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# *The Simple Analytics of Assets' Values and Infrequent Policy Changes*

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# The Simple Analytics of Assets' Values and Infrequent Policy Changes

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**Abstract:** This paper studies the effects on financial markets of an anticipated fiscal stabilization policy in a stochastic environment. Stabilization is defined as a discrete change in the budget process which is implemented when government consumption reaches some threshold level, known by economic agents. Our analysis integrates the study of financial markets within the framework adopted by Bertola and Drazen (1993) to explain the effects on private consumption of an anticipated fiscal retrenchment, such as the fiscal reform implemented in Denmark in 1983. The actual behavior of danish financial markets points in the direction of two interesting features of the policy change. First, in a model of intertemporal consumption smoothing, one can replicate the observed boom in the stock market only with expectations of an *increase* in net income to stock-holders. The term-structure evidence, on the other hand, is consistent with less than full *credibility* of the retrenchment, that is with investors attaching some probability to a further *expansion* of the government sector.

**Keywords:** fiscal retrenchments, government spending, policy regime, stock prices, term structure of interest rates, trigger point. **JEL #** E62, E63, E65, G12.

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# 1 Introduction

Tough plans of fiscal stabilization induce two opposite reactions at both the political and scientific level. Some fear the contractionary effect on economic activity of a sudden drop in government purchase and consumer demand; some others praise fiscal discipline for improving consumer confidence and business climate, through a change in the regime of expectations. The debate on the inclusion of fiscal rules in the Treaty of Maastricht, defining quantitative limits to government debt and deficit as requisites to join the European Monetary Union, has been no exception. For many European-Community countries, a mechanical application of the rules in the Treaty would entail massive cuts in spending, as well as increases in taxation. Would then the transition to a monetary union suffer from a contractionary bias? In the late eighties this question strongly revived economists' interest in studying what could prevent a fiscal retrenchment from having negative consequences on employment. The episodes of the danish debt stabilization of 1983, as well as the successful plan implemented in Ireland, in 1987, carefully discussed by Giavazzi and Pagano (1990) among others, soon became a standard reference.

Consider, for example, the case of Denmark. Between 1980 and 1982, public debt increased from 29% to 65% of GDP. In the fall of 1982 the government started a plan of severe fiscal austerity, which led to a 10% reduction of the full-employment-primary-deficit-to-GDP ratio by 1986. Over such a time span, the public-consumption-to-GDP ratio fell from 28% to 25%. The government plan also included wage-income policies and a strong commitment not to resort to exchange-rate depreciation to accommodate inflation.

The fiscal retrenchment was met by a sustained expansion in economic activity—a non-Keynesian effect that suggests a *reverse* crowding-out: as the government size shrank, resources were freed for an expansion of the private sector. Bertola and Drazen (1993) argue that the expansionary effect was felt even before the switch in policy, as rational consumers increased their current consumption in the anticipation of higher disposable income in the future. Their prediction is consistent with the experience of both Denmark and Ireland, where the inverse relation between private and public consumption flattened out as the ratio of government spending to GDP increased.

If expectations of a future fiscal retrenchment are so widespread, as to be reflected by the behavior of aggregate consumption, financial markets should give us some clear signal about the attitudes toward the future of forward-looking investors.

Thus, the goal of our paper is to explore financial-markets behavior within a framework of analysis similar to that of Bertola and Drazen (1993), looking for price patterns theoretically consistent with an anticipated change in the fiscal regime. While Bertola and Drazen (1993) focus on the dynamics of public and private consumption in a small open economy, assuming a constant world-wide real rate of interest, we concentrate on the closed-economy case. Although this assumption is not realistic for a country like Denmark, our main results are a first approximation to the study of financial-market behavior which cannot be investigated within the equally unsatisfactory paradigm of a small open economy. Namely, the small-open-economy hypothesis implies exogenously-given discount factors, and domestic developments (such as a fiscal retrenchment) may affect asset prices *only* through their effects on the distribution of future cash flows.

If we only consider the dynamics of public and private consumption, the implications for financial markets of an anticipated fiscal retrenchment are easy to draw: as the ratio of government spending to GDP increases, the fiscal retrenchment becomes more likely and investors should save less in anticipation of resources being freed for the private sector. The reduction in savings should reduce stock prices and push (real) interest rates on all maturities up. The effects on short-term interest rates just before the fiscal retrenchment should however be the strongest: both short- and long-term rates increase because of the imminent increase in private consumption, but long-term rates average the change over a longer period of time than short-term rates. In short, changes in discount rates should bring about a fall in the stock market, and a flatter (possibly, an inverted) of the term structure as we approach the time of the policy change.

It is interesting to note that the data for Denmark display an opposite pattern in the years preceding the fiscal retrenchment. Figure 1 plots the ratio between the danish stock-market index (industrials) and nominal GDP against the share of GDP consumed by the public sector.

The standardization of stock prices by GDP is an attempt in the direction of comparing the data with the implications of our model, which abstracts from the effects of business cycles and economic growth on stock prices. This index is further normalized to 100 in 1982, the year preceding the policy change. The figure shows how the index fell until 1980, but *increased* before the fiscal contraction was implemented in 1983.

The next figure plots the difference between the yield to maturity on five-year government bonds and the three-month average interbank rate against the share of GDP consumed by the public sector. This measure of the slope of the nominal term structure *increases* before 1983, while it decreases after the retrenchment is implemented. Moreover, the *real* term structure should have displayed a similar, if more pronounced, pattern. The following Table presents the inflation rate for the 1977–1986 period, based both on the Consumer Price Index and the GDP deflator, and the previous-year forecasts produced by the OECD. The Table indicates that the inflationary process consistently slowed down between 1979 and 1986, and such slowdown was not hard to forecast, at least from one year to the other (if anything, the OECD forecasts are biased towards lower inflation rates than those realized). If the market entertained roughly correct inflationary expectations at various horizons, then, before the fiscal retrenchment, the real term structure was even steeper than the nominal one.

