Economics Bulletin

Volume 31, Issue 3

The dividend puzzle and tax: a note

Frank Strobel
University of Birmingham

Abstract

The dividend puzzle, where consumers prefer capital gains to dividends due to differences in taxation, is examined in a two-period general equilibrium model with heterogeneous agents. Stressing the importance of interfirm equity holdings and their tax treatment, different scenarios where dividends are paid to some or all consumers in equilibrium are exposed, giving rise to the potential formation of tax clienteles.

Many thanks to an anonymous referee for valuable comments; the usual disclaimer applies.
Citation: Frank Strobel, (2011) "The dividend puzzle and tax: a note", *Economics Bulletin*, Vol. 31 No. 3 pp. 2736-2743.
Contact: Frank Strobel - f.strobel@bham.ac.uk.
Submitted: August 05, 2010. **Published:** September 30, 2011.

1. Introduction

When shareholders can receive equity income either as dividends or in form of capital gains when selling their shares, differential taxation of the two may lead to the dividend puzzle where firms would be expected (counterfactually) not to distribute any dividends at all; this goes back to the seminal papers by Miller and Modigliani (1961) and Black (1976). Asymmetric information frameworks (e.g. Ross, 1977; Bhattacharya, 1979; Hakansson, 1982 and Burnheim, 1991) have been drawn upon extensively to explain the observed payment of dividends; however, differential transaction costs (e.g. Farrar/Selwyn, 1967 and Baumol/Malkiel, 1967) or share purchase restrictions on firms (e.g. Auerbach, 1979; Bradford, 1981 and King, 1977) can generate similar results in ordinary common information structures. Here we follow the latter approach, using a simple two-period general equilibrium model with heterogeneous agents to explore the implications of particular equity (re)purchase and taxation constraints,[1] stressing the importance of interfirm equity holdings as suggested by Miller (1988). We are able to characterize equilibria in which consumers realize only capital gains, and the dividend puzzle thus arises, as well as other scenarios where dividends are distributed to some or all consumers in equilibrium and heterogeneity in consumers' tax positions may give rise to the formation of tax clienteles concerning their portfolio choices.

Section 2 now sets up the model, Section 3 derives and discusses our results, and Section 4 concludes the paper.

2. Model

We consider a two-date environment with dates $t = 0, 1$. Consumers $i = 1 \dots m$ have endowments of the single, nonstorable commodity $\overline{x}_i$ in period 0 and value consumption x_i in period 1. Firms $j = 1 \dots n$ invest x_j in period 0 to produce $y_j = f_j(x_j)$ in period 1. There are asset markets for equity a_j issued by firms j, trading at prices p_{j0} and p_{j1} in periods 0 and 1 and paying dividends d_j in period 1; the commodity is the numeraire in both periods. Taxes are levied on both firms and consumers. We now turn more explicitly to the agents' optimization problems and the characterization of competitive equilibrium.

Firm j issues equity $a_{jj0} < 0$ to finance its production plan and invests $x_j > 0$ in period 0, where (pure) profits $\pi_j \geq 0$ arise as a residual. In period 1 it sells its output $y_j = f_j(x_j)$, acquires a portfolio of other firms' equity $a_{fj1} \geq 0$ (where f is defined such that $f \neq j$) and adjusts its own equity's position to $a_{jj1} \leq 0$;[2] it pays corporate taxes T_j^C and distributes after-tax dividends d_j on its outstanding equity. Let the firm's valuation function[3] be $V_j = \pi_j$ and the firm's production function $f_j(x_j)$ have standard neoclassical properties. Then firm

[1] The closest predecessor to our paper in this sense might be Brennan (1970).

[2] Clearly, $a_{jj1} > a_{jj0}$ constitutes the firm repurchasing its own shares.

[3] The construct of firms maximizing their (pure) profits, which are then assigned to consumers in equilibrium, goes back to Arrow and Debreu (1954).

j solves

$$\max_{a_{jj0},a_{jj1},a_{fj1},x_j} \pi_j \qquad \text{s.t.} \qquad p_{j0}a_{jj0} + x_j + \pi_j = 0$$
$$-d_j a_{jj1} + T_j^C - f_j(x_j) - \sum_f d_f a_{fj1} + p_{j1}(a_{jj1} - a_{jj0}) + \sum_f p_{f1} a_{fj1} = 0$$
$$a_{jj0} < 0 \qquad a_{jj1} \leq 0 \qquad a_{fj1} \geq 0 \qquad x_j > 0$$

i.e. it maximizes its (pure) profits subject to the first and second period budget constraints, and the constraints specifying the first and second period equity holding restrictions and positive investment, respectively.

