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Dividend and Monetary Policy and the Differential Tax Treatment of Capital Gains in a Two-Country World

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Abstract

This paper adopts a representative-agent infinite-horizon two-country two-good framework and shows how the interdependence of monetary, fiscal, and dividend policy affects the cost of capital in a world of integrated capital markets under flexible exchange rates. The main implications are: (i) nominal variations in capital gains assign a role for the differentiation of capital gains taxes depending on the type of asset held; (ii) whereas the capital gains tax is assumed to be residence-based, the inflation tax is shown to be inherently a source-based tax.

I. Introduction

Recently, there has been an increased interest in the issue of coordination of tax policies between countries. The reason is that, in the presence of integrated capital markets, agents look for arbitrage opportunities offered by a distinct set of tax rates with respect to the type of asset held and the type of

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gain incurred. This paper studies these tax arbitrage opportunities in a two-country general equilibrium framework.

There have been many contributions in this area recently, for example Gordon [1986], Slemrod [1988], Giovannini [1990], Giovannini and Hines [1991], Razin and Sadka [1991a,b], Ihori [1991], Frenkel, Razin and Sadka [1991], Turnovsky and Bianconi [1992] and Bianconi [1993] . The main contribution of this paper relative to this literature is to adopt a representative-agent infinite-horizon two-country two-good world and to show how the interdependence of monetary, fiscal, and dividend policy affects the cost of capital in a world of integrated capital markets under flexible exchange rates.

The first implication of the framework developed below relates to the issue of production efficiency under the residence principle of capital income taxation. A benchmark result in this literature is that if the pure residence-based principle of capital income taxation is adopted[coupled with an effective enforcement of these taxes] production efficiency obtains, see *e.g.* Gordon [1990], Giovannini [1990], and Razin and Sadka [1991a,b].[1] In this paper, I adopt the pure residence-based principle of capital income taxation. However, in all cases examined, I do not obtain production efficiency. The reason is that in the studies mentioned above, the corporate sector financial structure is ignored as well as governments monetary policy.[2]

The second implication derives from the fact that I assume that in each country, there is a corporate sector who finances investment through the

1. This is in effect the international version of the production efficiency theorem of Diamond and Mirrlees [1971] where the optimal set of taxes minimizes output distortions. In the context of this paper, production efficiency leads to the modified golden rule.
2. In their recent manuscript, Frenkel, Razin, and Sadka [1991], chapter 5, present a two-period general equilibrium model, but they consider a real model abstracting from issues relating to money. Also, they consider a firm that only finances investment through domestic debt whereas I look at the case where firms finance investment through equities and retained earnings. Turnovsky and Bianconi [1992] consider a representative-agent infinitely-lived general equilibrium framework, but they consider an alternative dividend policy, abstract from money, and have a one-good model. Bianconi [1993] extends the Turnovsky and Bianconi [1992] model allowing for endogenous labor supply.

issue of equities. The evolution of the market price of these equities is determined endogenously as a function of the exogenous forcing variables. In turn, domestic and foreign households are subject to capital gains and losses when holding these assets. In turn, the taxation of the capital gains may be differentiated with respect to the type of equity held, *i.e.* domestic or foreign. The problem is that domestic equities yield nominal capital gains (losses) as a function of the domestic nominal price of the equity, but foreign equities yield nominal gains (losses) which depend on variations in the nominal exchange rate and in the nominal price of the foreign asset. These nominal variations assign a possible role, which is analyzed in detail, for the differentiation of capital gains taxes depending on the type of asset held, *i.e.* domestic or foreign.

The third implication of the framework developed regards the clear distinction between the capital gains tax and the inflation tax with respect to its base. In particular, the capital gains tax is assumed to be residence-based, *i.e.* income is taxed on the basis of the residence of the tax payer, regardless of the source of income. But, the inflation tax is shown to be inherently a source-based tax, *i.e.* it taxes whoever holds currency, regardless of its residence.

In sum, the contribution of this paper is fourfold. First, my model is a two-country two-good infinite horizon representative agent framework where money enters via cash-in-advance constraints in consumption and assets, and firms finance investment through equities.[3] Second, none of the referred authors show how tax, dividend, and monetary policy interact in a two-country framework with integrated capital markets as is done in this paper. Third, the case is made for a differential tax treatment of capital gains. And finally, I show the attributes of the inflation tax as opposed to the capital gains tax, mainly that the former is inherently a source-based tax.

The paper is organized as follows: section II presents the model; section III shows the determination of the equilibrium; section IV analyzes the alternative equilibria under tax, dividend, and monetary policy interactions; sec-

3. Sinn [1991] examined the issue of inflation in the firm's problem, but focused on an alternative dividend policy. My framework focuses on the dividend policy used by Brock and Turnovsky [1981], with the distinction that the dividend payout rate might be either exogenously or endogenously determined.

tions V discusses the inflation tax; and section VI concludes.

II. Two-Country Macroeconomic Structure

Consider a discrete time perfect foresight two-country two-good model of a decentralized monetary economy inhabited by government, firms, and households. The model is a two-country extension of the framework of Brock and Turnovsky [1981] with money introduced *via* cash-in-advance constraints on consumption and assets according to the setup of Helpman and Razin [1985] and Lucas [1990]. Domestic economy variables are unstarred while foreign economy variables are starred. The superscript d refers to holdings of domestic residents, while f refers to holdings of foreign residents.