Since anticipated changes in discount rates would lead to a *fall* in stock prices in anticipation of a fiscal contraction, we must argue that stock prices increased because of expectations of future net dividends under the new fiscal regime. In turn, this might be due to anticipated cuts of the relevant tax rates, to lower restrictions on capital inflows and outflows,

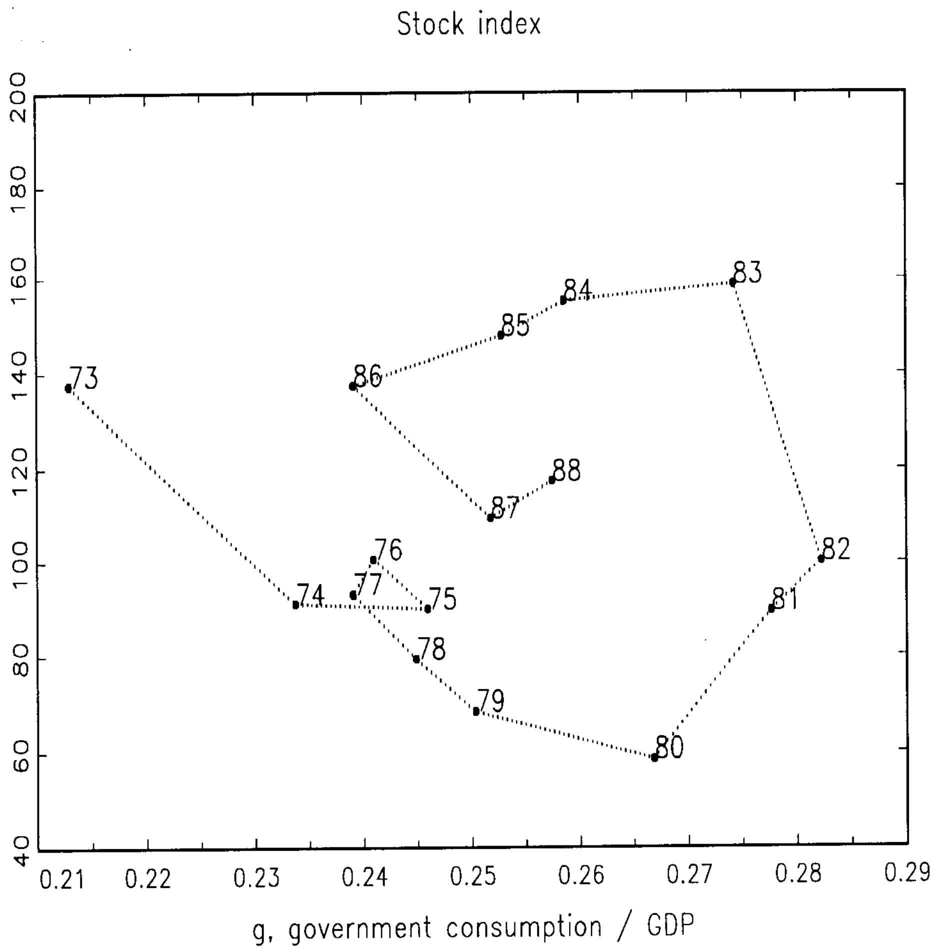



**Figure 1**

Figure 1 plots the ratio between the stock-market index (industrials) and GDP against the government-consumption-to-GDP ratio in Denmark, for the 1972–1990 period, yearly data. We set the ratio equal to 100 in 1982, the year before the retrenchment. (Source: IMF, International Financial Statistics.)

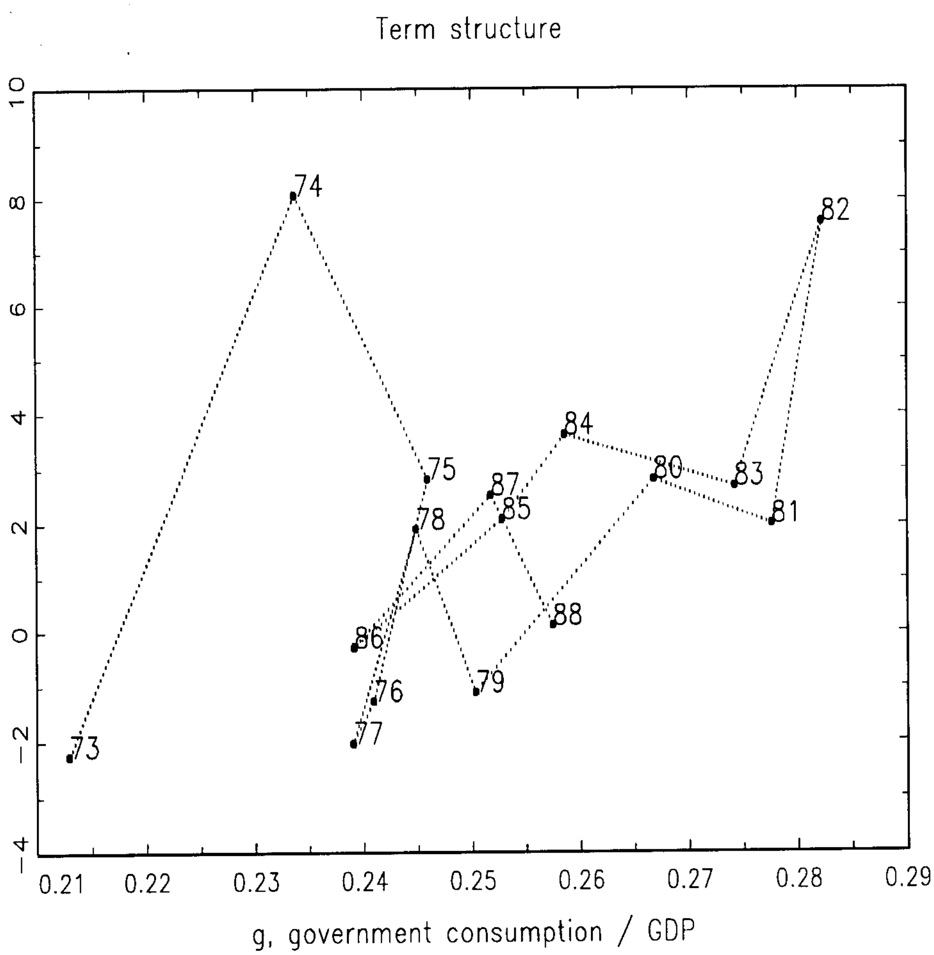



**Figure 2**

Figure 2 plots the difference between the yield to maturity on five-year government bonds and the three-month average interbank rate (both measured in percentage points) against the public-consumption-to-GDP ratio in Denmark, for the 1972–1990 period, yearly data. (Source: IMF, International Financial Statistics.)