Consumer i has an endowment of commodities $\overline{x}_i > 0$, shares $\theta_{ji} \geq 0$ in firms' (pure) profits (where $\sum_i \theta_{ji} = 1 \ \forall j$) and acquires a portfolio of firms' equity $a_{ji0} \geq 0$ in period 0. She adjusts the portfolio to $a_{ji1} \geq 0$ (thereby potentially realizing capital gains), pays income taxes T_i^I and consumes $x_i > 0$ in period 1. Assume there exists a utility function for the consumer $U_i(x_i)$ which is sufficiently well-behaved. Then consumer i solves

$$\max_{a_{ji0},a_{ji1},x_i} U_i(x_i) \qquad \text{s.t.} \qquad \sum_j p_{j0}a_{ji0} - \overline{x}_i - \sum_j \theta_{ji}\pi_j = 0$$
$$x_i + T_i^I - \sum_j d_j a_{ji1} + \sum_j p_{j1}(a_{ji1} - a_{ji0}) = 0$$
$$a_{ji0} \geq 0 \qquad a_{ji1} \geq 0 \qquad x_i > 0$$

i.e. she maximizes her utility subject to the first and second period budget constraints, and the constraints specifying the first and second period equity holding restrictions and positive consumption, respectively.

An equilibrium in this economy is then defined as a set of asset prices p^*, and allocations $(a_i^*, x_i^*, a_j^*, x_j^* \ \forall i, j)$ such that: (a_i^*, x_i^*) solve the consumer's problem $\forall i$, (a_j^*, x_j^*) solve the firm's problem $\forall j$, and all markets clear. We implicitly assume that all tax revenue is disposed of by an otherwise tacit government.

3. Equilibrium scenarios

We now use the framework described in Section 2 to study the implications of several specific tax formulations[4] and equity holding/repurchasing restrictions. In particular, we shall determine conditions under which the dividend puzzle, in the sense of dividends not being paid to consumers in equilibrium, may or may not arise in these different scenarios.

3.1 Unconstrained equity repurchase/interfirm equity

The equilibrium where sufficiently unrestricted arbitrage implies the corner solution of the dividend puzzle is easily demonstrated. Let corporate taxes be $T_j^C = t^c f_j(x_j)$ where $0 <$

[4] While we restrict ourselves here to simple piecewise linear tax functions, this approach potentially allows for analysis of very complex tax structures.

$t^c < 1$ (the corporate tax rate) and define consumers' income taxes as $T_i^I = \sum_j T_{ji}^I$ where

$$T_{ji}^I = \begin{cases} t_i^d d_j a_{ji1} - t_i^g p_{j1}(a_{ji1} - a_{ji0}) & \text{for} \quad a_{ji1} \leq a_{ji0} \\ t_i^d d_j a_{ji1} & \text{for} \quad a_{ji1} > a_{ji0} \end{cases}$$

and $0 < t_i^d < 1$ and $0 < t_i^g < 1$ are consumer i's dividend and capital gains tax rate, respectively.[5]

Using these tax functions in the general model of Section 2, the firm's first order conditions become (A.1)–(A.6) (see the Appendix), with λ_{j0} and λ_{j1} the Lagrange multipliers on the first and second period budget constraints, respectively. Similarly, the consumer's first order conditions (allowing for the non-differentiability at $a_{ji1} = a_{ji0}$) become (A.7)–(A.11), with λ_{i0} and λ_{i1} the respective Lagrange multipliers.

Now we can state

Lemma 1. *The consumer's holdings of a_{ji1} depend on asset returns and taxes as follows:*

$$a_{ji1} = 0 \quad \textit{for} \quad \tfrac{1-t_i^d}{1-t_i^g} d_j < p_{j1} \qquad ; \qquad 0 \leq a_{ji1} \leq a_{ji0} \quad \textit{for} \quad \tfrac{1-t_i^d}{1-t_i^g} d_j = p_{j1}$$
$$a_{ji1} = a_{ji0} \quad \textit{for} \quad (1-t_i^d) d_j < p_{j1} < \tfrac{1-t_i^d}{1-t_i^g} d_j \qquad ; \qquad a_{ji1} \geq a_{ji0} \quad \textit{for} \quad (1-t_i^d) d_j = p_{j1}$$

Proof. For $t_i^g > 0$, Lemma 1 follows from (A.8).

Intuitively, consumers will choose to receive their equity income as a portfolio of dividends and/or capital gains depending on the respective after-tax payoffs, $(1-t_i^d)d_j$ and $(1-t_i^g)p_{j1}$, and the asset's price p_{j1}.

