RICARDIAN EQUIVALENCE AND THE VALUE OF FIRMS IN THE CAPITAL MARKET

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The main idea of this article is that a rise in permanent general government consumption increases the permanent taxation imposed on firms and reduces the net present value of their profits and hence reduces their net present value. This hypothesis was examined empirically for Israel in the period 1974-2002 and a significant negative correlation between public consumption and the value of firms was found.

The assumption that a rise in public consumption erodes private wealth is the motive for examining the mechanism linking private and public consumption. The hypothesis proposed here is that private consumption is a function of public consumption even if consumers have not internalized the government's budget constraint. For a rise in public consumption to lead to a decline in the value of firms, the erosion of the public's wealth, and the reduction of private consumption, it is sufficient that agents active in the capital market internalize the government's budget constraint. In other words, an increase in permanent public consumption has a negative wealth effect, thus reducing private wealth even when individuals (consumers) do not internalize the government's budget constraint.

The empirical part of the article tests the hypothesis that the capital market is the main channel through which the above mechanism (Ricardian equivalence) operates in Israel. The regressions show that a shift in public consumption affects private consumption only through the change in firms' value. For a given value of shares, public consumption does not affect private consumption.

1. INTRODUCTION

The effects of the financing of public consumption on private consumption, savings, and the interest rate have been dealt with extensively in the macroeconomic literature. According to the Keynesian approach, private consumption is a function of current disposable income, which increases when public consumption is financed by debt rather than by taxes. Hence as the debt component in the financing of public consumption increases, so does private consumption. An increase in public consumption unaccompanied by a rise in taxes does not reduce disposable income, and hence, according to this approach, does not affect private consumption. An increase in total private and public consumption in an economy that is closed to capital flows will cause the interest rate to rise.

In contrast, the Ricardian approach (Barro, 1974) claims that private consumption is a function of permanent disposable income, which is equal to permanent income *less* permanent taxes. Thus, since individuals internalize the government's inter-temporal budget constraint, permanent taxes are a function of permanent public consumption and the public debt. For a given level of permanent public consumption, a reduction in taxes in the present implies an increase in the future; the change in timing does not affect permanent taxes, and hence does not affect consumption or the interest rate. A permanent increase in public consumption will, however, cause permanent taxes to rise, and will therefore reduce private consumption, whether or not it is accompanied by an increase in taxes in the present.

This approach is based on the assumption that the marginal utility of consumption declines, i.e., that the utitlty function is concave. The more concave the utility function, the greater the loss of welfare due to the deviation of consumption from its optimal level in that period. Consequently, in order to avoid a reduction in utility, precise information about the level of permanent disposable income is required. Thus, the more concave the consumption function, the greater the individual's need for information regarding both their permanent disposable income and public expenditure. The lower the cost of obtaining and internalizing this information, and the more concave the utility function, the greater the utility of individuals to internalize the government's budget constraint.

The Ricardian contention that the method of financing the budget deficit does not affect private consumption or the interest rate depends on three additional assumptions: a. individuals internalize the utility of their offspring; b. there exists an efficient capital market, in which the interest rate is the same for borrowers and lenders; c. there are no distorting taxes. Even though each of these assumptions seems quite far-fetched, many of the empirical studies that have examined Ricardian equivalence have been unable to reject it. The assumption of the present study is that private consumption may be a function of public consumption even if individuals do not internalize the government's budget constraint; it is sufficient that only agents active in the capital market do so.

There is a substantive difference between the implications of Ricardian equivalence for consumption and those for the value of firms as measured by the stock market. Private consumption is a weighted average of the consumption behavior of all 'Ricardian' and 'non-Ricardian' individuals. Since an economy is comprised of individuals facing a liquidity constraint and individuals with only partial information, the Ricardian hypothesis regarding consumption is only partially valid. The decision to invest in the stock market differs from the decision to consume, since it can reasonably be assumed that most individuals invest in the stock market via financial intermediaries who are able to respond rapidly to new information. Investors who do not use financial intermediaries and thus do not internalize the government's budget constraint will not affect the value of shares because more sophisticated investors will trade with them until the price of a firm reflects its true economic value. Thus, individuals who err in internalizing the government's budget constraint will affect total consumption in the economy but not the value of firms on the stock market, and therefore we can expect the market capitalization of firms to incorporate the government's budget constraint.