A. Governments

The government in each country faces an intertemporal budget constraint given by[4]

$$[(1+p_{t+1})m_{t+1} - m_t] + (T_t^H/P_t) = 0 \tag{1}$$

with

$$(T_t^H/P_t) = \tau_{c1}\,(\mu_{qt} + \mu_{pt})\,q_t\,e_t^d + \tau_{c2}\,(\mu_{st} + \mu_{qt}^* + \mu_{pt}^*)\,\Omega_t\,q_t^*\,e_t^{*d} + T_t;$$
$$0 \le \tau_{c1} < 1,\ 0 \le \tau_{c2} < 1 \tag{1a}$$

where

$\mu_{pt} = (P_t/P_{t-1}) - 1$ = domestic rate of inflation at time t

P_t = domestic price level at time t

$\mu_{pt}^* = (P_t^*/P_{t-1}^*) - 1$ = foreign rate of inflation at time t

P_t^* = foreign price level at time t

$m_t = (M_t/P_t)$ = domestic real stock of money at time t

4. For simplicity, I assume that government expenditures are zero, that labor, dividend, and corporate income are not taxed, and the government does not issue debt, since issues related to these variables are outside the scope of this paper.

M_t = domestic nominal stock of money at time t

$\Omega_t = (s_t P_t^*/P_t)$ = real exchange rate at time t

s_t = nominal exchange rate at time t, defined as units of domestic currency per units of foreign currency

$\mu_{st} = (s_t/s_{t-1}) - 1$ = rate of change of nominal exchange rate at time t

$q_t = (Q_t/P_t)$ = real price of domestic equities at time t

Q_t = nominal price of domestic equities at time t

$\mu_{qt} = (q_t/q_{t-1}) - 1$ = rate of change of real price of equities at time t

e_t^d = number of domestic equities(shares) owned by domestic residents outstanding at time t

$q_t^* = (Q_t^*/P_t^*)$ = real price of foreign equities at time t

$\mu_{qt}^* = (q_t^*/q_{t-1}^*) - 1$ = rate of change of real price of foreign equities at time t

Q_t^* = nominal price of foreign equities at time t

e_t^{*d} = number of foreign equities (shares) owned by domestic residents outstanding at time t

T_t = domestic real lump-sum tax/rebate at time t

τ_{c1} = capital gains tax rate on holdings of domestic equities by domestic residents

τ_{c2} = capital gains tax rate on holdings of foreign equities by domestic residents

The standard government budget constraint (1) is expressed in real flow terms with the domestic budget being financed by additions to the stock of domestic money. The tax structure (1a) is assumed linear with capital gains taxes accruing on nominal unrealized capital gains. Thus, being capital gains taxes levied on nominal gains, the interaction of inflation and taxes is inherent in the analysis. One of the issues discussed in this paper is the differential tax treatment of capital gains on domestic equities and capital gains on foreign equities, τ_{c1} and τ_{c2} respectively. The capital gains tax regime is residence-based since the domestic government taxes domestic residents

capital gains from wherever income is derived from. However, the inflation tax collected by the domestic government is source-based because it accrues on whoever holds the domestic currency. The foreign economy respects an intertemporal budget constraint symmetric to (1).

The government financial policy to be considered is the simple constant rate of growth of money rule. The nominal stock of domestic money follows

$$M_{t+1} = (1+\mu)M_t, \qquad \mu > 0 \tag{2a}$$

where μ is the rate of growth of domestic money; while the nominal stock of foreign money follows

$$M^*_{t+1} = (1+\mu^*)M^*_t, \qquad \mu^* > 0 \tag{2b}$$

where μ^* is the rate of growth of foreign money.

The introduction of money in this model is obviously essential to the analytic result that *nominal* variations in capital gains assign a role for the differentiation of capital gains taxes. However, the result of the interdependence of policies under integrated capital markets is not a function of the monetary framework adopted.

B. Firms Problem

The corporate sector in each country, consisting of a representative firm, maximizes a specific objective in order to choose capital and the dividend rate to be distributed to shareholders. Labor is assumed fixed, immobile across countries, and normalized to unity. Each country's firm produces its own good. The physical capital stock is assume immobile across countries, but equities are freely traded. The depreciation rate is zero for simplicity.

The domestic representative firm faces the following constraints

$$y_t = f(k_t) \tag{3a}$$

$$\pi_t = y_t - w_t = d^d_t + d^f_t + RE_t \tag{3b}$$

$$I_t = \Delta k_t = q_{t+1}(\Delta e_t) + RE_t \tag{3c}$$

$$d_t = d^d_t + d^f_t \tag{3d}$$

$$e_t = e^d_t + e^f_t \tag{3e}$$

$k(o) = k_o > 0$, $e(o) = e_o > 0$, given (3f)

where

Δ is the difference operator, or $\Delta k_t = (k_{t+1} - k_t)$

y_t = real output

k_t = stock of physical domestic capital

$w_t = (W_t/P_t)$ = domestic real wage rate

W_t = domestic nominal wage rate

d_t^d = real dividends of the domestic firm paid to the domestic resident

d_t^f = real dividends of the domestic firm paid to the foreign resident

RE_t = retained earnings

I_t = investment

π_t = real gross domestic profits

$f(.,.)$ = neoclassical production function common to both countries with positive but diminishing marginal physical products, assumed to be linear homogeneous such that: $MPP_k = f_k > 0$; $f_{kk}(.) < 0$.

The firm produces according to (3a), and real gross profits are defined in (3b) to be production minus the wage bill which is distributed as dividends to stockholders and retained earnings. Firms finance investment through the issue of equities and retained earnings according to (3c), (3d) is the distribution of dividends between domestic and foreign residents, (3e) is the distribution of equities, and (3d) denotes the given initial conditions.

The current market value of outstanding securities is defined as

$$V_t = q_t e_t \tag{4}$$

and the firm objective is to maximize the initial market value, $V_o = q_o e_o$. The domestic firm market value evolves according to the relationship

$$d_t + \mu_{qt} V_t = (V_{t+1} - V_t) + \gamma_t \tag{5a}$$

where $\gamma_t \equiv \{\pi_t - \Delta k_t\} = \{[f(k_t) - w_t] - \Delta k_t\}$ is the domestic firm real cash flow net of investment expenditures. Equation (5a) states that additions to the market value of the firm plus the firms real net cash flow must be distributed as dividends plus the current return on the outstanding market value, $\mu_{qt} V_t$. The size of the dividend payout is an endogenous decision of the firm subject to consumers preferences (in both countries) with respect to the available menu of assets as well as the rate of return μ_{qt}. In essence, the dividend payout and μ_{qt} are both driven by consumers and they are the link between the household sector and the corporate sector.

