The effect of debt tax benefits on firm investment decisions

Addessi, William and Saltari, Enrico

University of Rome "La Sapienza", University of Rome "La Sapienza"

17 December 2011

The effect of debt tax benefits on firm investment decisions

William Addessi* Enrico Saltari†

This Version: December 17, 2011

Abstract

In this paper we question the idea that the deduction of debt interest is always an effective policy instrument to spur firm investment. We analyze the investment decision in presence of a borrowing constraint on the amount of the debt that the firm can raise. We show that if the debt interest rate is decreasing in the firm capital accumulation and it is available another financial resource more expensive than debt (at least for levels of debt lower than the upper bound), then the deduction of the debt interest from taxes on capital income may reduce firm investment. This theoretical result should be considered when financial intermediaries are not willing to finance beyond a certain threshold but firms have access to other sources of finance.

JEL Classification: D21, G31, H32
Keywords: Corporate taxation, Financing constraints, Investment

*University of Rome "La Sapienza", Department of Economics and Law. Email: w.addessi@gmail.com.

†Corresponding author. University of Rome "La Sapienza", Department of Economics and Law, via del Castro Laurenziano 9, 00161 Rome (Italy), fax +39 06 4462040; tel. +39 06 49766213. Email: Enrico.Saltari@uniroma1.it.

1 Introduction

This paper investigates whether the tax benefits of debt may have negative effects on the firm investment. It is reasonable to expect that interest deduction always spurs investment because it reduces the cost of the debt. Perhaps surprisingly, we show that under credit rationing and endogenous debt interest rate such expectations may be disappointed.

We build on the standard neoclassical model of investment by introducing both financial constraints and distortionary taxation. We analyze the investment decision in the presence of a capital income tax, a tax benefit on the debt interest payments and an upper bound on the debt.

We show that if the debt constraint is binding and the firm has access to other sources of finance more expensive than debt, tax benefits of debt discourage investment. The intuition of this result is as follows. When the debt interest rate is inversely related to capital stock, there is an incentive to invest because each additional unit of capital reduces the debt burden, i.e. the interest payments.

If tax benefits of debt are introduced, capital accumulation affects the debt burden in two opposite ways: *i*) tax benefits imply that only a fraction of the interest rate is actually paid by the firm and, then, the reduction caused by capital accumulation of the unit cost of debt (the debt interest rate) is lower; *ii*) tax benefits stimulate debt accumulation and, by this way, the reduction of the interest rate induced by capital accumulation applies to a larger amount of debt. The first effect means that the introduction of tax benefits reduces the incentive to invest, while the second raises it. Under general conditions and no credit rationing, the second effect is dominant and tax benefits spur firm investment. On the contrary, if there is credit rationing only the first effect is present and, consequently, the incentive to invest decreases as tax benefit rate increases.

The paper is organized as follows: Section 2 illustrates the theoretical model; Section 3 determines the optimal solutions of the model distinguishing between the case with no binding constraint on debt and the case in which the optimal level of debt is higher than the upper bound; Section 4 concludes and discusses some policy implications.

2 The model

This section presents a baseline model describing the financial and investment choices of a risk neutral firm.[1] Our framework mainly refers to two fields of the economic literature on firm investment. First, we analyze the role of financial constraints on the investment choice thus following the strand of research that relax the assumption of perfect capital markets.[2] Moreover, we consider the role of distortionary taxation on both real investment and corporate financing decisions.[3]

The characterizing elements of the model are: *i*) endogeneity of the debt interest rate; *ii*) an upper-bound constraint; and *iii*) taxation on capital revenue that is instrumental to the introduction of deduction of interest payments. Let us discuss the assumptions that characterize our theoretical framework.

To our aims it is sufficient to hypothesize that the debt in period t, b, is a way to raise resources whose cost is, at least below a certain level of debt, cheaper than internal funds. In fact, even if debt requires the payment of a risk premium (see below), the distortionary tax scheme makes debt the dominating source of financing for low levels of debt (see Shahnazarian, 2009).[4] Debt interest rate, $r = r(b,k)$, is increasing in debt ($\frac{\partial r}{\partial b} > 0$) and decreasing in capital ($\frac{\partial r}{\partial k} < 0$). This relationship takes into account the risk of the lender in the price of debt.[5] We adopt a simple functional form (see Bond and Söderbom, 2011) that allows us to derive a closed form solution. Specifically:

$$r = \rho + \beta \frac{b}{k}, \tag{1}$$

where ρ is the cost of internal resources and the second term represents the risk premium with $\beta > 0$. Moreover, we assume that the debt has an upper bound, B.[6]

[1] For an analysis of investment decisions of a risk-averse firm, see Saltari and Ticchi (2005, 2007).