The model reveals a transmission mechanism whereby government affects 'non-Ricardian' consumers. The incorporation of the government's budget constraint in the market capitalization

of firms implies that a rise in permanent public consumption erodes individuals' wealth. An increase in permanent public consumption will also reduce the wealth of individuals who do not internalize the government's budget constraint. According to the Ricardian approach, private consumption is a function of permanent taxes, and the timing of tax collection is irrelevant. The hypothesis of this paper is that the Ricardian result can obtain even when consumers do not internalize the government's budget constraint. For the value of firms to reflect the permanent taxes imposed on them, it is sufficient that agents active in the capital market internalize this constraint. Thus the capital market is the transmission mechanism through which permanent taxes impact on private wealth and hence on private consumption.

In the empirical part of the paper we use data from Israel to examine the model's two hypotheses:
   a.   An increase in permanent public expenditure reduces the total yield on shares.
   b.   The capital market is the channel through which fiscal policy affects private consumption.

2. THE TAXATION OF CAPITAL IN THE KEYNESIAN MODEL

In the Keynesian model consumers do not internalize the government's budget constraint, and hence an increase in public consumption unaccompanied by a rise in taxes does not affect private consumption. We accept the assumptions of the Keynesian model and in addition we assume that firms are taxed and that the capital market correctly prices the shares of firms. Under these assumptions a rise in permanent public consumption unaccompanied by an increase in taxes will reduce the value of firms. As a result, private wealth will shrink, and the wealth effect will induce individuals to reduce their consumption. Thus, the decline in private consumption is not dependent on whether consumers internalize the government's budget constraint. It is sufficient that agents active in the capital market correctly price the present value of taxes.

The motivation of agents active in the capital market to internalize the government's budget constraint differs from that of individuals. The former are motivated by the desire to maximize yield (for a given level of risk), which is not dependent on the concave nature of the utility function or from the motive to smooth consumption. The maximization of yield is achieved when shares are priced correctly, which requires that analysts have an infinite horizon and internalize the government's budget constraint.
This model analyzes the implications of adding a perfect capital market and capital gains tax to the Keynesian model. Private consumption in the model is determined by the constant marginal propensity to consume out of labor income and the constant marginal propensity to consume out of wealth, in contrast to the Ricardian model, in which private consumption is determined through optimization.

The model

The model assumes an economy that is open to the movement of goods and capital, a fixed global interest rate, a single global product that is used for both consumption and investment, and no capital depreciation. The other assumptions in the model are: individuals live for an

infinite number of periods, the population is static, there exists a representative competitive firm in the economy whose production function is characterized by constant returns to scale, technology is constant, and there is a one-period delay from the investment in capital until it becomes operational. The government's expenses are financed by non-distorting taxes on individuals and firms.

Individuals
There is a representative individual who lives an infinite number of periods, with a completely inelastic labor supply which is identical in all periods.

(1) $$L_t = L = 1.$$

The individual's consumption function is as follows:

(2) $$C_t = a_1 \cdot (W_t - \tau_1) + a_2 \cdot (V_t + b_t + F_t),$$

where

W_t	=	the wage;
τ_1	=	the lump sum tax on individuals;
a_1	=	the marginal propensity to consume out of labor income;
a_2	=	the marginal propensity to consume out of wealth;
V_t	=	the market value of firms;
b_t	=	the market value of government bonds held by the individual;
F_t	=	the market value of foreign bonds held by the individual.

We assume that the global interest rate is constant in all periods:

(3) $$r_t = r,$$

(4) $$F_t = F_{t-1} \cdot (1 + r) + X_t - IM_t,$$

where $X_t - IM_t$ is the economy's export surplus.

Firms
The representative firm maximizes the net present value of its profits:

(5) $$V_t = \sum_{j=0}^{\infty} (1 + R_{t+j})^{-1} \times \left[Y_{t+j} - W_{t+j} \cdot L_{t+j} - I_{t+j} - \tau_{2,t+j} \right],$$

where

$I_t = K_{t+1} - K_t;$

$1 + R_{t+j} = \dfrac{1}{1 + r_l} \prod_{i=0}^{j} (1 + r_{t+i});$

Y_t = the firm's output;
I_t = gross investment;
τ_2 = the lump sum tax on the firm.