**Table**

Annual forecasted and realized inflation rates from 1977 to 1986, based on the Consumer Price Index (CPI) and the GDP deflator. Both forecasted and realized inflation rates are from the OECD Economic Outlook, several issues; details on the calculation of forecasts can be found in the Technical Annex of the same publication.

| Year | CPI (forecast) | CPI (actual) | GDP deflator (forecast) | GDP deflator (actual) |
|---|---|---|---|---|
| 1977 | 9 | 11 | 7.5 | 9.5 |
| 1978 | 11.5 | 9.75 | 10 | 8.5 |
| 1979 | 5.75 | 9.75 | 6 | 9 |
| 1980 | 12 | 13 | 10 | 9 |
| 1981 | 9.25 | 10.5 | 8.25 | 8.75 |
| 1982 | 8.5 | 9 | 9.5 | 10.5 |
| 1983 | 7 | 6.75 | 6.25 | 6.25 |
| 1984 | 5.33 | 6.25 | 5 | 6 |
| 1985 | 4.5 | 4.25 | 4.5 | 4.5 |
| 1986 | 2.5 | 3.5 | 2.5 | 4 |

or to supply-side effects leading to a genuine increase in capital productivity [Giavazzi and Pagano (1990)].

Unlike the stock market, expectations of higher cash flows after the reform cannot explain the observed term structure of interest rates. However, a positively sloped term structure is consistent with a fiscal retrenchment which is not fully credible. If the outcome of the fiscal plan is uncertain, and a further increase in government consumption at the expense of private consumption is also possible, short-term real rates may fall below long-term ones in the proximity of the fiscal retrenchment.

The paper is structured as follows: After introducing the general framework of analysis in Section 2, Section 3 draws the implications of alternative policy-change scenarios. Section 4 concludes.

# 2 Asset values and infrequent policy changes

In this section we extend the analysis of Balduzzi, Bertola, and Foresi (1993) to model the reaction of financial markets to infrequent policy-regime changes of the kind considered, for example, in Drazen and Helpman (1990) and Bertola and Drazen (1993).

## 2.1 The economy

The structure of the economy is as follows.

*Assumption 1.* The economy is populated by identical infinitely-lived investors who maximize their utility from consumption and have rational expectations about the dynamics of future cash flows and the structure of possible fiscal-policy changes.

*Assumption 2.* Investors can hold stocks, which entitle their owner to a constant flow of dividends, normalized to one, and default-free bonds used by the government to finance budget deficits. We abstract from issues of physical investment and economic growth, and assume that no storage technology is available: portfolio cash flows can only be consumed or saved in the form of stocks and bonds.

Abstracting from capital accumulation and access to international capital markets prevents intertemporal consumption smoothing, and helps emphasize the effects on discount factors, and thus on the prices of financial assets, of changes in fiscal policy.

*Assumption 3.* The flow of per-capita government spending is denoted by $g$. Taxes can be levied on the dividend flow on stocks, and in lump-sum form; total per-capita tax payments are denoted by $\tau$. We assume there exists a critical discrete value of $g$ which may trigger a discrete change in the level and stochastic behavior of government spending and taxes.

Lump-sum taxes allow the government to issue default-free debt in the face of changes in taxes on dividends and government spending: the government's intertemporal budget constraint is assumed to hold at every point in time, and the market value of government debt equals that of all future budget surpluses.

In our framework, as in Bertola and Drazen (1993), a fiscal stabilization is defined as an infrequent change in the fiscal-policy regime, in the absence of which either the solvency constraint of the public sector or the resource constraint for the economy would be violated.

Since our main interest lies in the effects of fiscal-policy changes on asset prices, we abstract from issues of business cycle and growth, and take the state of the economy at any point in time to be summarized by $g$. Of course the state of the economy depends also on a vector of policy variables describing the relevant information on current and future fiscal policy. This includes, for example, the anticipated tax rate on dividends and the expected growth of government spending, if a policy change occurs.

*Investors' Optimization Problem.* Let $c$ denote the consumption flow, while $u(c)$ is an increasing and concave utility function, $\rho$ is the rate of time preference. Investors solve the standard optimization problem

$$\max \int_t^\infty Eu(c(z))e^{-\rho z}dz,$$

subject to an equally standard intertemporal budget constraint.

Assuming an interior optimum, the following first-order condition links the price of any asset $A$ to its cash flow $F$, and the investor's consumption $c$:

$$\rho u'(c)A = u'(c)F + \frac{1}{dt}Ed(u'(c)A). \tag{1}$$

After adjusting prices and cash flows by the marginal utility of consumption, all assets should yield the same expected rate of return, $\rho$.

*Equilibrium.* As we have assumed away storage or physical investment, in equilibrium investors consume the output net of government consumption: $c = 1 - g$.

## 2.2 Asset prices

Consider next the equilibrium-supporting prices. It is useful to define the *risk-adjusted* security prices $a$ and cash flows $f$,

$$a \equiv u'(1-g)A, \qquad f \equiv u'(1-g)F,$$

and rewrite (1) as:

$$\rho a = f + \frac{1}{dt}Eda. \tag{2}$$

The differential equation (2) must be satisfied at all points in the economy's state space, regardless of the likelihood of a policy change. Given (2), $Eda$ cannot be of order larger than $dt$, and this rules out expected jumps in risk-adjusted price paths. It follows that

$$E\Delta a = 0, \tag{3}$$

also at policy-change times.