Following Brock and Turnovsky [1981], I define the dividend as some rate i_t applied to the outstanding market value,

$$d_t = i_t V_t = i_t q_t e_t \tag{5b}$$

and (5a,b) may be combined to yield

$$V_{t+1} = (1 + i_t + \mu_{qt}) V_t - \gamma_t \tag{6a}$$

which is a difference equation with variable term and coefficient. The solution of (6a), for an arbitrary t, is

$$V_t = \left[\Pi_{j=0}^{t-1} \theta_j\right] \sum_{n=t}^{\infty} \left[\Pi_{\tau=0}^{n} \theta_\tau\right]^{-1} \gamma_n \tag{6b}$$

where $\theta_t \equiv (1 + i_t + \mu_{qt})$ is the total cost of domestic capital. It is clear that the real net cash flow, γ_t, only depends on real variables and therefore separates from the firms financial decision which concerns the choice of the payout rate i_t in order to minimize the total cost of capital θ_t. Ultimately, the constraints for the choice of the payout rate will be the consumers optimality conditions. Then, the firm objective, in order to choose real quantities, is to maximize its initial value, and from (6b) the problem may be stated as

$$\underset{\{k_{t+1}\}_{t=0}^{\infty}}{\text{Max}}\ V_o = \sum_{t=0}^{\infty} \left[\Pi_{\tau=0}^{t} \theta_\tau\right]^{-1} \gamma_t \tag{7a}$$

subject to $\gamma_t = [f(k_t) - w_t] - (\Delta k_t)$ (7b)

$$k(0) = k_o > 0, \text{ given.} \tag{7c}$$

In equilibrium, the following transversality condition holds

$$\lim_{T\to\infty} \left[\Pi_{\tau=0}^{T}\ \theta_t\right]^{-1} k_{T+1} = 0. \tag{7d}$$

A symmetric problem holds for the foreign firm.

As noted above, Frenkel, Razin, and Sadka [1991] present a nonmonetary model where firms only finance investment through domestic debt. This essentially prevents firms from seeking foreign sources to finance investment. Introducing money in that alternative framework would lead to a different impact of monetary and tax policy on the cost of capital.

C. Households Problem

Every period, a representative household solves a choice-theoretic problem in order to optimally allocate his/her total wealth between consumption of the domestic and foreign good, stock holdings of the domestic and foreign firm, and holdings of the domestic and foreign currencies. Focusing on the domestic household (the foreign is symmetric), I assume that it can be consolidated into a single representative unit. However, I follow Lucas [1990] and assume that this consolidated unit consists of a multiple-member party.

The typical unit consists of the head of the household who supplies labor inelastically to the firm in exchange for the money wage; the shopper, who uses part of the unit's monetary resources from the money wage (in domestic and foreign currency) to buy domestic and foreign consumption goods from other households[domestic (foreign) goods can be bought only with domestic (foreign) currency such that the money demand functions are well defined]; and another member, the securities trader, who uses the remaining part of the unit's monetary resources (domestic and foreign) to engage in purchases of assets and/or currency trades (the available menu consists of domestic and foreign firms equities and domestic and foreign currencies). The three-member party regroups at the end of each period pooling its resources and information. The feature of this framework is that the household unit is subject to cash-in-advance constraints in both the goods and assets markets. Thus, the total stock of money must be divided for

transactions in the goods and assets markets.[5]

The domestic representative household unit faces the intertemporal problem

$$\underset{\{c_t^d,\ c_t^{*d},\ m_{t+1}^d,\ m_{t+1}^{*d},\ z_t^d,\ z_t^{*d},\ q_{t+1}e_{t+1}^d,\ q_{t+1}e_{t+1}^{*d}\}_{t=0}^{\infty}}{\text{Max}} \sum_{t=0}^{\infty} \beta^t U(c_t^d,\ c_t^{*d}) \tag{8}$$

subject to

$$z_t^d = q_t^d e_t^d \tag{8a}$$

$$z_t^{*d} = q_t^* e_t^{*d} \tag{8b}$$

$$m_t^d - z_t^d = c_t^d \tag{8c}$$

$$m_t^{*d} - z_t^{*d} = c_t^{*d} \tag{8d}$$

$$d_t^{*d} + \Omega_t d_t^{*d} - (T_t^H/P_t) - c_t^d - \Omega_t c_t^{*d} + (z_t^d - q_t e_t^d) + (m_t^d - z_t^d - c_t^d) +$$
$$\Omega_t (z_t^{*d} - q_t^* e_t^{*d}) + \Omega_t (m_t^{*d} - z_t^{*d} - c_t^{*d}) = [(1 + \mu_{pt+1}) m^d{}_{t+1} - m_t^d] +$$
$$\Omega_t [(1 + \mu_{pt+1}^*) m_{t+1}^{*d} - m_t^{*d}] + [(1 + \mu_{pt+1}) q_{t+1} e_{t+1}^d - q_t e_t^d] +$$
$$\Omega_t [(1 + \mu_{pt+1}^*) q_{t+1}^* e_{t+1}^{*d} - q_t^* e_t^{d^*}] \tag{8e}$$

$$M_o^d > 0,\ M_o^{*d} > 0 \text{ given.} \tag{8f}^*$$

In equilibrium, the following transversality conditions hold

$$\lim_{t \to \infty} \beta^{t-1} (\lambda_{3t} + \lambda_{5t}) m_t^d = 0 \tag{8g}$$

$$\lim_{t \to \infty} \beta^{t-1} (\lambda_{4t} + \lambda_{5t}) m_t^{*d} = 0 \tag{8h}$$

$$\lim_{t \to \infty} \beta^{t-1} (\lambda_{1t} + \lambda_{5t}) q_t e_t^d = 0 \tag{8i}$$

$$\lim_{t \to \infty} \beta^{t-1} (\lambda_{2t} + \lambda_{5t}) q_t^* e_t^{*d} = 0 \tag{8j}$$