It is then straightforward to show

Proposition 1. *As long as there is at least one firm in the corporate sector that is unconstrained in (re)purchasing equity a_j from consumers, and if $0 < t_i^g < t_i^d \; \forall i$, no dividends d_j will be paid to consumers in equilibrium (the dividend puzzle) and $p_{j1} = d_j$.*

Proof. Consider $a_{jj1} = 0$ (firm j repurchases all its equity) and thus $a_{jf1} = 0 \; \forall f$: it implies $p_{j1} = d_j$ from (A.2) and (A.3). Then for $0 < t_i^g < t_i^d \; \forall i$, this is consistent with $\left[(1-t_i^d)/(1-t_i^g)\right] d_j < p_{j1}$ and thus $a_{ji1} = 0 \; \forall i$ (the dividend puzzle) from Lemma 1. Alternatively, consider $a_{jj1} < 0$: it implies $p_{j1} = d_j$ from (A.2) and thus $a_{ji1} = 0 \; \forall i$ by above reasoning, which is feasible if $a_{jf1} > 0$ for at least one f in equilibrium.

We note that the equilibrium price p_{j1} is determined by no-arbitrage in the corporate sector in this scenario. The dividend puzzle then follows directly if the capital gains tax is lower than the dividend tax for all consumers in the fully unconstrained case. Furthermore, this result continues to hold even if firm j does not repurchase its own equity, as long as there is at least one other firm f that can take a counter-position to the consumers' preference, given the equity price p_{j1}, to receive only capital gains; note that dividends are being paid between firms in this case. This result forcefully illustrates the importance of interfirm equity holdings in this context, as suggested in Miller (1988).

[5] We consider a classical tax system with double taxation of corporate income.

3.2 Constrained equity repurchase and partial taxation of interfirm dividends

For an alternative scenario, let us now assume that firms cannot repurchase their own shares but are allowed to hold other firms' equity; we further introduce partial taxation of interfirm dividends, so that now $T_j^C = t^c \left(f_j(x_j) + \vartheta \sum_f d_f a_{fj1} \right)$ where $0 < \vartheta < 1$. The consumer's first order conditions then remain (A.7)–(A.11) as in Section 3.1, whereas the firm's first order conditions become (A.12)–(A.16) (see the Appendix), allowing us to obtain

Proposition 2. *With constrained equity repurchase and partial taxation of interfirm dividends, no dividends d_j will be paid to consumers in equilibrium (i.e. the dividend puzzle arises) if $(1 - t_i^g)(1 - \vartheta t^c) > (1 - t_i^d)$ $\forall i$.*

Proof. Consider $a_{jf1} > 0$ for at least one f in equilibrium: it implies $p_{j1} = (1 - \vartheta t^c)d_j$ from (A.13), requiring $\max_i(1 - t_i^d) \leq (1 - \vartheta t^c)$ as otherwise (A.8) would be violated for all i satisfying $(1 - t_i^d) > (1 - \vartheta t^c)$. This clearly holds if $(1 - t_i^g)(1 - \vartheta t^c) > (1 - t_i^d)$ $\forall i$, implying $a_{ji1} = 0$ $\forall i$ (the dividend puzzle) from Lemma 1.

Thus, the dividend puzzle will arise in this scenario if the interfirm dividend tax is relatively low and capital gains taxes are sufficiently lower than dividend taxes for all consumers. The equilibrium price p_{j1} is then determined in the corporate sector, implying positive interfirm holdings of equity a_j. This case, apart from the additional interfirm dividend tax factor, is very similar to the unconstrained scenario described by Proposition 1.

We can further obtain conditions under which the dividend puzzle will not arise in this context, as stated in

Proposition 3. *With constrained equity repurchase and partial taxation of interfirm dividends, no second period asset trades will take place (i.e. dividends will be paid to all consumers on their initial holdings of equity a_j, with no interfirm equity holdings) if $(1 - t_i^d)/(1 - t_i^g) > \max\left[(1 - \vartheta t^c), \max_i(1 - t_i^d)\right]$ $\forall i$. Otherwise, consumers will separate into four different tax clienteles according to their relative tax positions, in line with Lemma 1 where $p_{j1} = \left\{\max\left[(1 - \vartheta t^c), \max_i(1 - t_i^d)\right]\right\} d_j$; there will be no interfirm equity holdings if $\max_i(1 - t_i^d) > (1 - \vartheta t^c)$.*