[2] We limit ourselves to mention the seminal contribution Fazzari et al. (1988) and cite Hubbard (1998) as a reference survey.

[3] See Hasset and Hubbard (1996), Graham (2003) for a survey on the role of taxes in the corporate finance strategy and Gordon and Lee (2001) for empirical evidence.

[4] In a previous version of this paper we used a standard hierarchy model where the cost of debt was intermediate between a cheaper source of financing (i.e. internal funds) and a more expensive source of financing (i.e. new equity issue). However, the inclusion of equities does not add any interesting elements, since what we need is a source of financing more expensive than debt.

[5] For a general treatment of this topic see Bond and Meghir (1994) and Pratap and Rendon (2003).

[6] As highlighted by Whited (1992), for the upper bound to be effective, it is important that firm cannot affect it. The debt limit could also be assumed increasing in the firm capital stock. However, assuming that the maximum debt is proportional to firm capital stock (as in Saltari and Travaglini, 2003), would not significantly affect the main result of the paper, since it would only add a constant term to the optimality condition of capital accumulation that

We consider capital income taxation (we make no distinction between dividend and capital gains) with τ_k as the tax rate; it also represents the upper bound for the interest deduction rate, τ_b, i.e. we assume that τ_b ranges between zero (no tax benefit) and τ_k (full deductibility).

The other elements featuring the model are quite standard. The firm output y is increasing and concave in capital, $y = zk^{\eta}$ where $0 < \eta < 1$ and z is an i.i.d. stochastic productivity shock.[7] For simplicity, we normalize to 1 the expected value of z and suppose that there is no capital depreciation.[8] Finally, the discount factor is equal to the cost of internal resources, ρ.

Under these assumptions it is possible to define the firm's maximization problem solving the following maximazion problem:

$$\max_{k,b,\gamma} \pi = (1 - \tau_k) E(z) k^{\eta} - br(1 - \tau_b) + \gamma (B - b) - \rho (k - b)\}$$

where $k = c + b$ and γ is the Lagrangian multiplier associated with the debt constraint and E is the expectation operator.[9]

We solve this maximization problem by first defining the weighted average cost of capital (WACC) as follows:

$$r_k = \rho \left(1 - \frac{b}{k}\right) + (1 - \tau_b) r \frac{b}{k} \quad (2)$$

$$= \rho - \rho \tau_b \frac{b}{k} + \beta (1 - \tau_b) \left(\frac{b}{k}\right)^2 \quad (3)$$

so that the maximization problem can simply be rewritten as

$$\max_{k,b,\gamma} \pi = (1 - \tau_k) E(z) k^{\eta} - kr_k + \gamma (B - b) \quad (4)$$

does not interact with the rate of the tax benefit. Assuming a non linear relationship would prevent a closed form solution.

[7] In this case capital returns and value added overlap, as in Pratap and Rendon (2003). Alternatively, we could have assumed constant returns to scale and convex adjustment costs in the investment function. This option would have modified the analytical results but not the qualitative role of the tax rate and the interest deduction rate.

[8] The characterization of z allows us to introduce a source of uncertainty that explains the risk premium associated with debt. At the same time, since the expected value of z enters linearly in the first order conditions, we will write it using $E[z] = 1$ and, consequently, the expectation operator will not appear.

[9] We wrote the firm's maximization problem assuming that firm's tax base is positive ($y - rb > 0$). Furthermore, we confine our analysis to the case in which the debt is positive. The introduction of other constraints will not modify qualitatively our conclusions since they are not binding in the case we are interested in.