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5. In Lucas [1990], government financial policy follows an exogenous stochastic process and the timing of the transactions, the division of cash resources, and the observability of the government financial policy are of crucial importance. In my case of perfect foresight, these problems are not crucial. I assume that current labor income is available only for next period consumption and asset holdings. Also, for simplicity, I assume that equities are rolled over every period, see e.g. Lucas [1990], pages 251-253 for an extension to the case of multi-period equities.

and the government budget constraint (1), where (T_t^H/P_t) is given in (1a), d_t^d is given by (5b), $0 < \beta < 1$ is the discount factor common to both countries,[6] and

c_t^d= real domestic consumption of the domestic good at time t

c_t^{*d} = real domestic consumption of the foreign good at time t

z_t^d= (Z_t^d/P_t) = real stock of domestic money for domestic firms equity purchases by domestic residents at time t

Z_t^d= nominal stock of domestic money for domestic firms equity purchases by domestic residents at time t

z_t^{*d} = (Z_t^{*d}/P_t^*) = real stock of foreign money for foreign firms equity purchases by domestic residents at time t

Z_t^{*d} = nominal stock of foreign money for foreign firms equity purchases by domestic residents at time t

λ_{it} $(i = 1, 2, 3, 4, 5)$ = nonnegative Lagrange multiplier on budget constraints (8a – e) respectively at time t

$U(.,.)$ = utility function, common to both countries, with

$$U_1(.,.) > 0,\ U_2(.,.) > 0,\ U_{11}(.,.) < 0,\ U_{22}(.,.) < 0,$$
$$U_1(0,.) = U_2(.,0) = \infty,\ U_1(\infty,.) = U_2(.,\infty) = 0.$$

Equations (8a, b, c, d) are the cash-in-advance constraints on assets and consumption respectively. (8e) is the household budget constraint in real flow terms with dividend income as the main source to be used as tax payments, consumption, or additions to the money and equities stock. Equations (8f) are the initial conditions, and (8g, h, i, j) are the appropriate transversality conditions. The domestic government budget constraint is also a constraint for the domestic household unit. A symmetric problem holds for the foreign household.

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6. This assumption of common fixed subjective discount factors simplifies the analysis and is not critical in a world of two goods and perfectly pooled equilibrium. It may be defended on the grounds of two countries who peg to a world discount rate. In the one good models of Turnovsky and Bianconi [1992] and Bianconi [1993] this assumption is relaxed and it has important implications for the endogenous distribution of consumption across nations.

III. General Equilibrium and Steady State

I am going to focus on the stationary perfectly pooled equilibrium for quantities as in Lucas [1982], Svensson [1985], and Stockman and Svensson [1987].[7] The allocation of resources in this case is even between the two countries, allowing me to determine the price and aggregate quantity effects of the various distortions in the model. The general equilibrium of the world economy consists of the domestic (and its foreign counterpart) government budget constraint, (1), the domestic (and foreign) firm first order conditions to problem (7), the domestic household (and its foreign counterpart) cash constraints (8a,b,c,d), the domestic (and foreign) household first order condition to problem (8), and the goods, money, and equity markets equilibrium, given the even distribution. The general equilibrium, under certainty, is essentially a situation where all planned demands are equal to their corresponding real supplies, and all future variables are correctly anticipated.

The long-run stationary equilibrium of the economy is attained when all real variables are constant, or

$$k_{t+1} = k_t = k; \quad k^*_{t+1} = k^*_t = k^* \tag{9a}$$

$$c_{t+1} = c_t = c; \quad c^*_{t+1} = c^*_t = c^* \tag{9b}$$

$$\lambda_{it+1} = \lambda_{it} = \lambda_i, \; i = 1, 2, 3, 4, 5; \tag{9c}$$

$$\lambda^*_{it+1} = \lambda^*_{it} = \lambda^*_i, \; i = 1, 2, 3, 4, 5; \tag{9d}$$

$$\Delta(m_{t+1}) = 0 \rightarrow (1+p)(m' - m) = 0 \tag{9e}$$

$$\Delta(m^*_{t+1}) = 0 \rightarrow (1+p^*)(m^{*\prime} - m^*) = 0 \tag{9f}$$

where a prime over a variable indicates next period.

In equilibrium, the underlying market value of the firm is equal to its capital stock, or alternatively, there is no divergence between the equity value

7. The analysis is narrowed to the stationary state because, given the nonlinearities, a full dynamic characterization of the model would require approximation techniques beyond the scope of this paper. In addition, the stationary state seems to be the appropriate framework to analyze the no-arbitrage conditions that emerge from the equilibrium.

and the capitalized value of earnings, that is

$$V = q\,e = k \tag{10a}$$

$$V^* = q^* e^* = k^*. \tag{10b}$$

The governments financial policies (2a,b) together with (9e,f) imply that the steady state rate of inflation is equal to the rate of growth of money in each country, or

$$\mu_p = \mu \text{ and } \mu_p^* = \mu^*. \tag{10c}$$

The solution of the model is as follows. In the steady state general equilibrium, given the even distribution, the following equilibrium conditions for quantities are common to the domestic and foreign economies

$$z/2 = q\,e/2 = k/2 \tag{11a}$$

$$z^*/2 = q^* e^*/2 = k^*/2 \tag{11b}$$

$$m/2 = k/2 + c/2 \tag{11c}$$

$$m^*/2 = k^*/2 + c^*/2. \tag{11d}$$

The core equilibrium conditions for the solution of the aggregate domestic variables are described by

$$\beta\{[-(1+\mu-\beta)/\beta] + (1+i) - \tau_{c1}(\mu_q + \mu)\} = (1+\mu) \tag{12a}$$

$$\beta\{[-(1+\mu-\beta)/\beta] + (1+i) - \tau_{c2}^*(\mu_q + \mu - \mu_s)\} = (1+\mu) \tag{12b}$$