Capital, K, is invested one period ahead and hence in period t the firm determines K_{t+1} and L_t.

The firm has a constant returns to scale production function: $Y_t = K_t^\alpha L_t^{1-\alpha}$

The first order condition is:

$$(6) \qquad W = (1-\alpha)A \cdot \left(\frac{r}{\alpha A}\right)^{\frac{1}{\alpha-1}}.$$

$$(7) \qquad K = \left(\frac{r}{\alpha A}\right)^{\frac{1}{\alpha-1}}.$$

$$(8) \qquad I = 0.$$

The public sector
The public sector's budget constraint is:

$$(9) \qquad \sum_{j=0}^{\infty}(1+R_{t+j})^{-1}\times\left[\tau_1 + \tau_2 - G_{t+j}\right] = b_t,$$

where
G_t = public consumption;
b_t = the public sector's internal debt.

The present value of income *less* expenditure equals the public sector's internal debt.

We assume that the permanent tax on firms, τ_2, and the permanent tax on individuals, τ_1, are constant proportions of total permanent taxes, T:

$$\tau_2 = \theta(\overline{G}_t + b_t) \equiv \theta T_t$$

$$\tau_1 = (1-\theta)(\overline{G}_t + b_t).$$

General equilibrium
If we assume that G_t is constant for every t in equations (2) and (5) to (9), we obtain:

$$(10) \qquad IM_t - X_t = Z \cdot Y + a_2 \cdot (F_t + b_t) - a_1 \cdot (1-\theta)T_t + G_t \cdot (1 - \frac{a_2 \cdot \theta}{r}),$$

where
$Z = a_1 \cdot (1-\alpha) + a_2 \cdot \alpha \cdot r^{-1} - 1$

A change in the tax without a change in permanent public consumption yields the following:

$$(11) \qquad \frac{\partial(IM_t - X_t)}{\partial T_t} = -a_1 \cdot (1 - \theta).$$

The government's ability to affect domestic demand by changing the timing of taxes declines as the marginal propensity to consume out of labor income decreases and as the share of the tax on capital in total tax revenues increases.

A shift in permanent public consumption without a change in the timing of the tax yields the following:

$$(12) \qquad \frac{\partial(IM_t - X_t)}{\partial G} = 1 - \frac{a_2 \cdot \theta}{r}.$$

The government's ability to affect domestic demand by means of a change in permanent public consumption declines as the marginal propensity to consume out of capital income and the share of the tax on capital in total tax revenues increase, and as the interest rate falls.

If we assume that the marginal propensity to consume out of labor income is equal to 1 and that the marginal propensity to consume out of capital income is equal to the interest rate, we obtain:

$$(13) \qquad IM_t - X_t = (1 - \theta) \cdot (G - T) + r \cdot (F_t + b_t).$$

A permanent rise in G will increase the import surplus by $(1 - \theta)\Delta G$, while reducing taxes in period t without altering permanent public consumption will reduce the import surplus by $(1 - \theta)\Delta T_t$.

To conclude: in this Keynesian model, individuals do not internalize the government's budget constraint. However, the model assumes an efficient capital market and that capital is taxed. Private consumption is determined by the marginal propensity to consume out of labor income and the value of private wealth. The model will enable us to analyze how changes in permanent public consumption and the timing of taxes affect excess demand. A rise of ΔG in permanent public consumption will increase domestic demand by $(\Delta G \times (1 - a_2 \cdot \theta / r))$ (a_2 is the marginal propensity to consume out of private wealth, and θ is the share of tax on capital in total tax revenues). If capital is not taxed, demand rises by ΔG, i.e., taxes on capital moderate the effect of fiscal policy on demand, and when $\theta = r / a_2$, an increase in permanent public consumption has no effect on excess demand. The model demonstrates that a rise in taxes without a change in permanent public consumption will reduce demand by only $\Delta T \times (1 - \theta / r) \times a_1$ (a_1 is the marginal propensity to consume out of disposable labor income). The effect of a change in the timing of taxation on domestic demand declines as the share of the tax on capital in total tax revenues rises.

