EFFECTS OF VARYING TAX RECEIPTS WHEN THE TIMING OF TAX PAYMENTS IS INDETERMINATE: THE CASE OF A TAX ON CORPORATE DISTRIBUTIONS

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FOREWORD

This Collaborative Paper is one of a series embodying the outcome of a workshop and conference on Economic Structural Change: Analytical Issues, held at IIASA in July and August 1983. The conference and workshop formed part of the continuing IIASA program on Patterns of Economic Structural Change and Industrial Adjustment.

Structural change was interpreted very broadly: the topics covered included the nature and causes of changes in different sectors of the world economy, the relationship between international markets and national economies, and issues of organization and incentives in large economic systems.

There is a general consensus that important economic structural changes are occurring in the world economy. There are, however, several alternative approaches to measuring these changes, to modeling the process, and to devising appropriate responses in terms of policy measures and institutional redesign. Other interesting questions concern the role of the international economic system in transmitting such changes, and the merits of alternative modes of economic organization in responding to structural change. All of these issues were addressed by participants in the workshop and conference, and will be the focus of the continuation of the research program's work.

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Effects of Varying Tax Receipts When the Timing of Tax Payments is Indeterminate: The Case of A Tax on Corporate Distributions

by

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1. Introduction.

This paper concerns an aspect of the question: When do government deficits matter? My original intent was to sketch out as a starting point the extension of previous work (1981) showing how endogenously generated deficits might have no real effect, a result obtained under an assumption of perfect substitutability between government and private debt, to a world of risky debt where the latter assumption would no longer hold. My intuition was that the extension would go through in a straightforward way. As it turns out, the extension is not quite as direct as I had expected, and I think the difference may be of some general interest. In particular, the conditions for neutrality seem less likely to be fulfilled in a practical context.

The underlying idea is that it should not matter when taxes are paid, provided there is an appropriate compensating interest element in the postponed liability. This notion conflicts with the assumption often employed that it is the government's cash flow balance

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that counts, even though current deficits may be offset by correspondingly larger liability for future tax payments, and surpluses may reflect drawing down liabilities for future taxes. This issue arises expecially strongly in the context of analysis of proposals for consumption-type taxes, where there is a choice between a literal consumption tax and a tax on wage and transfer receipts. Typically the two approaches generate the same liabilities in a present value sense, but very different cash flows.

The specific case I analyze involves a tax on distributions by corporations to equity holders, in essence, a dividend tax. If such a tax is assessed at a flat rate which is not expected to change, and if negative distributions (sales of new equity) are included (i.e., subsidized), the case is quite compelling in a partial equilibrium setting, that the level of the tax should have no influence on real or financial transactions of a corporation acting in the interest of its stockholders. The reason is simply that the flat tax changes proportionately the consequences of all decisions as far as stockholder outcomes are concerned. In particular, the trade-off in after-tax dollars for the shareholders between a larger distribution today and the consequently smaller distribution at some future time is unaffected by the rate of tax.

In the absence of all taxes (and transactions costs) the various versions of the Modigliani-Miller (1958) Theorem tell us the corporation will be indifferent between debt and equity finance. An implication is that the timing of dividend payments is a matter of indifference. Since, as I have just argued informally, a flat tax on dividends has

no effect on the optimal financial policy, something like the Modigliani-Miller Theorem should continue to hold. Hence, government receipts from such a tax will be determined by the whims of corporate managers and need follow no particular path as far as wealth-maximizing calculations are involved. Will fluctuations in tax receipts, as might arise in such an economy, have real effects?

In Bradford (1981) I spelled out an overlapping-generation model in which government debt does generally influence the rational expectations equilibrium path, but in which variations in government debt attributable to variations in distribution tax receipts do not matter. The indifference about financial policy at the level of the firm, in spite of the tax on distributions, carries over to neutrality of the economy's path to the choice of financial policy, even though the flow of tax receipts is affected.

The basis for this conclusion is fairly simple: The capital investment level chosen by the firm is governed by the going interest rate. Therefore, a decision to issue an extra dollar of debt implies a decision to distribute an extra dollar to shareholders. This in turn implies extra tax receipts of t dollars (where t is the rate of tax). If real government spending is fixed, the extra t dollars are devoted to reducing the public debt. The result thus far is a net addition of $1-t$ dollars to the supply of financial assets. There remains, however, the equity interest in the corporation, the value of which is predicted to fall, not by one dollar, as a result of the extra debt cum distribution, but by $1-t$ dollars, in reflection of the government's claim to a fraction t of all cash flows

to shareholders. As a consequence, all markets continue to clear. The firm's decision has no real effect, even though tax receipts are increased.