We integrate (2) and impose the transversality condition $\lim_{z\to\infty} Eae^{-\rho(z-t)} = 0$, to obtain the familiar relation

$$a = \int_t^\infty Ef(z)e^{-\rho(z-t)}dz$$

which states that market-clearing prices ($A = a/u'$) are the expected value of cash flows, discounted at the marginal rate of substitution of current consumption for consumption at time $z$.

It is useful for the solution of the asset-pricing problem to decompose risk-adjusted prices in the form

$$a = p + h, \tag{4}$$

where $p$ is defined as

$$p = \int_t^\infty E\{f(z)|\text{no policy change}\}e^{-\rho(z-t)}dz. \tag{5}$$

By (4) and (5), we have

$$h = a - p = \int_t^\infty \left(Ef(z) - E\{f(z)|\text{no policy change}\}\right)e^{-\rho(z-t)}dz.$$

If the policy regime were given and immutable, $p$ would be the asset's value; the $h$ component is due to anticipated policy changes which affect the asset's price through anticipated changes in discount rates or cash flows following a policy-regime switch.

The effect of an expected policy change is simple to predict. Assume, for example, that the policy change is expected to induce an increase in private consumption. In this case rational consumers would be less willing to save, and the price of all assets should *fall* relative to the no-policy-change case before the policy change. Conversely, asset prices should *increase* if the policy change were to affect positively after-tax cash flows.

# 3 Alternative policy-change scenarios

In this section we trace the effects on asset prices of an anticipated fiscal retrenchment. With the aim of disentangling the specific impact of each elementary component of a fiscal reform, we allow for three different policy scenarios: a cut in spending, a cut in spending together with a reduction in capital-income taxes, and uncertainty as to the nature of the policy-regime change. The purpose of these exercises is to identify general patterns of price behavior which may help us interpret the empirical evidence produced in the introduction to this paper.

We specialize our analytical framework as follows.

*Assumption 4.* We further assume that the investor's instantaneous utility function is quadratic,

$$u(c) = \alpha c - \frac{1}{2}\beta c^2,$$

and that the flow of per-capita government spending can be described by a random walk with drift,

$$dg = \theta dt + \sigma dw,$$

with $\theta$ and $\sigma$ positive constants.

These hypotheses follow closely those in Bertola and Drazen (1993), with the exception of the small-country assumption. If investors can freely buy and sell foreign assets, consumption follows a random walk and the expected marginal rates of substitution, and hence interest rates, are unaffected by possible changes in fiscal policy. This same result would hold if rather than an open economy we had one with capital accumulation, and a constant-returns-to-scale production technology.

Using Assumption 4, we can now expand $Eda$ in (2) by the usual stochastic calculus arguments: in the interior of no-policy-change regions $a$ should satisfy the valuation equation

$$\rho a = f + \theta a_g + \frac{\sigma^2}{2} a_{gg} + a_t. \tag{6}$$

Thus, risk-adjusted prices satisfy the partial differential equation (6), and the boundary condition (3) at times of policy changes.

## Stocks

As stocks are infinitely-lived assets, stock prices do not depend on time and the partial differential equation (6) reduces to an ordinary differential equation in $g$.

If we write the solution for the stock price as the sum of two components, $a^s = p^s + h^s$, the first component, $p^s$, is the particular solution of (6) corresponding to the case in which there is no fiscal-policy change. Since net dividends are $1 - \tau_0$ and consumption equals $c = 1 - g$, the risk-adjusted cash flow on stocks is

$$f^s = (\alpha - \beta)(1 - \tau_0) + \beta(1 - \tau_0)g.$$

We can verify that

$$p^s = \gamma_1 + \gamma_2 g$$

solves (6) for $\gamma_1 = (\alpha - \beta)(1 - \tau_0)/\rho + \theta\gamma_2/\rho \ (> 0)$ and $\gamma_2 = \beta(1 - \tau_0)/\rho \ (> 0)$.

The policy-change component $h^s$ can be interpreted as the homogeneous solution of (6) (that is $h^s$ satisfies $\rho h^s = \theta h^s_g + \sigma^2 h^s_{gg}/2$ ): this component is of the form

$$h^s = \delta_1 e^{\eta_1 g} + \delta_2 e^{\eta_2 g},$$

where $\eta_1$ and $\eta_2$ are the positive and negative roots of the associated quadratic equation $(1/2)\sigma^2\eta^2 + \theta\eta - \rho = 0$, respectively, and the constants of integration $\delta_1$ and $\delta_2$ depend at most on the parameters of fiscal policy.

### Discount bonds

The price of a discount bond maturing at time $t+m$ depends on the residual time to maturity, $m$, and we need to solve the partial differential equation

$$\rho a^b = \theta a_g^b + \frac{\sigma^2}{2} a_{gg}^b - a_m^b,$$

and two boundary conditions: The first is the condition that a discount bond is valued at face value at maturity ($m = 0$),

$$a^b(m = 0) = u'(c) = \alpha - \beta(1 - g).$$

The second is the no-jump condition (3) which prevents (risk-adjusted) arbitrage at the time of a policy change.

The particular solution corresponding to the case of no change in policy is

$$p^b(m) = e^{-\rho m}[\alpha - \beta + \beta(g + \theta m)].$$

The homogeneous part of the solution, $h^b$, depends on the specific nature of the policy change, to which we now turn.

## 3.1 A cut in government consumption

Consider first a simple reduction of government consumption:

*Assumption 5.* There is a critical value for $g$, $g_0$, which triggers a fiscal retrenchment: after $g_0$ is reached, government spending is cut and stays constant at a new *lower* level $g_1$ ($< g_0$). Taxes are levied upon dividends at the constant rate $\tau_0$ before and after retrenchment.