The first order condition for capital implies the equality between the expected marginal productivity of capital and the marginal cost of financing, $\frac{\partial(r_k k)}{\partial k}$:

$$(1-\tau_k)\,\eta k^{\eta-1} = \rho - \beta\,(1-\tau_b)\left(\frac{b}{k}\right)^2 \tag{5}$$

Equation (5) describes the optimal capital accumulation. On the left there is the net (of taxes) expected return on capital.[10] The firm invests until this return is equal to the cost of capital. In turn, this is given by the cost of internal resources plus the marginal effect of capital accumulation on the cost of debt financing. Indeed, the second addend on the right shows that when the debt interest rate is decreasing in capital, the firm has the incentive to invest in order to reduce the risk premium and thus the debt burden. It is important to observe that, *coeteris paribus*, this reduction is increasing in the amount of debt but decreasing in the debt deduction rate.

Since capital markets are imperfect, we can determine the optimal capital structure, say $\frac{b}{k}$, by minimizing the WACC with respect to $\frac{b}{k}$:

$$\frac{dr_k}{d\frac{b}{k}} = -\rho\tau_b + (1-\tau_b)\,2\beta\frac{b}{k} = 0$$

that is

$$\left(\frac{b}{k}\right)^* = \frac{\rho}{2\beta}\frac{\tau_b}{1-\tau_b} \tag{6}$$

By using this solution, we first determine the optimal capital stock when there is no constraint and then, using again Equation (6), the level of debt, b.

3 Results and discussion

Substituting equation (6) in the first-order condition for capital gives:

$$(1-\tau_k)\,\eta k_{nb}^{\eta-1} = \rho - (1-\tau_b)\left(\frac{\rho}{2\beta}\frac{\tau_b}{1-\tau_b}\right)^2$$

or

[10] Had we chosen a framework with constant returns to scale and convex adjustment costs, the tax rate of capital returns would have appeared in an additive, not multiplicative, way but the direction of the effect would have been the same.

$$k_{nb} = \left(\frac{\eta \left(1 - \tau_k\right)}{\rho \left(1 - \rho \frac{\tau_b^2}{4\beta \left(1 - \tau_b\right)}\right)} \right)^{\frac{1}{1-\eta}} \tag{7}$$

where the subscript nb indicates that the debt constraint is not binding. From equation (7) it is straightforward to verify that an increase in τ_b boosts capital accumulation. The optimal amount of debt is simply:

$$b_{nb} = k_{nb} \frac{\rho}{2\beta} \frac{\tau_b}{1 - \tau_b} \tag{8}$$

Now, suppose the constraint is binding. The optimal solution in this case is determined by substituting the debt threshold $B < b_{nb}$ in the first order condition for capital, equation (5). It reads:

$$\eta \left(1 - \tau_k\right) k_{bind}^{\eta - 1} = \rho - \beta \left(1 - \tau_b\right) \left(\frac{B}{k_{bind}} \right)^2 \tag{9}$$

where the subscript *bind* indicates that the constraint on debt is binding. From equation (9) one can show that when the optimal debt is higher than the threshold value of debt, an increase in the deduction rate reduces investment.[11,12]

Thus, an increase in tax benefit has opposite effects according to whether the debt constraint binds or not. To see what is at work here, it is useful to look at the effect of capital accumulation on the debt burden (interest payments). Of course, this is just the product of two elements – the unit cost of debt net of tax benefit, i.e. $\left(1 - \tau_b\right) r$, and the amount of debt, i.e. b_t. We assumed that capital accumulation reduces the risk premium and therefore the interest rate. This creates an incentive to invest. What happens to this incentive when the deduction rate increases? First, it decreases the marginal effect of capital accumulation on the interest rate, thus reducing the incentive to invest, but, second, it increases the optimal amount of debt[13] – thus enlarging the base

[11] The derivative is:

$$\frac{\partial k_{bind}}{\partial \tau_b} = \frac{\beta \left(\frac{B_t}{bind k} \right)^2}{\eta \left(\eta - 1\right) k_{bind}^{\eta - 2} - 2\beta \left(1 - \tau_b\right) \frac{B_t^2}{k_{bind}^3}} < 0$$

[12] It is worth noticing that one can obtain the same results reversing the procedure followed thus far. Instead of first maximizing the profit and then determining the optimal capital structure, one can first minimize the cost of financing – and thus the optimal capital structure – and then maximize the profit.