$$f_k(k) + 1 = \theta = 1 + i + \mu_q \tag{12c}$$

$$f(k) = c. \tag{12d}$$

The foreign aggregate variables are solved according to symmetric core conditions

$$\beta\{[-(1+\mu^*-\beta)/\beta] + (1+i^*) - \tau_{c1}^*(\mu_q^* + \mu^*)\} = (1+\mu^*) \tag{13a}$$

$$\beta\{[-(1+\mu^*-\beta)/\beta] + (1+i^*) - \tau_{c2}(\mu_q^* + \mu^* + \mu_s)\} = (1+\mu^*) \tag{13b}$$

$$f_k(k^*) + 1 = \theta^* = 1 + i^* + \mu_q^* \tag{13c}$$

$$f(k^*) = c^*. \tag{13d}$$

Equations (12a,b) and (13a,b) are arbitrage conditions that are central to the analysis in this paper, and require further explanation. Equation (12a) is the first order condition of the domestic resident with respect to the optimal choice of domestic equities in his/her portfolio. The left-hand-side denotes the discounted value of the gain incurred in holding an additional domestic equity net of the liquidity value of cash forgone, $(1 + \mu - \beta)/\beta$. This equates to the right-hand-side which describes the opportunity cost of holding cash. Equation (12b) is the first order condition of foreign residents with respect to the optimal choice of domestic equities in his/her portfolio. It is equivalent to (12a) but it involves the capital gains tax paid to the foreign government, τ^*_{c2}, and the capital gains or losses due to variations in the exchange rate, μ_s. In turn, the cost of capital of the domestic firm depends on the willingness of domestic and foreign residents to hold its equities, which, in turn, depends on the arbitrage opportunities embodied in (12a, b).

Equations (13a, b) are the foreign country analogous to (12a, b) and, therefore, symmetric. Thus, equation (13a) is the first order condition of foreign residents with respect to the optimal choice of foreign equities in his/her portfolio, and equation (13b) is the first order condition of domestic residents with respect to the optimal choice of foreign equities in his/her portfolio.

The solutions for the relative prices are given by

$$\Omega = (\lambda^*_5/\lambda_5) = [U_2(c/2, c^*/2)(1+\mu)]/[U_1(c/2, c^*/2)(1+\mu^*)] \quad (14a)$$

$$s = [U_2(c/2, c^*/2)(1+\mu)P]/[U_1(c/2, c^*/2)(1+\mu^*)P^*] \quad (14b)$$

$$\mu_s = (\mu - \mu^*)/(1+\mu^*) \quad (14c)$$

$$\lambda_3/\lambda_5 = \lambda^*_4/\lambda^*_5 = (1+\mu-\beta)/\beta \quad (14d)$$

$$\lambda_4/\lambda_5 = \lambda^*_3/\lambda^*_5 = (1+\mu^*-\beta)/\beta. \quad (14e)$$

Finally, each country balances its budget by endogenously adjusting the lump-sum tax/rebate accordingly[8]

8. Because this paper abstracts from government debt, the endogenous transfer scheme is essential to maintain the government budget balanced. If the government had to finance a required level of expenditures, then its financial decision would have an impact on the equilibrium allocation.

$$T = -(k/2)\{\tau_{c1}(\mu_q + \mu)\} - \Omega(k^*/2)\{\tau_{c2}(\mu_s + \mu_q + \mu)\} - \mu(k + c) \quad (15a)$$

$$T^* = -(k^*/2)\{\tau^*_{c1}(\mu^*_q + \mu^*)\} - (1/\Omega)(k/2)\{\tau^*_{c2}(\mu^*_q + \mu^* - \mu_s)\} - \mu^*(k^* + c^*). \quad (15b)$$

The system of equations (11)-(15) determine the solutions for the equilibrium prices and aggregate (and country-specific) quantities given the policy variables, μ, μ^*, τ_{c1}, τ^*_{c1}, τ_{c2}, and τ^*_{c2}; and the discount factor β.

IV. Alternative Equilibria and the Tax Structure

Let me focus on the core equilibrium conditions for the domestic economy. Given that the system (12) is block recursive, I going to focus on equations (12a)-(12b). This pair of equations shows the interdependence between tax policy, monetary policy, and dividend policy facing the government and firms.

The capital gains, μ_q, reflects the market price of the outstanding shares and is naturally an endogenous variable.[9] The other endogenous variable may be one of the following: (i) the dividend payout rate, i, chosen by firms; (ii) the capital gains tax rate, τ_{c1}, chosen by the government; or (iii) the rate of monetary growth, μ, chosen by the government. In turn, the equilibrium cost of capital, given by (12c), depends critically on the way tax, monetary, and dividend policy interact with each other.

In particular, this is the "corner solution problem" which has been emphasized by Slemrod [1988], among others. In his article, only certain combinations of capital income taxes allow both foreigners and domestic citizens to hold both domestic and foreign shares, or alternatively for the equilibrium to be an interior one. In the framework of this paper, only certain combinations of the rates of inflation, the rates of capital gains taxes, and dividend policies are consistent with both foreigners and domestic citizens

9. The equilibrium capital gain is paid out of retained earnings in each country. In equilibrium in each country:

$$\Delta V_{t+1} = 0 \rightarrow \mu_e = -\mu_q$$

which implies that in steady state RE adjusts endogenously to the changes in the rate of capital gains and equals [by (3c) with $I_t = 0$]

$$RE = k\,\mu_q.$$

holding both domestic and foreign shares, or alternatively with the equilibrium being an interior one. Thus, for each type of agent, domestic or foreign, two arbitrage restrictions are relevant, making it impossible to specify as well the rate of money growth, the capital gains taxes, and the dividend rate exogenously. One of these has to yield, and I describe three possible scenarios below.