Since $g$ is regulated only at $g_0$, large negative values can be attained in finite time with finite probability: the transversality condition that $\lim_{g \to -\infty} h(g) = 0$ sets $\delta_2 = 0$ to avoid unbounded prices:[1] the solution is thus of the form

$$a^s = \gamma_1 + \gamma_2 g + \delta_1 e^{\eta_1 g}.$$

The component $h^s = \delta_1 e^{\eta_1 g}$ introduces a nonlinearity in the stock price, and thus predictable changes in the mean and variance of stock returns even if cash-flows changes are, by Assumption 4, *iid.*

[1]Introducing a lower positive boundary to $g$, so as to avoid negative values of public spending, would be straightforward. In this case $\delta_2 \neq 0$, and $\delta_1$ and $\delta_2$ would be determined simultaneously by two boundary conditions.

To determine $\delta_1$ note the following. After $g$ is regulated at $g_0$, there is no more uncertainty and the risk-adjusted stock price is $a^s(g_1) = (1-\tau_0)[\alpha - \beta(1-g_1)]/\rho$. To guarantee positive stock prices, we require $\alpha \geq \beta(1-g_1)$. Since the risk-adjusted stock price cannot jump at times of policy change, we have

$$(1-\tau_0)[\alpha - \beta(1-g_1)]/\rho = \gamma_1 + \gamma_2 g_0 + \delta_1 e^{\eta_1 g_0},$$

which allows us to solve for $\delta_1$.

A similar reasoning determines term-structure behavior. *After* a change in policy, $g = g_1$, and the risk-adjusted discount bond of maturity $m$ is simply $e^{-\rho m}[\alpha - \beta(1-g_1)]$. *Before* the policy change, the risk-adjusted value of the bond which satisfies the partial differential equation and the two boundary conditions is

$$a^b(m) = \mathcal{P} e^{-\rho m}[(\alpha - \beta) + \beta(g + \theta m)] + (1-\mathcal{P}) e^{-\rho m}(\alpha - \beta + \beta g_1), \tag{7}$$

where $\mathcal{P}$ is the probability that the maximum $g$ between $t$ and $t+m$ is below $g_0$. This is the probability of the one-sided first passage in time for a Brownian motion with drift,

$$\begin{aligned} \mathcal{P} &= \Pr[\sup\{g(s), t \leq s \leq t+m\} < g_0 \mid g(t)] \\ &= \Phi\left(\frac{g_0 - g(t) - \theta m}{\sigma m^{1/2}}\right) - e^{2\theta g_0/\sigma^2} \Phi\left(\frac{-g_0 + g(t) + \theta m}{\sigma m^{1/2}}\right) \end{aligned}$$

where $\Phi(z)$ denotes the cumulative normal distribution evaluated at $z$ [see, *e.g,* Harrison (1985) p.14].

The no-policy-change component of the solution is

$$p^b(m) = e^{-\rho m}[(\alpha - \beta) + \beta(g + \theta m)],$$

whereas the component

$$h^b(m) = (1-\mathcal{P})\left[e^{-\rho m}(\alpha - \beta + \beta g_1) - e^{-\rho m}((\alpha - \beta) + \beta(g + \theta m))\right]$$

reflects the expected capital gain or loss (in a risk-adjusted sense) which would occur at the time of a policy change.

Numerical simulations will give us further insights on the features of the model. In choosing parameter values, we resort to numerical magnitudes which seem to be roughly realistic. The two preference parameters $\alpha$ and $\beta$, for example, are chosen to yield a rate of relative risk aversion of 2.5, when $g = g_0$. The parameter of time discount is set at $\rho = .05$, which would lead to a real rate of interest of 5% per year, in the absence of uncertainty and consumption growth. The percentage share of GDP consumed by the public sector is assumed to grow by .2 percentage points on average every year, where the standard deviation of such increment is one percentage point per year. The retrenchment takes place when the share of GDP consumed by the public sector reaches 27% ($= g_0$). When the retrenchment is implemented, this share is set permanently at $g_1 = 25\%$. The degree of fiscal pressure $\tau_0$ is set at 40%.

Figure 3 shows the behavior of stock prices and the term structure spread. For sake of comparison between the implications of our model and the danish evidence on the term structure of Figure 2, we chose the maturities $m = 5$ and $m = .25$ years. Since the *effective* maturity (duration) of the five year-bond considered in Figure 2 is slightly below 5, because of coupon payments, we replicated our exercises here, and in the following sections, for values of $m$ between 4.5 and 5, with essentially the same results.