[13] This is simple to verify. We have seen above that the capital stock k is increasing in τ_b when the debt constraint is not binding. On the other hand, the first-order condition for debt, eq.(8), says that the optimal debt increases with τ_b and k. It follows that the optimal debt is also increasing in τ_b.

to which the interest rate reduction applies so stimulating investment. We know from equation (7) that overall this latter effect is stronger than the former since capital accumulation increases with τ_b. In other words, the higher τ_b the higher the incentive to invest.

On the other hand, when the constraint on debt is binding, only the direct effect on the unit cost of debt matters because the debt cannot be increased. Thus, the marginal effect of capital accumulation on the debt burden is weakened as tax benefit increases. This explains the negative relationship between the firm investment and the deduction rate that emerges from equation (9).

To sum up, our analysis of the relationship between firm investment and tax benefits shows that its sign depends on whether the constraint on the maximum amount of debt binds or not. Or, to put it another way, the effectiveness of tax benefits in stimulating investment is linked to the possibility to raise debt. We thus have two possible regimes.

Regime 1: ${}_{nb}b < B$ (debt constraint is not binding). Increases in tax benefits spur investment because they decrease the marginal cost of capital.

Regime 2: ${}_{nb}b \geq B$ (debt constraint is binding). Increases in tax benefits sap investment because they increase the marginal cost of capital.

4 Conclusions

Our analysis shows that when the interest rate is decreasing in the capital accumulation and firms are rationed in the debt market, increases in tax benefits reduce investment if firms use an alternative source of financing to overcome such binding constraint. This theoretical result suggests caution in using tax benefits as a policy instrument when firms are rationed. In fact, if the credit crunch is circumscribed to the debt market while firms have access to other financial resources, then tax benefits may reduce investment.

Moreover, it also suggests that the form of the binding constraint on the level of debt we used is not as decisive as it may seem. In fact, as we have also alluded to, if the constraint is not binding the optimal level of capital can also be obtained by first minimizing the cost of capital with respect to the debt-capital and then equating it to its marginal productivity. Therefore, the truly relevant variable to the optimization process is the firm financial structure, i.e. its debt to capital ratio. It follows that the binding constraint could also be reformulated by taking into account the firm size, as summarized by the level of its capital stock. We leave this task to future research.

References

[1] Bond S. and C. Meghir (1994): "Dynamic Investment Models and the Firm's Financial Policy", Review of Economic Studies, 61(2), 197-222.

[2] Bond S. and M. Söderbom (2011): "Conditional Investment-Cash Flow Sensitivities and Financing Constraints", forthcoming in *Journal of the European Economic Association*.

[3] Fazzari S. M., Hubbard R. G., Petersen B. C., Blinder A. S., Poterba J. M. (1988): "Financing Constraints and Corporate Investment", *Brookings Papers on Economic Activity*, 1988(1), 141-206.

[4] Graham J. R. (2003): "Taxes and Corporate Finance: A Review", *Review of Financial Studies*, 16(4), 1075-1129.

[5] Gordon R. H. and Y. Lee (2001): "Do taxes affect corporate debt policy? Evidence from U.S. corporate tax return data", *Journal of Public Economics*, 82, 195-224.

[6] Hasset K. A. and R. G. Hubbard (1996): "Tax Policy and Investment", *NBER Working Paper* n. W5683.

[7] Hubbard R. G. (1998): "Capital-Market Imperfections and Investment", *Journal of Economic Literature*, XXXVI, 193-225.

[8] Pratap S. and S. Rendon (2003): "Firm investment in imperfect capital markets: A structural estimation", *Review of Economic Dynamics*, 6, 513-545.

[9] Saltari, E. and D. Ticchi (2005). Risk-aversion and the investment-uncertainty relationship: A comment. *Journal of Economic Behavior and Organization*, 56, 121-125.

[10] Saltari, E. and D. Ticchi (2007). Risk Aversion, Intertemporal Substitution, and the Aggregate Investment-uncertainty Relationship. *Journal of Monetary Economics*, 54, 622-648.

[11] Saltari E. and G. Travaglini (2003): "How Do Future Constraints Affect Current Investment?", *Topics in Macroeconomics*, 3 (1), article 8.

[12] Shahnazarian H. (2009): "Does Tax Debt Capacity Matter?", *Finnish Economic Papers*, 22 (1), 21-30.

[13] Whited T. M. (1992): "Debt, Liquidity Constraints, and Corporate Investment: Evidence from Panel Data", *Journal of Finance*, 47 (4), 1425-1460.