Proof. More generally, $a_{jf1} > 0$ for at least one f in equilibrium, and thus $p_{j1} = (1 - \vartheta t^c)d_j$ as in Proposition 2, are feasible for $\max_i(1 - t_i^d) \leq (1 - \vartheta t^c)$ as long as there exists at least one i satisfying $(1 - \vartheta t^c) \geq (1 - t_i^d)/(1 - t_i^g)$. In this case, from Lemma 1, $a_{ji1} = 0$ for all i satisfying $(1 - t_i^d)/(1 - t_i^g) < (1 - \vartheta t^c)$, $0 \leq a_{ji1} \leq a_{ji0}$ for all i satisfying $(1 - t_i^d)/(1 - t_i^g) = (1 - \vartheta t^c)$, $a_{ji1} = a_{ji0}$ for all i satisfying $(1 - t_i^d)/(1 - t_i^g) > (1 - \vartheta t^c) > (1 - t_i^d)$, and $a_{ji1} \geq a_{ji0}$ for all i satisfying $(1 - t_i^d) = (1 - \vartheta t^c)$. However, with $(1 - \vartheta t^c) < (1 - t_i^d)/(1 - t_i^g)$ $\forall i$ we get $a_{ji1} = a_{ji0}$ $\forall i$ implying $a_{jf1} = 0$ $\forall f$. Now consider $\max_i(1 - t_i^d) > (1 - \vartheta t^c)$: if $a_{ji1} > a_{ji0}$ for at least one i in equilibrium, $p_{j1} = \max_i(1 - t_i^d)d_j$ and thus $a_{jf1} = 0$ $\forall f$ from (A.13) (note that $p_{j1} > (\max_i(1 - t_i^d))d_j$ implies $a_{ji1} \leq a_{ji0}$ $\forall i$ from Lemma 1 (a contradiction), while $p_{j1} < (\max_i(1 - t_i^d))d_j$ violates no-arbitrage for all i satisfying $p_{j1} < (1 - t_i^d)d_j \leq (\max_i(1 - t_i^d))d_j$ from (A.8)). Then, from Lemma 1, $a_{ji1} = 0$ for all i satisfying $(1 - t_i^d)/(1 - t_i^g) < \max_i(1 - t_i^d)$, $0 \leq a_{ji1} \leq a_{ji0}$ for all i satisfying $(1 - t_i^d)/(1 - t_i^g) = \max_i(1 - t_i^d)$, $a_{ji1} = a_{ji0}$ for all i

satisfying $(1-t_i^d)/(1-t_i^g) > \max_i(1-t_i^d) > (1-t_i^d)$, and $a_{ji1} \geq a_{ji0}$ for all i satisfying $\max_i(1-t_i^d) = (1-t_i^d)$. Clearly, $a_{ji1} = a_{ji0}$ $\forall i$ if $(1-t_i^d)/(1-t_i^g) > \max_i(1-t_i^d)$ $\forall i$. Therefore, $p_{j1} = \left\{\max\left[(1-\vartheta t^c), \max_i(1-t_i^d)\right]\right\} d_j$, and $a_{ji1} = a_{ji0}$ $\forall i$ if $(1-t_i^d)/(1-t_i^g) > \max\left((1-\vartheta t^c), \max_i(1-t_i^d)\right)$ $\forall i$ generally.

The two basic candidates for the equilibrium price p_{j1} in this framework are those arising in the corporate and consumer sectors, respectively. Clearly, only the higher of the two can support the equilibrium. We see that dividends will be paid to at least some consumers in this scenario if the interfirm dividend tax is sufficiently high and capital gains taxes are sufficiently elevated compared to dividend taxes for some or all consumers. If the equity price p_{j1} is determined in the consumer sector, by the individual with the highest after-tax dividend payoff $(1-t_i^d)d_j$, interfirm equity holdings will be zero. There will be no second period asset trades at all, i.e. dividends will be paid to all consumers on their initial holdings of equity a_j and there are no interfirm equity holdings, if no consumer is willing to sell equity a_j at the prevailing equilibrium price p_{j1}, be it determined in the corporate and consumer sectors. Otherwise, consumers will form tax clienteles by structuring their portfolios according to their relative tax positions, in line with Lemma 1 given the prevailing equity price p_{j1}. This framework thus proves sufficiently rich to allow nontrivial predictions about when the dividend puzzle may or may not arise, outlining the importance of both interfirm equity holdings and the taxation of interfirm dividends for whether or not dividends can be expected to be paid to consumers in equilibrium.