The analysis just sketched sufficed to demonstrate the point that a tax on corporation distributions may not have the often-assumed incentive effects with respect to real and financial allocations. The neutrality of the tax as far as the aggregate economy is concerned was something of a by-product, necessary for the rigorous validity of the firm-level proposition, but not the main point. In the present investigation the emphasis is reversed, in that I am principally concerned with how the government cash-flow neutrality result is affected if the perfect substitutability among financial assets, used in the argument above and attributable to the assumption of certainty, is replaced in the context of an explicit treatment of uncertainty. Here the indeterminacy of the firm's financial policy is needed to allow government receipts to vary.

As it turns out, the earlier results carry over without significant complication when only equity is risky while government and corporate debt are risk free, and therefore perfect substitutes. When, however, both government and corporate debt are risky, the neutrality conclusions require two restrictions. First, the risk properties of government debt must be pre-specified. Second, the government must be committed to maintaining a portfolio of corporate bonds amounting to a fraction t of the total supply. While the practical requirements of implementing the first restriction do not seem particularly demanding, the second restriction would

involve a major change in government financial behavior.

In section 2 below I review the certainty results as a way of introducing the basic model. The extension to a model with uncertainty is presented in Section 3.

2. Review of the Certainty Model.

The model underlying the analysis is in the Samuelson (1959) consumption loan tradition. Individuals live for two periods in an infinite time horizon world. In the first life-period each individual works (offering one unit of labor inelastically), consumes, and saves for retirement. "Retirement" describes the second life-period, when each individual dissaves and consumes, leaving nothing to his heirs.

All production takes place in the consolidated corporate sector which is modeled as a single price-taking firm. Production conditions are described by a neoclassical production function of capital and labor employed, with constant returns to scale. The capital available to the corporation in any period is inherited from the previous period and is thus fixed in amount before the time of actual production. The output of a period may either be consumed or frozen into infinitely durable capital. Investment is regarded as reversible.

Savings may be held in three forms, bonds issued by the corporation, shares of its common stock, or bonds issued by the government. A given generation of individuals acquires these financial assets at the end of its first life-period, after production for that period has been completed, and after the investment and financial plans of the corporation have been realized.

The holders of its common stock "own" the corporation. The owners at the beginning of a period control that period's production and the real investment which determines the amount of capital which will be available for use in production at the beginning of the next period. The owners of the firm at the beginning of a period specify as well the financial policy for that period, which means they set the amount of funds to be distributed to themselves as dividends and the amount of corporate borrowing.

The government's real spending program is assumed fixed, for simplicity at a zero level. The government is thus modeled as a mechanical cash flow manager: in each period the inherited debt obligation must be paid off, with any shortfall of tax receipts covered by the issue of new debt.

Notation.

To describe the results of the analysis formally, I use the following notation (involving minor changes from that of the 1981 paper to facilitate extension to incorporate uncertainty):

L: total number of labor units available for application during the period (equals the number of individuals born in the period, exogenously given).

K: stock of corporate capital at the beginning of the period (used for production during the period).

B: total stock of corporate indebtedness at the beginning of the period, which must be repaid during the period.

$F(K,L)$: the production function, characterized by constant returns to scale.

D: total distribution made by the corporation during the period.

B^g: total stock of government indebtedness at the beginning of the period, which must be repaid during the period.

t: rate of tax on corporate distributions to stockholders.

There are two ordinary prices in the model (current output is numeraire), and one price-like "valuation function":

w: wage.

d: the discount rate; a bond payable next period sells for d in the current period.

$V(K_+,B_+)$: a function relating the "ex dividend" value of corporate equity, that is, the value at the end of a period, after production is complete, to the financial and investment decisions of the current owners.

For any variable, X, let X_+, X_{++}, etc., represent its value in succeeding periods; X_- its value in the preceding period. Let X_+^e denote the value of X expected to obtain in the next period.

There are three classes of agents in the model, two displaying maximizing behavior. The "young" try to maximize $U(c^1,c_+^2)$

(labor is supplied inelastically), where c^i is consumption during the i^{th} period of the life cycle. The "old" manage the corporation to maximize c^2, which means maximize $(1-t)D+V(K_+,B_+)$. The third agent is the government which, as has been mentioned, acts mechanicallly in managing the cash flow according to $dB^g_+ = B^g-tD$.

Evolution of the Economy.

The situation inherited from the past is described by (K,B,B^g,L), with L evolving exogenously along a known path. The requirements placed on the model world are that the evolution to (K_+,B_+,B^g_t,L_+) be determined by clearing of competitive "spot" markets for labor, corporate bonds, government bonds, corporate equity and goods, and that the expectations on which demands and supplies depend be "rational." The general notion of rational expectations, attributed to Muth (1961), here encompasses two properties: Expectations are correct, and they are determinate, in the sense that they are governed by knowledge of the economic structure and the current state of the economy. For rational expectations to make sense, there must be an appropriate degree of determinacy of the model as a whole, including its expectations-formation. Solving the model involves showing that the endogenous variables, including prices and expectations, can be expressed as stationary functions of the state variables, K, B, and B^g, given the known path of L. Properly, there should as well be a demonstration that the proposed equilibrium path is at least locally unique--otherwise, why should the economic agents pick the required expectations-forming rule?

