).

If indexed bonds are unavailable and the government is therefore forced to issue nominal bonds, then the maturity of the nominal debt could be designed to hold down fluctuations in taxes. Since innovations to inflation tend to persist, the prices of long-term nominal bonds would be more volatile than those of short-term bonds. Therefore, the greater the volatility and persistence of inflation, the more the government would shift toward short-term issues to minimize the effect of unanticipated inflation on financing costs.

For example, in the United States, the average maturity of the public debt (weighted by nominal amounts of principal outstanding) fell from around nine years in 1946 to less than three years in 1976, then returned to five-to-six years at recent times. It seems reasonable that these changes were caused by shifts in the variance of inflation, which was low from the mid 1950s to the early 1970s, high from then to the mid 1980s, and reduced again in recent years. Although a shortened maturity of the public debt is a sensible response to more volatile inflation—given that the debt takes a nominal form—this shift also makes the government’s refunding costs more sensitive to movements in real interest rates. The whole point of the use of indexed consols in the original model was to leave the government’s financing expenses—and, hence, its path of real taxes—invariant

with changes in riskless real interest rates. This insulation is lost by a reliance on short-term nominal (or real) debt.\textsuperscript{15}

Bohn (1988, 1990) and Calvo and Guidotti (1990) argue that nominal debt may be a desirable form of funding because of the covariance of inflation with other variables, such as the $G_t$ in the present model. The usual idea is that high $G_t$ tends to go along with high inflation. This pattern reflects partly the positive correlation between inflation and government spending (especially apparent for large wars) and partly the negative correlation between inflation and long-run economic activity (and, hence, the tax base). Since nominal bonds pay off badly in real terms when inflation is surprisingly high, this kind of debt has some of the characteristics of the $G$-contingent debt that was considered before. As an example, the presence of nominal bonds allows the government to effect partial default via inflation during wartime.

The covariance between inflation and $G_t$ would be of no advantage and would provide no case for nominal public debt issue if $G$-contingent debt were already available and exploited. However, if this type of debt were precluded, then it might seem worthwhile to issue nominal bonds. The gain from the negative \textsuperscript{15}The significance of this lost insulation depends on the volatility of riskless real interest rates. From an empirical standpoint, the extent of this volatility can be gauged from the U.K. experience with indexed government bonds. From 1982 to 1995, the 2-year-ahead real forward rate (for the subsequent 6 months) ranged from around 2\% to 5-1/2\%, whereas the rate 20 years ahead varied from about 2-1/2\% to 4-1/2\%.
covariance of the real returns on these bonds with $G_t$ might outweigh the costs from independent variation in inflation—which would generate volatility in the real returns on nominal debt and thereby adversely impact the stability of real taxes.

The problem with this line of argument is the same as the one that arose in the previous discussion of the maturity structure of indexed bonds. If the reason for the exclusion of $G$-contingent debt is the moral-hazard problem, then this same problem arises for indirectly $G$-contingent debt. In the previous section, therefore, it did not seem desirable to skew the maturity structure of indexed bonds to create a negative covariance between $G_t$ and the government’s financing costs. Similarly, it seems inadvisable to use nominal debt as another way to generate a negative covariance between $G_t$ and financing costs. Nominal debt seems always to be inferior to explicitly $G$-contingent debt because it entails the same moral hazard but also introduces unnecessary randomness in real financing costs and, hence, in real taxes.

One way to generate a role for nominal government bonds is to assume that the government is already involved with nominal obligations in some other way. For example, the government has nominal monetary obligations outstanding. Surprise increases in inflation (likely engineered by the monetary authority) benefit the government’s budget by depreciating the outstanding real cash balances and perhaps by signaling a higher prospective flow of seignorage income. But then the
government would have to hold nominal assets—not debts—to offset this effect and thereby insulate the overall budget situation from surprise inflation.\textsuperscript{16}

Similarly, if the indexing of government bonds involves a lag in the formula—that is, if the adjustments of nominal coupons and principal are based on lagged inflation—then the government effectively already has some nominal debt outstanding. The way to offset this exposure of real obligations to inflation would be for the government to hold some other nominal assets.

A rationale for a positive quantity of nominal government bonds along these lines would require the government to have other outstanding claims that suffer in real value when inflation is surprisingly high. Under some circumstances, the tax system can have this feature, especially if liabilities are specified in nominal terms and taxpayers have opportunities for delaying payment to the government. Then the nominal public debt could be an instrument that keeps the government’s budget constraint invariant overall with shocks to inflation. In this case, however, the previous analysis of indexed and $G$-contingent debt would be fully separable from the behavior of inflation and nominal debt. In particular, the consol form of indexed financing would still be desirable.

\textsuperscript{16}Persson, Persson, and Svensson (1987) argue that the insulation of the government’s budget constraint from surprise inflation can also be desirable on time-consistency grounds, that is, to deter the government from engineering surprise changes in inflation.
4 Concluding observations

This analysis has analyzed public-debt management from an optimal-tax perspective. This approach seems inevitably to favor indexed bonds that have long, consol-like durations. Possibly one could explain the observed tendency for indexed debt to be shorter term than consols by allowing for the potential of government default.

The analysis suggests little role for nominal government bonds, except perhaps as devices to offset other kinds of nominal exposure that the government possesses. Possibly one can go further here by introducing commitment problems into the optimal-tax problem, but it is hard to see how these considerations will favor the use of nominal public debt.

One possible reaction to these results is that the case for nominal government bonds must rely not on orthodox public-finance considerations but rather on short-run macroeconomics, which is often thought to have something to do with sticky prices. This is reassuring—to understand the desirable role for nominal government bonds one has only to understand macroeconomics and business fluctuations. These are things that I have always wanted to understand in any case.
References


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