4. Conclusion

We used a simple two-period general equilibrium model with heterogeneous agents to explore the implications of particular equity (re)purchase and taxation constraints for the occurrence of the dividend puzzle, stressing the importance of interfirm equity holdings in this context. We characterized equilibria in which consumers realize only capital gains, and the dividend puzzle thus arises, as well as other scenarios where dividends are distributed to some or all consumers in equilibrium and heterogeneity in consumers' tax positions might give rise to the formation of tax clienteles regarding their portfolio choices. Our model highlighted the particular importance of interfirm equity holdings and their tax treatment for the discussion of the dividend puzzle, an aspect that might be interesting to pursue further in future work.

A. Appendix

Firm's first order conditions (Section 3.1):

$$-\lambda_{j0}p_{j0} + \lambda_{j1}p_{j1} = 0 \tag{A.1}$$

$$\lambda_{j1}\left(-p_{j1} + d_j\right) \geq 0 \qquad a_{jj1} \leq 0$$

$$a_{jj1}\left(\lambda_{j1}\left(-p_{j1} + d_j\right)\right) = 0 \tag{A.2}$$

$$\lambda_{j1}\left(-p_{f1} + d_f\right) \leq 0 \qquad a_{fj1} \geq 0$$

$$a_{fj1}\left(\lambda_{j1}\left(-p_{f1} + d_f\right)\right) = 0 \tag{A.3}$$

$$-\lambda_{j0} + \lambda_{j1}(1 - t^c)\frac{\partial f_j}{\partial x_j} = 0 \tag{A.4}$$

$$p_{j0}a_{jj0} + x_j + \pi_j = 0 \tag{A.5}$$

$$-d_j a_{jj1} - (1 - t^c)f_j(x_j) - \sum_f d_f a_{fj1} + p_{j1}(a_{jj1} - a_{jj0}) + \sum_f p_{f1}a_{fj1} = 0 \tag{A.6}$$

Consumer's first order conditions (Sections 3.1–3.2):

$$-\lambda_{i0}p_{j0} + \lambda_{i1}(1 - t_i^g)p_{j1} = 0 \qquad \text{for} \qquad 0 \leq a_{ji1} < a_{ji0} \tag{A.7}$$

$$-\lambda_{i0}p_{j0} + \lambda_{i1}p_{j1} \leq 0 \qquad \text{and} \qquad a_{ji0}\left(-\lambda_{i0}p_{j0} + \lambda_{i1}p_{j1}\right) = 0$$

$$\text{for} \qquad 0 \leq a_{ji0} < a_{ji1}$$

$$\lambda_{i1}\left(-(1 - t_i^g)p_{j1} + (1 - t_i^d)d_j\right) \leq 0 \qquad \text{and} \tag{A.8}$$

$$a_{ji1}\left(\lambda_{i1}\left(-(1 - t_i^g)p_{j1} + (1 - t_i^d)d_j\right)\right) = 0 \qquad \text{for} \qquad 0 \leq a_{ji1} < a_{ji0}$$

$$\lambda_{i1}\left(-p_{j1} + (1 - t_i^d)d_j\right) = 0 \qquad \text{for} \qquad 0 \leq a_{ji0} < a_{ji1}$$

$$\frac{\partial U_i}{\partial x_i} - \lambda_{i1} = 0 \tag{A.9}$$

$$\sum_j p_{j0}a_{ji0} - \overline{x}_i - \sum_j \theta_{ji}\pi_j = 0 \tag{A.10}$$

$$x_i + T_i^I - \sum_j d_j a_{ji1} + \sum_j p_{j1}(a_{ji1} - a_{ji0}) = 0 \tag{A.11}$$

Firm's first order conditions (Section 3.2):

$$-\lambda_{j0}p_{j0} + \lambda_{j1}d_j = 0 \tag{A.12}$$

$$\lambda_{j1}\left(-p_{f1} + (1 - \vartheta t^c)d_f\right) \leq 0 \qquad a_{fj1} \geq 0$$

$$a_{fj1}\left(\lambda_{j1}\left(-p_{f1} + (1 - \vartheta t^c)d_f\right)\right) = 0 \tag{A.13}$$

$$-\lambda_{j0} + \lambda_{j1}(1 - t^c)\frac{\partial f_j}{\partial x_j} = 0 \tag{A.14}$$

$$p_{j0}a_{jj0} + x_j + \pi_j = 0 \tag{A.15}$$

$$-d_j a_{jj0} - (1 - t^c)f_j(x_j) - (1 - \vartheta t^c)\sum_f d_f a_{fj1} + \sum_f p_{f1}a_{fj1} = 0 \tag{A.16}$$

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