In my previous work I described an equilibrium path of the economy sketched out above. (I did not actually demonstrate local uniqueness, although I think the solution is probably globally unique.) The neutrality result concerning the rate of tax on corporate distributions followed from the conclusion that the equilibrium valuation function is given by (1).

$$V(K_+,B_+) = (1-t)d(F_+(K_+,L_+) - w_+^eL_+ - B_+ + K_+) \ . \tag{1}$$

The objective of the owners of the firm is to set employment together with K_+, B_+ and D to maximize $(1-t)D + V(K_+,B_+)$. If we substitute for D in the objective function, using accounting relationship (2) among the outlays by the firm, B_+ drops out.

$$D = F(K,L) - wL - B + dB_+ - K_+ \ . \tag{2}$$

Maximizing values of the other variables are independent of t, while the financial structure of the firm is indeterminate.

Indeterminacy of financial structure corresponds to indeterminacy of government tax receipts. The reason the equilibrium path of the economy's real variables and prices is nonetheless determinate is suggested by the expression (3) of equality between the value of demanded and supplied claims to future consumption:

$$dc_+^2(d,w)L = dB_+ + dB_+^g + (1-t)d(F_+(K_+,L_+) - w_+L_+ - B_+ + K_+), \tag{3}$$

where $c_+^2(d,w)$ is the retirement-period consumption (which will take place next period) demanded by a representative young person, where the values of K_+ and B_+ have been set by the current owners of the

firm, and where I have taken for granted $w_+^e = w_+$. The expression on the left is the value of claims demanded on the basis of life-cycle optimization by members of the young generation. The first two terms on the right are the values of bonds supplied, and the third is the value of corporate equity. Exploiting the government's budget constraint, $dB_+^g = B^g - tD$, and the already mentioned accounting relationship (2) between D and the other variables, allows us to write condition (3) as

$$dc_+^2 L = B^g - t(F - wL - B + K - K_+) + (1-t)d(F_+(K_+, L_+) - w_+ L_+ + K_+). \tag{4}$$

Once again, B_+ has been eliminated, so the condition is independent of corporate financial policy.

Equation (5) expresses a further reformulation of the same condition, taking advantage of Euler's theorem (an open question: Can one dispense with linear homogeneity of F?):

$$dc_+^2 L = K_+ + B^g - t(F(K,L) - wL - B + K). \tag{5}$$

The left-hand side of (5) is, as before, the demand by the young generation for assets. The right-hand side, the economy's net supply of assets, is the difference between government bonds carried over from the past and the tax receipts that would be generated if the corporation were to be liquidated in the current period. The last term, in other words, affects the real equilibrium path like an anticipated tax receipt "asset" of the government, offsetting explicit government debt. Through this relationship one obtains a clear sense of why deficits or surpluses due

to variations in corporate distributions have no effect on the real path of the economy, even though government debt does matter. An increase in distributions simultaneously reduces government debt and the potential tax receipt asset by equal amounts.

3. Introducing Uncertainty.

There are various ways one might introduce uncertainty to this model. I have chosen to make the future production conditions dependent upon the particular state (for example, weather conditions) occurring. Specifically, I assume that the investment decision is fixed in the current period, but the actual production function is determined in the next period.

Let S stand for the set of possible states that might obtain in the current period, S_+ the set of possible states in the next period, and so on. The larger dimensionality of the problem requires some new notation. The following describes my compromise between comprehensiveness and mnemonics. In general, variables are now understood to have a subscript to designate the state and time with which they are associated. Thus, w_i, $i \in S_+$, refers to the wage rate realized in state i next period. Since the story starts with a known current state, we can let variables with no subscript refer to the values currently realized.

I shall also assume that S is finite in each period, and that an ordering has been agreed upon for the states in each period, so we can use the subscript "+" to refer to the vector of values of a variable obtaining in the next period. (I make an exception for K_+ and L_+, which keep their previous scalar interpretation.) Thus,

w_+^e, refers to the vector of wage rates presently anticipated for next period, with components w_i, $i \varepsilon S_+$, and has dimensionality equal to the number of states in S_+.

The firm and the government must now specify, instead of the single-dimensional bonds, vectors of state-specific claims, where, for example, B_i, $i \varepsilon S_+$, pays one unit if state i is realized next period, and zero if another state is realized. To issue a riskless bond is equivalent to selling one unit each of claims B_i, $i \varepsilon S_+$.

