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Corporate taxation and financing decisions in Italy: a modified pecking order approach

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Maria Elena Bontempi[*], Silvia Giannini[**] and Roberto Golinelli[**]

Abstract

The aim of this paper is to measure the relationship between fiscal variables and companies debt choices in Italy using an empirical representation of the modified pecking order model, where both trade-off and pecking order theories are nested. Main results suggest that: fiscal effects are significant and robust explanations of firms' financial behavior. Moreover, both the two routes through which corporate taxation may affect financing decisions - on the one hand the relative price of debt and equity finance, and on the other, net-of-tax cash flow - turn out to be significant.

JEL classification: G32, H32, C23, C11

Keywords: Capital structure, Modified pecking order approach, Corporate taxes, Dynamic panel models

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1. Introduction[*]

Corporate capital structure is one of the most studied areas of business decisions, and yet it remains one of the least understood and more difficult to quantify. In this field of research, a large body of work has modeled the interaction between taxation and corporate financing decisions, yet little empirical support has been found so far. The Anglo-Saxon research has found little clear evidence of the effects of tax benefits on debt financing (see Graham, 2003, for a review). The same is true also for Italy (see *e.g.* Bonato, Faini and Ratti, 1993, Staderini, 2001, and Alworth and Arachi, 2001).

There are several problems involved in analyzing the role of taxation on debt financing. First of all, it is difficult to translate the technical details of the tax code into a proper measure of the relative tax benefits of debt versus equity finance. Various empirical approaches have been adopted in an attempt to account for the interaction between tax rates, interest deductions, non-debt tax shields and loss carry-back and carry–forward provisions. However, none of them has proven completely satisfactory, due in part to the lack of confidential firm-level tax return data.

Secondly, fiscal variables are endogenous: for example, the greater a firm's borrowing, the lower the effective tax benefit from interest deductions, since the tax advantage of debt falls as companies become tax-exhausted, and this could in fact be the case with growing interest payments.

Thirdly, fiscal and non fiscal variables are intra- and inter-correlated. Correlation between fiscal factors worsens the endogeneity problem: current operating losses, non-debt tax deductions (losses carried forward and depreciation allowances) and interest deductions from already existing debt, may together with interest deductions on new debt, contribute towards increasing the tax-

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exhaustion of firms. Moreover, borrowing also depends on other factors linked to tax status. If these factors were omitted from the model, this would lead to bias in the fiscal parameter estimates.

This paper has the main objective of providing a systematic quantitative analysis of the relationship between fiscal variables and borrowing in Italy, tackling the problems outlined above. The Italian case is very useful for this kind of analysis because the available sample period for estimation is characterized by a high variability of tax code. Moreover, the accounting data of our sample of Italian companies are very detailed, thus offering both alternative measures of the explanatory variables, and information useful for simulating tax code.

The paper is set out as follows. Section 2 describes the model used to represent debt-financing choices. This is a dynamic representation of the modified pecking order approach (MPO) where both trade-off and pecking order theories are nested. The specification of the major potential determinants of debt financing avoids bias in the relationships between borrowing and the tax variables due to omitted variables eventually correlated with fiscal factors.

Section 3 explains how we measured the tax variables introduced into the model. To this end, a fundamentally important role was played by a microsimulation model (MATIS) capable of taking into account the complex interaction of the various aspects of tax law.

Section 4 presents the results for the debt-ratio determinants obtained by estimating the MPO econometric specification on an unbalanced panel of 24,796 manufacturing companies for the 1982-1999 period. The robustness of the empirical results is assessed by using alternative measures of the leverage determinants. In doing these experiments, the size of the statistical information, the number of models specified, and the new (in this field) dynamic panel approach for manufacturing companies substantially enlarge in many directions the currently available results of the literature.

Section 5 concludes by summarizing our main findings.

2. The MPO econometric model

Studies of the determinants of corporate financial structure focus on two opposing explanations: the trade-off (TO) and the pecking order (PO) theories. Following up from a suggestion made by Myers (1984) and its empirical representation in a previous paper by one of the present authors (Bontempi, 2002), we have adopted the modified pecking order (MPO) econometric model that nests both TO and PO leverage determinants.