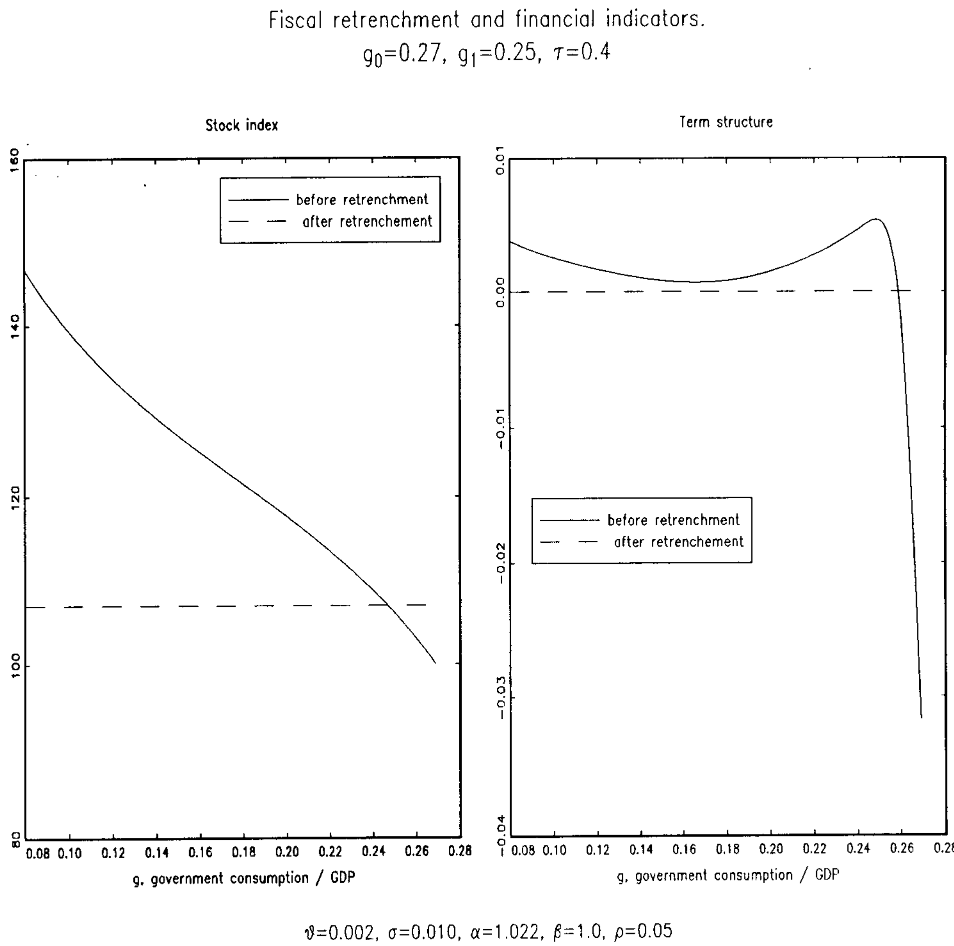
The nonlinear component $(\delta_1 e^{\eta_1 g_0})$ in the stock price is negative as long as there is an actual fiscal retrenchment $(g_1 < g_0)$. This component, which is induced by expectations of policy changes, reduces the stock price. As $g$ approaches $g_0$, the likelihood of an imminent higher income and consumption increases, and stock-holders try to liquidate part of the stocks in an attempt to boost current consumption. This information effect adds to the income effect due to the fall in current net dividends, and further depresses stock prices. At the time of the policy change stock prices jump upwards: following the retrenchment, the time profile of private consumption is flat, and investors have a renovated incentive to save and demand assets.

We now turn to the implications for the term structure. As the price of long-term bonds incorporates early on the possibility of an increase in consumption, their demand and price are depressed, while the yield to maturity is high. The short-term bond yield is also affected by anticipations of a retrenchment, but only in the very proximity of $g_0$. At that point the expected growth rate of consumption over the life of the instrument is very high, and short-term interest rates increase over and above long-term ones. Hence, the term structure becomes steeper with $g$ until we reach values close to $g_0$; then it flattens out, and becomes inverted in the neighborhood of $g_0$.

This first policy scenario does not seem to shed light on the evidence presented in Figure 1 and 2. The above results are quite general: in any life-cycle model of consumption the savings rate (and thus asset prices) should fall in anticipation of higher future consumption, and interest rates on short-term debt instruments should increase more than those on longer-term ones. It would nonetheless be unreasonable to think that changes in discount rates alone would be anticipated by people expecting a major episode of fiscal reform. We need to add other elements to our basic scenario.

## 3.2 Tax on dividends

In the following, we show that in order for the price of stocks to increase in anticipation of a policy change, the policy-change package should include measures that increase net cash flows on stocks. In our framework, we capture these effects by assuming that the tax rate on dividends is reduced at the time of a policy change.




## Figure 3

Figure 3 plots stock prices and the term structure spread against $g$, the public-consumption-to-GDP ratio for the simple fiscal-retrenchment scenario. The stock index is normalized to be 100 at the time of policy change. The term spread is the difference between the yield to maturity on a long- ($m = 5$ years) and a short-term ($m = .25$ years) pure discount bond. The preference parameters $\alpha$ and $\beta$ are chosen to yield a rate of relative risk aversion of 2.5, when $g = g_0$. The parameter of time discount is set at $\rho = .05$, which corresponds to an interest rate of 5% per year in the absence of uncertainty and consumption growth. The percentage share of GDP consumed by the public sector is assumed to grow by .2 percentage points on average ($= \theta$), where the standard deviation of such increment is one percentage point ($=\sigma$). The retrenchment takes place when the share of GDP consumed by the public sector reaches 27% ($= g_0$). When the retrenchment is implemented, this share is set permanently at $g_1 = 25\%$. The degree of fiscal pressure $\tau_0$ is set at 40%.

*Assumption 5'*. When $g_0$ is reached, government spending is cut and stays at the new constant level $g_1 < g_0$. The tax rate on dividends is reduced to $\tau_1 < \tau_0$.

The above assumption leads to the boundary condition for the stock price

$$(1-\tau_1)[\alpha - \beta(1-g_1)]/\rho = \gamma_1 + \gamma_2 g_0 + \delta_1 e^{\eta_1 g_0}.$$

In the following, all parameters are the same as in the previous Section, with the after-policy-change tax rate on dividends set at $\tau_1 = 20\%$. In Figure 4 the price of stocks is shown to be a non-monotonic function of $g$.

There are in fact two effects at work, which drive stock prices in opposite directions: The first effect is negative, and is due to the attempt to finance higher consumption rates before the fiscal retrenchment by liquidating financial assets. The second effect is positive, and is due to the anticipation of higher future stock cash flows. As a retrenchment becomes more likely, investors weigh the diminishing incentives to save with the higher cash flows on the asset. For our choice of parameter values $\delta_1$ is positive and sizable: thus, as $g$ increases, stocks fall first, but then rally as the expected-capital-gain effect overcomes the adverse discounting effect. This behavior is consistent with the evidence on the danish stock market presented in Figure 1.

The term structure effects are instead identical to those described in the previous section, as cash flows on bonds do not depend on the fiscal treatment of dividend income.