A. Dividend Rate Accommodation

Consider the case where the dividend payout rate accommodates endogenously, leaving tax and monetary policy exogenous. Equations (12a)-(12b) solve for μ_q and i yielding

$$\mu_q = [\tau^*_{c2}(\mu - \mu^*)/(\tau^*_{c2} - \tau_{c1})] - \mu \tag{16a}$$

$$i = \{2(1+\mu) - \beta]/\beta\} + \{[\tau_{c1}\tau^*_{c2}(\mu - \mu^*)]/(\tau^*_{c2} - \tau_{c1})(1+\mu^*)\} - 1 \tag{16b}$$

These equations show the tax arbitrage restriction between the two countries in the term $(\tau^*_{c2} - \tau_{c1})$. This is because there is a linear dependence in (12a,b) such that if $\tau^*_{c2} = \tau_{c1}$ then there is no interior equilibrium. For instance, these restrictions are the subject of recent studies by Razin and Sadka [1991a, b], among others. However, they do not consider the firm dividend policy and the government monetary policy, and consequently its implications for the international transmission of tax policies on capital stocks and consumption.

Equations (16a, b) yield solutions for μ_q and i as a function of domestic and foreign monetary and tax policy, *i.e.* $\mu_q = \mu_q(\mu, \tau_{c1}, \mu^*, \tau^*_{c2})$ and $i = i(\mu, \tau_{c1}, \mu^*, \tau^*_{c2})$. Then, by (12c), the solution for the domestic capital stock (cost of capital) is given by

$$f_k(k) = i(\mu, \tau_{c1}, \mu^*, \tau^*_{c2}) + \mu_q(\mu, \tau_{c1}, \mu^*, \tau^*_{c2}) \tag{17}$$

and aggregate domestic consumption is obtained by (12d).

Symmetrically, for the foreign economy one obtains the functions $\mu^*_q = \mu^*_q(\mu^*, \tau^*_{c1}, \mu, \tau_{c2})$ and $i^* = i^*(\mu^*, \tau^*_{c1}, \mu, \tau_{c2})$. The solution for the foreign capital stock (cost of capital) is given by [recall (13c)]

$$f_k(k^*) = i^*(\mu^*, \tau^*_{c1}, \mu, \tau_{c2}) + \mu^*_q(\mu^*, \tau^*_{c1}, \mu, \tau_{c2}) \tag{18}$$

with foreign aggregate consumption given by (13d).

Several properties emerge from the equilibrium in equations (16)-(18). First, it shows how tax and monetary policy transmit internationally in the presence of integrated capital markets. These effects depend on the relative magnitudes of the capital gains tax rates and the rates of growth of money in each country. Second, the role of the differential taxation of capital gains is highlighted. If $\tau_{c1} = \tau_{c2} = \tau_c$ and $\tau^*_{c1} = \tau^*_{c2} = \tau^*_c$, the transmission of tax policy becomes simultaneous in the domestic and foreign economy. A change in τ_c(or τ^*_c) transmits directly to the other economy. The government looses one degree of freedom in the conduct of tax policy with respect to the way it impinges on the domestic and foreign economy. In other words, the differential tax treatment of capital gains eliminates the spillover of tax policy across countries.

Moreover, a symmetric tax structure effectively ignores the gains(or losses) associated with changes in the relative inflation rates, and its induced effects on the exchange rates. This may be seen from the arbitrage conditions of domestic residents with respect to domestic and foreign equities, (12a) and (13b). In equation (12a), domestic capital gains are realized in domestic currency and taxed at the rate τ_{c1}. In equation (13b), the capital gains of the domestic resident are subject to variations in the exchange rate because they are realized in foreign currency and must be transformed into domestic currency. They are taxed at the rate τ_{c2}. If the two rates are equated, or $\tau_{c1} = \tau_{c2} = \tau_c$, variations in the nominal exchange rate may easily induce capital flows in both directions which may be undesirable from a macro policy perspective. The differential tax treatment of the domestic and foreign capital gains may be an additional policy instrument used in order to adjust these induced capital flows.

Finally, equations (16)-(18) show that, in the presence of monetary and dividend policy, the pure residence principle of capital income taxation does not guarantee production efficiency.[10]

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10. Production efficiency is obtained when

$f_k(k) = f_k(k^*) = (1 - \beta)/\beta$

which is the modified golden rule.

B. Capital Gains Tax Accommodation

Consider now the case where the capital gains tax, τ_{c1}, accommodates endogenously, leaving dividend and monetary policy exogenous. The solution for μ_q and τ_{c1} is

$$\mu_q = \{\beta i - 2(1+\mu-\beta) - \beta\tau^*_{c2}\mu^*(1-\mu)\}/\beta\tau^*_{c2} \quad (19a)$$

$$\tau_{c1} = \{\beta i - 2(1+\mu\text{-}\beta)\}/\{\beta\mu + \beta i - 2(1+\mu-\beta) - \beta\tau^*_{c2}\mu^*(1-\mu)\}. \quad (19b)$$

The equilibrium is restricted by $0 \leq \tau_{c1} < 1$ which is assumed to be satisfied. Equations (19a, b) yield the functions $\mu_q = \mu_q(\mu, i, \mu^*, \tau^*_{c2})$, and $\tau_{c1} = \tau(\mu, i, \mu^*, \tau^*_{c2})$, with the solution for the domestic capital stock (cost of capital) given by

$$f_k(k) = i + \mu_q(\mu, i, \mu^*, \tau^*_{c2}). \quad (20)$$

where the dividend payout rate is exogenously given. Symmetrically, for the foreign economy one obtains the functions $\mu^*_q = \mu^*_q(\mu^*, i^*, \mu, \tau_{c2})$, and $\tau^*_{c1} = \tau^*(\mu^*, i^*, \mu, \tau_{c2})$, with the solution for the foreign capital stock (cost of capital) given by

$$f_k(k^*) = i^* + \mu^*_q(\mu^*, i^*, \mu, \tau_{c2}). \quad (21)$$

The role of the differential taxation of capital gains is more dramatic in this case. Note that when the domestic and foreign governments treat domestic and foreign capital gains differently from the point of view of taxation, the functions $\mu_q(\mu, i, \mu^*, \tau^*_{c2})$, $\tau(\mu, i, \mu^*, \tau^*_{c2})$, $\mu^*_q(\mu^*, i^*, \mu, \tau_{c2})$, and $\tau^*(\mu^*, i^*, \mu, \tau_{c2})$ depend entirely on exogenous parameters. This is because τ_{c2} and τ^*_{c2} are determined exogenously independently of the endogenous rates τ_{c1} and τ^*_{c1} which are levied on the domestic capital gains.