3. A FINITE HORIZON AND THE POSTPONEMENT OF TAXATION

The neutrality of the timing of tax collection with regard to private consumption, the interest rate, investment, and saving is known as Ricardian equivalence. As discussed above, this equivalence obtains when individuals possess an infinite horizon. When individuals have a finite horizon, the postponement of taxation can increase their wealth, as they may die before the government collects all the deferred taxes, and thus the burden of deferred taxation will fall at least in part on succeeding generations. Prior to Barro (1974) the Ricardian theory was based on the assumption that individuals have an infinite horizon.[2] Barro proved that Ricardian equivalence also appplies when it is assumed that individuals have a finite horizon, provided that they internalize the welfare of their offspring in their utility function. Although the postponement of taxes to the next generation increases the tax burden of offspring and reduces that of parents, it does not affect the inter-generational budget constraint, and hence the solution that determines parents' consumption remains unchanged. Parents do not increase their consumption, and the postponement of taxes increases their bequest. Thus, the net bequest passed on by parents to their children remains unchanged.

Barro claimed that parents internalize their offspring's tax burden, and so the postponement of taxes to future generations impairs Ricardian equivalence. If capital is taxed, there is no need to assume either an infinite horizon or that the individual internalizes the utility function of his offspring. The deferment of taxes on capital does not increase the tax burden on future generations as the value of assets already incorporates it. If capital is taxed, the neutrality of the timing of tax collection does not depend on the individual's horizon or the bequest motive as the value of the assets incorporates the future tax burden.

4. TAXATION OF CAPITAL AND SPECIFICATION PROBLEMS

Many of the studies that examined Ricardian equivalence in the US ignored the capital market channel and the existence of taxes on capital, and thus their results are biased against Ricardian equivalence. Feldstein (1982) estimated the following equation:

$$C_t = a_0 + a_1 \cdot Y_t + a_2 \cdot W_t + a_3 \cdot SSW_t + a_4 \cdot G_t + a_5 \cdot T_t + a_6 \cdot TR_t + a_7 \cdot D_t + e_t,$$

where
C = total private consumption;
Y = current income;
W = the market value of individuals' wealth at the beginning of the period;
SSW = an estimate of future social rights;
G = total public consumption;
T = total tax receipts;
TR = transfer payments by the government to individuals;
D = the total net debt of the public sector.

According to Feldstein, the Ricardian hypothesis is $a_4 < 0$, $a_3 = a_5 = a_6 = 0$, and $a_2 = -a_7$. By using 2SLS estimation, it is possible to reject the hypothesis that $a_6 = 0$, but not the hypothesis that $a_4 = 0$, so that the Ricardian theory is rejected.

Feldstein's specification ignores the fact that increases in transfer payments to individuals and private consumption are financed in part by the tax on capital. The regression estimates the partial derivative with regard to a change in transfer payments and government expenditure, while controlling for the value of wealth. Although it is a rise in government expenditure which leads to a decline in the value of wealth, this decline is perceived as exogenous in the model and is unrelated to the rise in government expenditure. This means that W captures the changes in G that are financed by the tax on firms, which makes it difficult to reject the hypothesis that $a_4 = 0$. It also makes it easier to reject the hypothesis that $a_6 = 0$, because TR must have a positive effect if W captures the effect of the future taxes required. The specification fixes the value of wealth, so that a bias is created that leads to the rejection of Ricardian equivalence.

Feldstein's specification has served as the prototype for many studies that examined the effect of fiscal policy on private consumption in a way that fits the permanent income and life cycle theories. According to this approach, private consumption is a function of human capital, non-human capital, and permanent taxes. Scholars have utilized current income and private wealth as indicators of human capital (before taxes) and non-human capital (before taxes) respectively, while public consumption has served as an indicator of permanent taxes. As stated above, this specification is incorrect because private wealth constitutes an estimate of capital *less* permanent taxes on firms (rather than an estimate of physical capital before tax), giving rise to a problem of partial correlation between government expenditure and wealth. Studies of Ricardian equivalence that have fixed the value of private wealth include Feldstein (1974, 1978, 1982), Feldstein and Elmendorf (1990), Modigliani (1986), Sterling (1990, 1996), which reject Ricardian equivalence, and Kormendi (1983), Kormendi and Meguire (1986, 1990), and Leimer and Lesony (1982), which accept it.