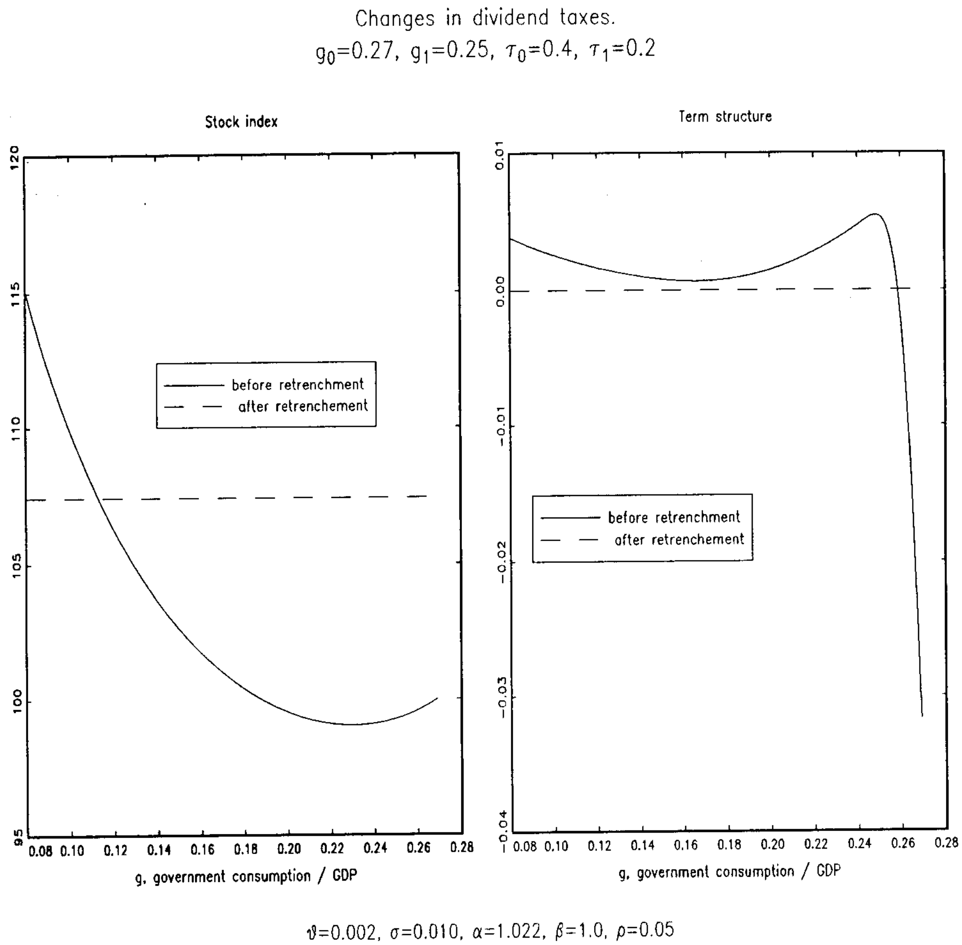
### 3.3 An uncertain policy-regime shift

In order to account for the increasing steepness of the term structure in Denmark illustrated in Figure 2, we consider the effect of uncertainty about the nature of the anticipated fiscal reform. This last scenario fits a situation where two parties have opposite views about the fiscal stabilization. One party favors low spending and taxes, the other party wants to maintain taxation of capital income at the current level, while expanding the size of the government sector.

*Assumption 5''*. When $g_0$ is reached, government spending stays at the new constant level $g_1 < g_0$ with probability $\pi$, or at $g_1^f > g_0$ with probability $1-\pi$. The new tax rate on dividends is $\tau_1 < \tau_0$ with probability $\pi$, or $\tau_1^f$ with probability $1-\pi$.

The previous assumption leads to the following no-expected-jump boundary condition for stock prices, which determines the constant of integration $\delta_1$:

$$\pi(1-\tau_1)[\alpha - \beta(1-g_1)]/\rho + (1-\pi)(1-\tau_1^f)[\alpha - \beta(1-g_1^f)]/\rho = \gamma_1 + \gamma_2 g_0 + \delta_1 e^{\eta_1 g_0}.$$




## Figure 4

Figure 4 plots stock prices and the term structure spread against $g$, the public-consumption-to-GDP ratio for a fiscal retrenchment coupled with reduced dividend taxes. As in Figure 3, the stock index is normalized to be 100 at the time of policy change and the term spread is the difference between the yield to maturity on a long- ($m$ = 5 years) and a short-term ($m$ = .25 years) pure discount bond. The preference parameters $\alpha$ and $\beta$ are chosen to yield a rate of relative risk aversion of 2.5, when $g = g_0$. The parameter of time discount is set at $\rho = .05$, which corresponds to an interest rate of 5% per year in the absence of uncertainty and consumption growth. The percentage share of GDP consumed by the public sector is assumed to grow by .2 percentage points on average ($= \theta$), where the standard deviation of such increment is one percentage point ($=\sigma$). The retrenchment takes place when the share of GDP consumed by the public sector reaches 27% ($= g_0$). When the retrenchment is implemented, this share is set permanently at $g_1$ = 25%. The tax rate on dividends ($= \tau_0$) is initially 40% but falls to 20% ($= \tau_1$) after the policy change.

The no-expected-jump boundary condition for bond prices is

$$\alpha - \beta[1 - (g + \theta m)] = \pi[\alpha - \beta(1 - g_1)] + (1 - \pi)[\alpha - \beta(1 - g_1^f)],$$

and results in a straightforward modification of the pricing equation (7).

We set the probability of the retrenchment succeeding, $\pi$, equal to 75%; if the retrenchment fails, the share of public consumption will increase to $g_1^f = .4$, while the tax rate on dividends remains $\tau_1^f = .4$. All other parameters are the same as in the previous section. Figure 5 illustrates the resulting stock-price and term-structure behavior before and after a successful fiscal retrenchment.

The effects on stock prices are more pronounced than in Figure 2: investors take into account the possibility of a further fall in consumption, should the fiscal retrenchment fail. Hence, they are more eager to save, and the demand and price of assets increases with $g$ more rapidly than in the no-uncertainty case. To put it somewhat differently, stock prices increase for $g < g_0$ not only because of the possible increase in cash flows in some states of nature, but also because cash flows are discounted less (are more valuable) in some other states of nature.