However, if the taxation of capital gains is not differentiated in both countries, *i.e.* $\tau_{c1} = \tau_{c2} = \tau_c$ and $\tau^*_{c1} = \tau^*_{c2} = \tau^*_c$, then the functions $\mu_q(.)$, $\tau(.)$, $\mu^*_q(.)$, and $\tau^*(.)$ are all interdependent. In this case, the endogenous tax rates will be given by the solution to the pair of simultaneous equations

$$\tau_c = \tau[\mu, i, \mu^*, \tau^*(\mu^*, i^*, \mu, \tau_c)] \quad (22a)$$

$$\tau^*_c = \tau^*[\mu^*, i^*, \mu, \tau(\mu, i, \mu^*, \tau^*_c)]. \quad (22b)$$

The implication of equations (22a, b) is that the size of the exogenous dividend payout rate of the domestic firm affects the cost of capital of the foreign firm and vice-versa through the channel of the endogenous tax rates. In this case, it is the exogenous dividend policy that transmits internationally since tax policy is endogenously determined and the differential tax treatment of capital gains eliminates the spillover of dividend policies across countries. Indeed, there is a trade off between dividend and tax policy in the open economy with integrated capital markets.

There is an implicit tax coordination problem in this case of capital gains tax accommodation. This arises when one country chooses to differentiate the capital gains tax with respect to domestic and foreign shares, and the other country chooses to tax domestic and foreign shares symmetrically. The solution in this case has a leader-follower flavor because the country that chooses to tax symmetrically may simply take the tax of the other country as given and choose its tax as in (19b). It is clear from above that, in an interior equilibrium with endogenous residence-based capital income taxation, production efficiency does not obtain.

C. Monetary Policy Accommodation

Consider the case where monetary policy accommodates endogenously, leaving capital gains taxes and dividend policy exogenous. The solution for m is given by

$$\mu = \{[-2(1-\beta) - \beta i](\tau^*_{c2} - \tau_{c1})(1+\mu^*) + (\beta\tau^*_{c2}\tau_{c1}\mu^*)\} / \{(2+\beta\tau_{c1})(\tau^*_{c1} - \tau_{c1})(1+\mu^*) + \beta\tau_{c1}[\tau_{c1}(1+\mu^*) - \tau^*_{c2}\mu^*]\} \quad (23a)$$

which yields the implicit function $\mu = \mu(\tau_{c1}, i, \mu^*, \tau^*_{c2})$. Then, the solution for μ_q is

$$\mu_q = \{\mu(\tau_{c1}, i, \mu^*, \tau^*_{c2})[\tau_{c1}(1+\mu^*) - \tau^*_{c2}\mu^*] - \tau^*_{c2}\mu^*\} / (\tau^*_{c2} - \tau_{c1})(1+\mu^*) \quad (23b)$$

which is an implicit function $\mu_q(\tau_{c1}, i, \mu^*, \tau^*_{c2})$. The main restriction to the equilibrium, in this case, is that (23a) must satisfy $1 + \mu > \beta$, in order to gen-

erate a positive liquidity value of money from (14d, e) and this restriction is assumed to be satisfied.

Equations (23a, b) yield the the solution for the domestic capital stock (cost of capital) given by

$$f_k(k) = i + \mu_q(\tau_{c1}, i, \mu^*, \tau^*_{c2}). \tag{24}$$

Symmetrically, for the foreign economy one obtains the functions $\mu^*_q = \mu^*_q(\tau^*_{c1}, i^*, \mu, \tau_{c2})$, and $\mu^* = \mu^*(\tau^*_{c1}, i^*, \mu, \tau_{c2})$, with the solution for the foreign capital stock (cost of capital) given by

$$f_k(k^*) = i^* + \mu^*_q(\tau^*_{c1}, i^*, \mu, \tau_{c2}). \tag{25}$$

The choice of monetary accommodation means implicitly that the government is choosing a source-based endogenous tax as opposed to the capital gains tax which is residence-based. If $\tau_{c1} = \tau_{c2} = \tau_c$ and $\tau^*_{c1} = \tau^*_{c2} = \tau^*_c$, the transmission of tax policy becomes simultaneous in the domestic and foreign economy as in the case of dividend rate accommodation, case A above. However, in this case, the channel of transmission of tax policy is through the endogenous money supplies. The property of this equilibrium is that tax policy basically determines the exchange rate by (14a, b), and an interaction between the exchange rate and tax rates emerges. Obviously, production efficiency does not obtain in this case as well.

V. The Inflation Tax

The lump-sum adjustment in equations (15a, b) shows the implications of the inflation tax versus the capital gains tax in this model. In effect, equations (15a, b) show that the capital gains tax is residence-based by assumption. For example, in the case of the domestic tax/rebate, it accrues on the portions of the domestic and foreign capital stocks held by domestic residents, *i.e.* the terms associated with $(k/2)$ and $(k^*/2)$ in (15a). However, the inflation tax is source-based. In the case of the domestic tax/rebate, it accrues on the total domestic capital stock and consumption of domestic and foreign residents, *i.e.* the term associated with $(k + c)$ in (15a).