Instead of the single discount factor d, we now have a vector of prices of unit claims contingent on the next period's state. If e_+ is the vector of ones of appropriate dimension, $e_+ \cdot d$ is the price of a riskless bond. Since we shall want to continue to use the ordinary subscript to refer to the state and time in which a particular variable is realized, for example, d_i, $i \varepsilon S_+$ is the vector of discount rates (applicable to claims on output two periods hence) realized if state i occurs next period, I shall use parentheses when I wish to identify a particular element of d. Thus, $(d)_i$, $i \varepsilon S_+$, is a scalar, namely, the present price of a claim to one unit if state i occurs next period. The symbol d_+ refers to the matrix of discount factor vectors, one for each possible state that might be realized next period.

We are now in a position to study the analogues in the world of risk to the temporary equilibrium relationships discussed earlier. We may guess, for example, that the valuation function for corporate equity is given by (6).

$$V(K_+,B_+) = (1-t)d(F_+(K_+,L_+) - w_+^e L_+ - B_+ + e_+K_+). \tag{6}$$

This is simply the value of the vector of payoffs, contingent on the state realized, that the purchaser of the equity expects to obtain in the form of distribution plus proceeds from sale of the equity interest.

To analyze asset market clearing in this case, it is not sufficient to look at the aggregate value of present claims, as we did above. We must now look for the state-by-state equality of supplies and demands of contingent claims. Recall that $c_+^2(w,d)$ is now to be interpreted as the vector of consumption planned by the representative young person for the retirement period, contingent on the state realized. Asset market clearing now requires the vector equation (7)

$$c_+^2(w,d)L = B_+ + B_+^g + (1-t)(F_+(K_+,L_+) - w_+L_+ - B_+ + e_+K_+), \tag{7}$$

where, as before, we are taking for granted the determination of K_+ and w_+ via other equilibrium relationships, given w and d. In the certainty case we were able to use the government budget relationship, $d \cdot B_+^g = B^g - tD$, together with the relationship between D and B_+, to eliminate both B_+ and B_+^g from the asset market clearing condition. Under uncertainty, the combination of these two relationships is no longer sufficient. Whereas before, constraining the value of the government's bond sales or purchases determined the quantity (given d), the government now may choose among various combinations of state-contingent claims, (i.e., deal in bonds of different risk characteristics). Moreover, the same can be said of the firm. Thus, if we take as a starting point that the government only issues riskless

bonds (buys riskless bonds in the case of negative government debt), we have still not pinned down temporary equilibrium because the risk characteristics of the firm's debt have not been determined. Temporary equilibrium therefore depends on the firm's financial policy, but, since the firm is a price taker, that policy is still a matter of indifference. The economy may apparently wander aimlessly.

If both the government and the corporation are restricted to riskless debt, the argument goes through much as it did in the risk-free analysis. In that case, extra bonds issued by the corporation generate not only the exact withdrawal in value of government bonds (as a consequence of extra taxes paid) required to maintain financial market equilibrium in view of the associated decline in the value of corporate equity, but also the matching change in the state-by-state contingent claims.

Neither assumption, risk-free government bonds or risk-free corporate bonds is altogether attractive. In a time of stochastic inflation rates, government bonds are anything but risk free. More obviously, corporate bonds do carry default risk.

What is required is a mechanism to assure that, in any period, $tB_+ + B^g_+$ is independent of the firm's financial policy and predetermined as far as government policy is concerned. Here is one mechanism to bring about the desired result: Make it government policy to purchase a fraction t of every corporate bond issue, while fixing in advance the risk characteristics of government debt. I shall describe this formally not as the purchase of corporate debt, but as the purchase (i.e., reduced supply) of the equivalent package

of state-specific claims on the government. Taken literally, such a policy would change the explicit risk characteristics of government debt. Actual implementation, however, should be imagined as simultaneous issue of extra government debt and purchase of corporate debt. The effect on the government's portfolio of state-specific claims is the same.

The suggested policy then is described by (8)

$$B_+^g = (B^g - tD)\frac{a_+}{d \cdot a_+} + tdB_+ \frac{a_+}{d \cdot a_+} - tB_+, \tag{8}$$

where a_+ is a pre-specified vector with dimension equal to the size of S_+. (For example, a_+ might equal e_+, in which case the government issues riskless bonds.)

Using the accounting relationships describing D, condition (8) implies (a)

$$B_+^g + tB_+ = (B^g - t(F - WL - B + K - K_+))\frac{a_+}{da_+}, \tag{a}$$

providing the desired independence of $B_+^g + tB_+$ from B_+, while the characteristics of government debt are determined by a.

References

Bradford, David F. (1981), "The Incidence and Allocation Effects of a Tax on Corporate Distributions," Journal of Public Economics, XV, pp. 1-22.

Muth, J. (1961), "Rational Expectations and the Theory of Price Movements," Econometrica, XXIX, pp. 315-335.