A different method of examining Ricardian equivalence involves the Euler equation, and is based on the permanent income and life cycle theories. The specification of the equation includes only the first order condition of the consumer problem, $u'(C_{t+1}) = \left(\dfrac{R}{\delta}\right)^i u'(C_t)$. According to the Euler equation, all the information regarding the consumer's human and non-human capital in the previous period is captured by consumption with a lag. Present consumption is explained by the interest rate, the time preference rate (δ), consumption in the previous period, and unanticipated changes in the value of private capital since the previous period. By means of the Euler equation it is possible to examine whether a rise in the government's commitments has a positive impact on consumption. Evance (1988a) found no evidence of this; Aschauer (1985) and Haug (1991), who adopted the Euler equation approach, uphold the existence of Ricardian equivalence.

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[2] Diamond (1965) showed that in an overlapping-generations model with no bequest motive, Ricardian equivalence does not obtain.

5. RICARDIAN EQUIVALENCE IN ISRAEL

Three empirical studies have examined the validity of Ricardian equivalence for Israel's economy. Meridor (1985) and Leiderman and Razin (1988) examined the effect of the fiscal deficit on private consumption. Meridor explained per capita private consumption as a function of lagged per capita private consumption, per capita GDP, and per capita public consumption. She found that the response of private consumption to a rise in public consumption financed by taxes is identical to the response to a rise in public consumption financed by debt. Meridor's study focused on the period from 1955 to 1979, and concluded that Israel's economy exhibits Ricardian equivalence. This conclusion is supported in the study by Leiderman and Razin. They restricted their study to the period from 1980 to 1985, during which the fiscal deficit was characterized by high variance, and hence its effect on private consumption was clearly discernible. Leiderman and Razin's stochastic model is based on Hall's approach and makes it possible to examine the two main assumptions of the Ricardian theory: that individuals have an infinite horizon and that no individuals suffer from a liquidity constraint. The study does not reject the hypothesis that these two Ricardian assumptions are valid at a significance level of one percent.

In contrast to these two studies, which examined the change in private consumption using the Euler equation approach, the study by Elkayam, Tal and Yariv (1988) analysed private consumption as a function of labor income, private wealth, the internal debt, and the external debt. The study, which focused on the period from 1971 to 1984, showed that individuals relate to the internal debt as net wealth, but do not regard the external debt as an obligation they will have to repay in the future. This result contradicts the Ricardian theory and the results of the other two studies, thus reinforcing the claim that individuals do not internalize the government's budget constraint.

Elkayam, Tal and Yariv made a distinction between the internal debt and other wealth (including the value of firms), so that their study perceives a decline in the latter (due to a rise in the internal debt) as exogenous rather than the result of government policy. Elkayam, Tal and Yariv examine the Ricardian theory while holding private wealth constant, and hence ignore the wealth effect. Another way of explaining the contradiction between the two studies is to ask whether the capital market is viewed by the model as the main channel through which Ricardian equivalence operates in Israel. When this channel is not included, Ricardian equivalence is rejected; when it is included, as it was by Meridor as well as Leiderman and Razin, it cannot be rejected.

6. THE LINK BETWEEN SHARE PRICES AND CONSUMPTION

Hall (1978) found a positive relation between share prices and private consumption. There are two possible explanations for this:
  a. The change in both share prices and consumption reflects a shift in the public's expectations regarding the capitalized value of future dividends. The change in consumption and in the value of firms may be due to several factors, such as the updating of expectations regarding the economy's terms of trade, technological developments, and shifts in permanent taxes.

b. The change in share prices alters individuals' wealth, thus affecting consumption.