In a recent paper, Canzoneri [1989] focused on the adverse incentives

induced by the inflation tax and its incidence on foreigners. In another contribution, Bohn [1991] examined these effects in the case of nominal debt held by foreigners. The new point of the present analysis is that these effects materialize as the policy maker faces a trade-off between residence- and source-based taxation when choosing the mix of capital gains and inflation tax. This may be seen by noting that the lump-sum tax rebate may be thought of as the sustainable amount of government expenditures in each country. *Ceteris Paribus* the policy maker may choose to sustain a given level of government expenditures transferring the burden of taxation to foreigners by switching from the residence-based capital gains taxation to the source-based inflation taxation. The attractiveness of the inflation tax as a source-based tax is that its collection does not rely on assumptions of effective enforcement as, for example, in Razin and Sadka [1991a], or in this paper for that matter. On the other hand, the relative effects on the tax bases may lead to Laffer-style effects reducing the scope for this choice.

VI. Concluding Remarks

The main result of this paper is that monetary and fiscal policy, on the one hand, and dividend policy on the other hand, all interact in an open economy framework with integrated capital markets. In particular, depending on the type of accommodation chosen, monetary, fiscal, or dividend, the equilibrium must satisfy a set of distinct restrictions.

It is shown that in the three cases of dividend, fiscal, and monetary policy accommodation studied, the production efficiency theorem under pure residence-based taxation does not obtain. The normative implications of the model are the usual ones that capital income taxes should be zero and money should contract at the rate of time preference in both countries in order to attain production efficiency.[11]

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11. In the model presented here, production efficiency (the modified golden rule) obtains when

$$\tau_{c1} = \tau_{c2} = \tau^*_{c1} = \tau^*_{c2} = 0 \text{ and } 1 + \mu = 1 + \mu^* = \beta,$$

i.e. when there are no capital income tax distortions and money contracts at the rate of time preference (the Friedman optimum quantity of money rule).

The differential treatment of capital gains taxes is shown to allow for an elimination of the spillover effect of tax policy across countries on the capital stocks. The result is robust to the three alternative accommodation rules considered. Furthermore, it allows for a distinctive treatment of domestic inflation gains (losses) versus exchange rate and/or foreign inflation gains or losses. Indeed, it may be considered as a policy tool in the presence of residence-based taxation, whenever the policy maker intends to reduce the international transmission of capital income taxes. Obviously, the reason behind this strong result is the plausible assumption of two distinct goods.

One caveat of the present analysis is that the arbitrage conditions for an interior equilibrium are very restrictive. In order to relax these restrictions, effort should be directed to the introduction of uncertainty and risk aversion. Once uncertainty and risk aversion enter the picture, it might be possible for domestic and foreign residents to hold assets with different rates of return and risk characteristics.

References

Bianconi, M. [1993], "Fiscal Policy in a Simple Two-country Dynamic Model," *Journal of Economic Dynamics and Control* (forthcoming).

Bohn, H. [1991], "Time Consistency of Monetary Policy in the Open Economy," *Journal of International Economics*, 30; pp. 249-266.

Brock, W. A. and S. J. Turnovsky [1981], "The Analysis of Macroeconomic Policies in Perfect Foresight Equilibrium," *International Economic Review*, 22; pp. 179-209.

Canzoneri, M. B. [1989], "Adverse Incentive in the Taxation of Foreigners," *Journal of International Economics*, 27; pp. 283-297.

Diamond, P. A. and J. Mirrlees [1971], "Optimal Taxation and Public Production I: Production Efficiency," *American Economic Review*, 61; pp. 8-27.

Frenkel, J. A., A. Razin, and E. Sadka [1991], *International Taxation in an Integrated World*, The MIT Press, Cambridge.

Giovannini, A. [1990], "International Capital Mobility and Capital Income Taxation: Theory and Policy," *European Economic Review*, 34; pp. 480-488.

Giovannini, A. and J. R. Hines [1991], "Capital Flight and Tax Competition: Are There Viable Solutions to Both Problems?" Giovannini, A. and C. Mayer, Eds., *European Financial Integration;* pp. 172-210, Cambridge University Press, Cambridge.

Gordon, R. H. [1986], "Taxation of Investment and Savings in a World Economy," *American Economic Review,* 76; pp. 1086-1102.

Gordon, R. H. [1990], "Can Capital Income Taxes Survive in Open Economies," *NBER Working Paper Series,* No. 3416, August.

Helpman, E. and A. Razin [1985], "Floating Exchange Rates with Liquidity Constraints in Financial Markets," *Journal of International Economics,* 19; pp. 99-117.

Ihori, T. [1991], "Capital Income Taxation in a World Economy: A Territorial Versus a Residence System," *Economic Journal,* 101; pp. 958-965.

Lucas, R. E., Jr. [1982], "Interest Rates and Currency Prices in a Two-Country World," *Journal of Monetary Economics,* 10; pp. 335-359.

Lucas, R. E., Jr. [1990], "Liquidity and Interest Rates," *Journal of Economic Theory,* 50; pp. 237-264.

Razin, A. and E. Sadka [1991a], "International Tax Competition and Gains from Tax Harmonization," *Economics Letters,* 37; pp. 69-76.

Razin, A. and E. Sadka [1991b], "International Fiscal Policy Coordination and Competition: An Exposition," *NBER Working Paper,* No. 3779, July.

Sinn, H.-W. [1991], "The Non-neutrality of Inflation for International Capital Movements," *European Economic Review,* 34; pp. 1-22.

Slemrod, J. [1988], "Effects of Taxation with International Capital Mobility," Aaron, H., *et. al.,* Eds., *Uneasy Compromise: Problems of a Hybrid Income-Consumption Tax;* pp. 115-148. The Brookings Institution, Washington, D.C.

Stockman, A. C. and L. E. O. Svensson [1987], "Capital Flows, Investment, and Exchange Rates," *Journal of Monetary Economics* 19; pp. 171-201.

Svensson, L. E. O. [1985], "Currency Prices, Terms of Trade, and Interest Rates: A General Equilibrium Asset-pricing Cash-in-advance Approach," *Journal of International Economics* 18; pp. 17-41.

Turnovsky, S. J. and M. Bianconi [1992], "The International Transmission of Tax Policies in a Dynamic World Economy," *Review of International Economics,* 1; pp. 49-72.