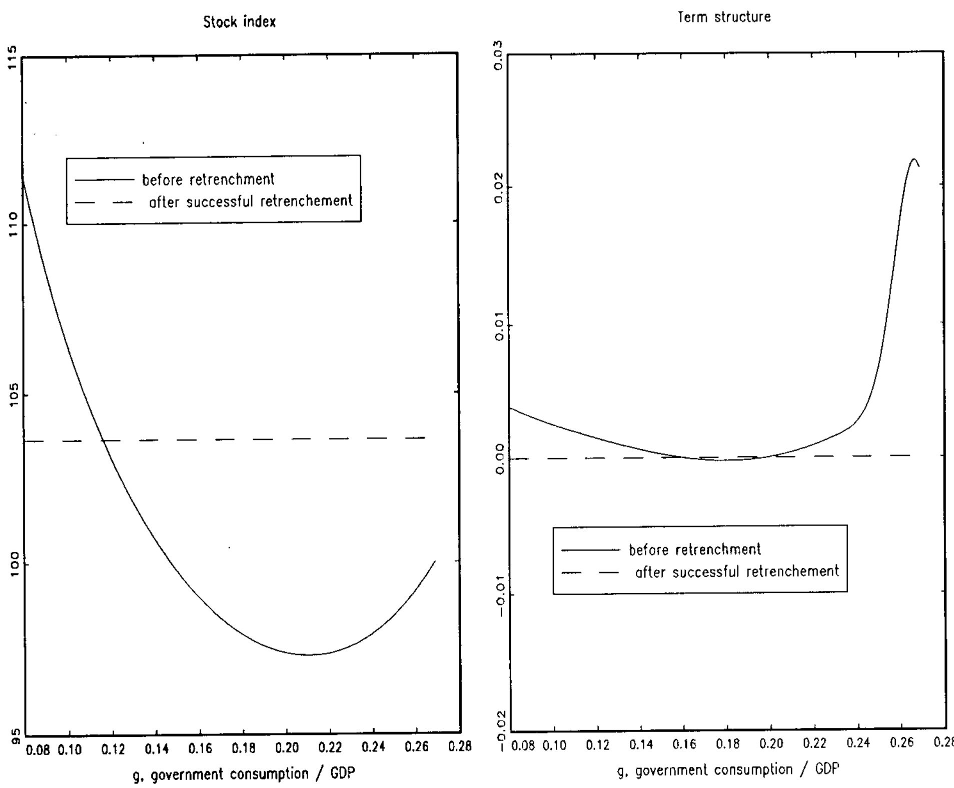
The term structure, which more clearly mirrors changes in discount rates, is especially affected by the uncertainty of the outcome of the policy change. While the expectation of a successful fiscal retrenchment drives short-term rates up, a possible failure drives them down. Long-term rates are similarly affected, but less so, since the incipient change in consumption is averaged over a longer period of time. Even with a rather high probability of a successful austerity program, the term structure may thus be positively sloped when $g$ approaches $g_0$. Also, note that the magnitude of the spread between long- and short-term rates around $g_0$ is roughly consistent with the danish experience.

# 4 Conclusions

This paper studies the effect on financial markets of an anticipated fiscal-stabilization policy in a stochastic environment. Stabilization is defined as a discrete change in the budget process which is triggered by government consumption reaching some threshold level, known by market participants. Our analysis integrates the study of financial markets within the framework adopted by Bertola and Drazen (1993) to explain the macroeconomic effects of the anticipated fiscal retrenchments of Denmark and Ireland.

The actual behavior of danish financial markets illustrated in the Introduction points in the direction of two interesting features of the policy change. First, in a model of intertemporal consumption smoothing, one can replicate the observed boom in the stock market only with expectations of an *increase* in net income to stock-holders. This increase would be consistent, for example, with direct or indirect reduction of the fiscal pressure on capital

Uncertain policy changes. Probability of success $\pi$=0.8
$g_0$=0.27, $\tau_0$=0.4, $g_1$=0.25, $\tau_1$=0.2, $g_1^f$=0.40, $\tau_1^f$=0.4




$\vartheta$=0.002, $\sigma$=0.010, $\alpha$=1.022, $\beta$=1.0, $\rho$=0.05

## Figure 5

Figure 5 plots stock prices and the term structure spread against $g$, the public-consumption-to-GDP ratio, when the fiscal retrenchment is uncertain. As in Figures 3 and 4, the stock index is normalized to be 100 at the time of policy change and the term spread is the difference between the yield to maturity on a long- ($m$ = 5 years) and a short-term ($m$ = .25 years) pure discount bond. The preference parameters $\alpha$ and $\beta$ are chosen to yield a rate of relative risk aversion of 2.5, when $g = g_0$. The parameter of time discount is set at $\rho$ = .05, which corresponds to an interest rate of 5% per year in the absence of uncertainty and consumption growth. The percentage share of GDP consumed by the public sector is assumed to grow by .2 percentage points on average (= $\theta$), where the standard deviation of such increment is one percentage point (=$\sigma$). The retrenchment takes place when the share of GDP consumed by the public sector reaches 27% (= $g_0$). We set the probability of the retrenchment succeeding, $\pi$, equal to 75%. If the retrenchment succeeds $g$ is permanently reduced at $g_1$ = 25%, and the tax rate on dividends–initially set at $\tau_0$=40%–falls to 20% (= $\tau_1$) if the retrenchment is successful. If the retrenchment fails, $g$ increases to $g_1^f$ = .4, while the tax rate on dividends remains at $\tau_1^f$ = .4.

income, due to lower restrictions on capital inflows and outflows or to genuine productivity increases. The term-structure evidence, on the other hand, is consistent with less than full *credibility* of the retrenchment, that is with investors attaching some probability to a further *expansion* of the government sector.

Undoubtedly, there are many other factors at work, both at the national and international level, shaping danish financial markets during the early 80s. Nonetheless, we believe that our analysis helps identify some fundamental patterns in asset prices which are consistent with expectations of a change in the fiscal-policy regime.

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