The expectations mechanism is consistent with the Ricardian approach and the assumption of an efficient capital market, whereas the second mechanism, which operates via the wealth effect, is consistent with the Keynesian approach. Two studies undertaken in the US sought to assess the mechanism whereby share prices affect consumption. The question posed by the authors was simple: do changes in share prices only affect the consumption of shareholders, or that of all consumers? If the former is the case, it implies a wealth effect; if the latter is the case, it reflects a change in the public's expectations.

The results of the two studies contradicted one another: Mankiw and Zeldes (1991) found that most of the impact was due to the wealth effect, while Poterba and Samwick (1995), who repeated the experiment and expanded the database, found that most of the effect was due to the updating of expectations. In the opinion of the latter, share prices serve as a leading indicator, i.e., they precede consumption in the internalization of new information, thus enabling changes in consumption to be predicted.

Whether the link between share prices and consumption stems from the wealth effect or from updated expectations, it is generally agreed that the factors influencing the value of shares will also affect private consumption. If fiscal policy affects share prices then a mechanism exists through which fiscal policy impacts on consumption even though it may derive from the wealth effect. This finding weakens the Keynesian approach, which regards consumption as a function of current rather than permanent taxes.

7. AN EMPIRICAL EXAMINATION

In this section we show that a rise in public expenditure reduces the yield on shares. We test the validity of Ricardian equivalence in Israel, and examine whether the capital market constitutes the main channel through which it operates.

The model predicts that a rise in public consumption constitutes an increase in permanent taxes and hence reduces the yield on shares. Before testing this claim it is necessary to examine whether the change in public consumption is permanent or transitory. If the rise in public consumption is transitory, its effect on permanent taxes will be relatively small. A similar but permanent rise in public consumption will increase permanent taxes to a greater extent, and therefore its effect on share yields will be greater. The regression in Table 1 rejects the hypothesis that a rise in per capita public consumption[3] in Israel is transitory, as it significantly increases

Table 1
Dependent Variable *log*(*Gov*)
(*t* statistics in parentheses)

	Constant	Log(Gov(–1))	Sample Range	R^2	D.W.
	–0.61 (–0.96)	0.90 (8.96)	1974–2002	0.75	2.12

[3] The source for the public-sector data is the Bank of Israel *Annual Report 2002, Statistical Appendix* (Table 5.A.1a); public consumption actually excludes defense imports and includes domestic investment.

public consumption in the following period. In fact, the regression shows that the permanent component of per capita public consumption constitutes 90 percent of total public consumption, and does not reject the claim that the rise in public consumption is entirely permanent.

Table 2 examines the model hypothesis that a rise in per capita government consumption will reduce the yield on shares. The dependent variable is the general share-price index in the Tel Aviv Stock Exchange (adjusted by the GDP deflator). This index comprises both capital gains and the distribution of dividends, and therefore represents total yield. The regressions reject the null hypothesis and support the model hypothesis that a rise in government consumption reduces the yield on shares. As expected, the general share-price index is positively correlated with business-sector product. The dummy variable for 1984 captures the stock-market collapse in the wake of the bank shares crisis.

Table 2
Dependent Variable *Dlog* (*Spi*)
(*t* statistics in parentheses)

	1	2	3	4	5	6	7	8
Constant	0.01	0.04	0.04	0.04	0.05	0.02	0.06	0.07
	(1.29)	(0.95)	(0.93)	(1.04)	(1.18)	(0.48)	(1.36)	(1.57)
Dlog(Gov)	–1.71	–1.79	–1.81		–1.63	–1.52	–1.76	
	(–1.92)	(–2.36)	(–2.3)		(–2.3)	(–1.85)	(–2.23)	
Dlog(Gdpbs)	2.67	2.58	2.61	2.60	2.62	2.71	2.18	2.27
	(2.03)	(2.31)	(2.24)	(2.21)	(2.73)	(2.41)	(1.90)	(2.01)
Dlog(Dum84)		–0.68	–0.68	–0.69	–0.69		–0.70	–0.70
		(–3.35)	(–3.11)	(–3.23)	(–3.45)		(–3.66)	(–3.75)
Dlog(Bond 5-7)			0.1					
			(0.12)					
Dlog(Govcc)				–1.24				–1.47
				(–1.85)				(–2.42)
Sample Observations	74–02	74–02	74–02	74–02	71–02	71–02	78–02	78–02
	29	29	29	29	32	32	25	25
R^2	0.40	0.46	0.44	0.40	0.44	0.20	0.49	0.50
D.W.	1.93	2.01	2.01	1.77	2.05	1.97	2.05	1.97

Gov	= per capita public consumption (which also include public investment and exclude defense imports) adjusted by the GDP deflator;
Spi	= the general share-price index adjusted by the GDP deflator (the annual index is calculated as the monthly average of the share-price index);
Gdpbs	= GDP of the business sector;
Dum84	= the dummy variable for 1984;
Bond 5-7	= the yield index of CPI-indexed government bonds;
Govcc	= public civilian consumption per capita (which also include public investment and exclude defense consumption) adjusted by the GDP deflator.

The negative correlation between the rise in government consumption and the general share-price index may be due to the influence of the interest rate, as an increase in government expenditure leads to a rise in the interest rate and a decline in the capitalized value of firms' profits. The regressions in Table 2 show that the addition of the total yield index of CPI-indexed government bonds (5-7 years) does not significantly affect the negative correlation between public consumption and the value of shares. Therefore, the fact that an increase in government expenditure raises the interest rate still does not explain the negative correlation between government expenditure and the yield on shares.

Another hypothesis which was examined was that the negative correlation between per capita public consumption and the value of firms is associated with Israel's security situation. A deterioration in the security situation increases both public consumption and uncertainty, and the latter reduces the value of firms. However, the data indicate that per capita civilian expenditure alone (without defense consumption) also has a negative and significant effect on the share-price index. The negative effect of public consumption on the value of firms is not sensitive to the sample range, see for example regressions 5 and 6 for the period 1971-2002, and regressions 7 and 8 for 1978-2002 (the sample in the previous version of this paper covered the period 1974-96).

Ricardian equivalence and the capital market channel
The dependent variable in Table 3 is per capita private consumption in Israel. Regression 1 supports the claim that Ricardian equivalence holds in Israel. A one-percent rise in per capita public consumption reduces private consumption by 0.32 percent in the following year. It is preferable to analyze Ricardian equivalence using lagged public consumption for two reasons: first, it allays the suspicion that Ricardian equivalence derives from the sources constraint; second, it is reasonable to assume that a certain period of time passes before individuals recognize a change in fiscal policy and are able to adapt their consumption to it.

The regressions which follow will test the hypothesis that the capital market is the main channel through which Ricardian equivalence operates. Regression 2 indicates that changes in private consumption are explained by movements in the general share-price index with a one-year lag, which is similar to the result obtained by Lavi (1995).[4] As shown above, the share-price index incorporates the change in public consumption; we will therefore examine whether per capita public consumption impacts on per capita private consumption beyond its effect on the share-price index. Private consumption in regression 3 is explained by the share-price index, and that part of public consumption that is not explained by the general share-price index (i.e., the residuals from the regression of per capita public consumption on the general share-price index). The results showed that changes in per capita public consumption that do not impact on the share-price index have no significant effect on per capita private consumption either. In regression 4 (which is algebraically identical with regressions 3 and 5) per capita private consumption is dependent on per capita GDP, lagged per capita public consumption, and the general share-price index. The coefficients in the regression are the partial derivatives of the variables, i.e., the effect of a change in one independent variable

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[4] This study showed that the elasticity of consumption with respect to the yield on shares ranged from 0.06 to 0.08.

Table 3
Dependent Variable *Dlog* (*C*)
(*t* statistics in parentheses)

	1	2	3	4	5	6	7	8	9
Constant	0.030	0.022	0.023	0.026	0.030	0.031	0.025	0.034	0.027
	(3.77)	(3.04)	(3.13)	(3.42)	(4.07)	(3.47)	(2.85)	(3.65)	(3.00)
$Dlog(Gov_{-1})$	−1.71			−0.23	−0.32	−0.36	−0.26		
	(−2.15)			(−1.62)	(−2.36)	(−1.98)	(−1.52)		
$Dlog(Spi_{-1})$		0.09	0.08	0.08			0.07		0.07
		(2.97)	(3.05)	(2.53)			(2.16)		(2.2)
RGM_{-1}			−0.23						
			(−1.62)						
RMG_{-1}					0.08				
					(2.53)				
$Dlog(Govcc_{-1})$								−0.28	−0.22
								(−2.05)	(−1.65)
Sample Observations	74–02	74–02	74–02	74–02	71–02	71–02	78–02	78–02	78–02
	29	29	29	29	29	25	25	25	25
R^2	0.40	0.46	0.44	0.40	0.44	0.20	0.49	0.50	0.50
D.W.	1.78	2.02	1.79	1.79	1.79	1.74	1.78	1.58	1.63

C	=	per capita private consumption;
RGM	=	the residuals from the regression of per capita private consumption on the general share-price index, i.e., the component of public consumption which is not explained by the share-price index;
RMG	=	the residuals from the regression of the general share-price index on per capita private consumption, i.e., the component of the general share-price index which is not explained by private consumption.

when the others are held constant. The regressions indicate that a change in public consumption impacts on private consumption only when there is a shift in the value of firms; a change in public consumption while the value of shares is held constant does not affect private consumption.

Regressions 6–9 focus on the period 1978–2002 and leads to the same conclusions: both total public consumption and civilian public consumption have significant effect on private consumption. However, by controlling the share-price-index effect, public consumption has a much smaller and less significant effect on private consumption. The results of the regressions support the hypothesis that the capital market constitutes an essential channel through which Ricardian equivalence operates.

8. CONCLUSION

This study has shown that a rise in permanent public consumption increases the permanent tax imposed on firms and thus reduces the net present value of their profits. Changes in the timing of taxes do not affect the permanent tax burden, and hence do not influence the value of firms. In Israel we found a significant negative correlation between the extent of public consumption and the value of firms. The negative correlation does not derive from the fact that an increase in public consumption raises the real interest rate nor from the security situation.

The assumption that an increase in public consumption erodes private wealth led to the examination of the mechanism through which Ricardian equivalence operates. Ricardian equivalence is based on several assumptions: individuals internalize both the government's budget constraint and the utility of their offspring, the capital market is efficient, and there are no distorting taxes. Even though each of these assumptions seems quite far-fetched, many of the empirical studies that have examined Ricardian equivalence have been unable to reject it. The assumption of the present study is that private consumption may be a function of public consumption even if individuals do not internalize the government's budget constraint; it is sufficient that only agents active in the capital market do so.

The internalization of the government's budget constraint is motivated by consumers' desire to smooth consumption, a desire which increases with the concavity of the utility function. Whether it is worthwhile or feasible for consumers to invest the necessary resources to internalize the government's budget constraint is doubtful, but there is no question that it is worthwhile for agents active in the capital market to estimate the value of firms correctly, and this requires that they internalize the government's budget constraint. Individuals operate through financial intermediaries in the capital market, and an intermediary who does not internalize the government's budget constraint will obtain a lower yield than other intermediaries. An intermediary of this type will not influence share prices, because the smarter intermediaries will trade with him until share prices accurately reflect the value of firms. The capital market thus internalizes the government's budget constraint, so that an increase in permanent public consumption erodes individuals' wealth. Consequently, consumption by individuals who do not internalize the government's budget constraint will also decline in response to a rise in public consumption.

In the empirical part of the study we examined the hypothesis that the capital market is the principal channel through which Ricardian equivalence operates in Israel. The regressions indicate that a change in public consumption affects private consumption only when the model permits a change in the value of firms. A shift in public consumption with the value of shares held constant does not affect private consumption. We also found that a change in public consumption that does not impact on the value of shares does not affect private consumption either. The results of the regressions support the hypothesis that the capital market is the principal channel through which Ricardian equivalence operates. This makes it possible to explain the lack of agreement between the results of the study by Elkayam, Tal and Yariv, which ignored the capital market channel and rejected Ricardian equivalence in Israel, and those of Meridor and of Leiderman and Razin, which included the capital market channel and did not reject Ricardian equivalence.

Many of the important studies that examined the validity of Ricardian equivalence in the US included the value of private wealth in their models. In effect, these studies ignored the capital market channel, and therefore were biased towards rejecting Ricardian equivalence.

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