The TO part of the specification focuses on the benefits and costs of issuing debt (for a survey, see Harris and Raviv, 1991). The benefits include: the tax deductibility of interest paid (fiscal factors); the use of debt to indicate high-quality company performance (signalling factors); the use of debt to reduce the amount of a company's resources that managers are free to waste on unprofitable projects (agency factors). The costs include: the likelihood and cost of inefficient liquidation, and the agency costs due to debtors' propensity towards taking actions that may be detrimental to lenders (failure factors); the possibility of losing the tax benefit of other (non-debt) tax shields (fiscal factors).

The TO debt-ratio determinants are sub-divided into four different groups of regressors (fiscal, failure, agency and signalling effects), included in the $trade_{it}$ vector, so that for company i at time t, we have:

$$d_{it}^{*} = (b' / -a)\ trade_{it} \qquad (1)$$

where vector b and scalar a are parameters. In the long run, these variables characterize the target leverage d_{it}^{*} that firms have to achieve in order to maximize shareholders' wealth. In the short term, debt-ratio (d_{it}) dynamics ought to follow an equilibrium-correction mechanism towards the target debt-ratio, so that:

$$\Delta d_{it} = a\ (d_{it-1} - d_{it-1}^{*}) \qquad (2)$$

where Δ is the first-difference operator.

The PO part of the MPO specification measures the Myers and Majluf (1984) theory on the role of information asymmetries between firms and capital markets on financing[1]. PO predicts that companies will adopt a hierarchy of financing options: internal funds will be given preference over

[1] Information asymmetries regard both presently-held assets and investment opportunities.

external ones. If external financing is needed to fund investment, firms first seek low-risk debt funding that cannot be sold for more than it is worth. New shares are issued only as the last resort, when debt financing would be extremely costly.

The PO determinants can be grouped into three variables: cash-flow, investment needs and financial slack (cash, liquid assets and marketable securities), that are included in the fcf_{it} vector:

$$\Delta d_{it} = c' fcf_{it} \qquad (3)$$

where c is a vector of parameters. The components of the *fcf* vector in equation (3) are proxies for so-called "*free cash flow*", that is to say, internal funds in excess of investment opportunities.

As already mentioned, the MPO empirical specification is a general model that nests "pure" PO and TO theories:

$$\Delta d_{it} = c' fcf_{it} + a\, d_{it-1} + b' trade_{it-1} + u_{it} \qquad (4)$$

where $u_{it} = \mu_i + \lambda_t + \varepsilon_{it}$ represents individual, time and random unobservable components. According to this specification, firms may modify their leverage position not only in order to readjust to their long–term target, but also because they need short-term external funding.

In equation (4), the vectors fcf_{it} and $trade_{it-1}$ contain both fiscal and non-fiscal variables. In order to focus on the effects of the former, the next Section is specifically devoted to a detailed explanation of how they can be measured.

3. The measurement of tax variables

Our explanatory fiscal variables are: in the *trade* vector, the relative cost of debt and equity capital and non-debt tax shields; and in the *fcf* vector, the after-tax cash flow.

As we already mentioned, over the period considered the tax legislation undertook several changes, which affected both the relative cost of debt and equity finance and the net-of-tax cash flow available to finance new investment projects. A summary of the major tax changes is provided in Table 1.

Table 1 here

Measurement of the net-of-tax cash flow variable is fairly straightforward and uncontroversial: cash flow is generally defined as the sum of operative earnings before depreciation, non-operative and extraordinary items, and other non-cash expenses, net of total interest expenses, taxes and dividends paid. Thus, cash flow is influenced by taxation through the fiscal liabilities in each accounting period. Looking at Table 1, the most important tax changes negatively affecting the net-of-tax cash flow occurred with the progressive increase in the overall statutory rates in the 1980s and early 1990s, and with the introduction, in 1992, of the net wealth tax. The tax reform implemented in 1998, on the contrary, had the overall effect of reducing the tax burden on companies. However, along with gainers, an almost equal proportion of taxpayers turned out to be losers, experiencing a greater tax burden, as a consequence of the reform.[2]

Measurement of the TO fiscal factors (the relative cost of capital and non-debt tax shields) proves more difficult. Theoretically, their effect on leverage is relatively clear: the deductibility of interest charges from taxable income lowers the cost of debt financing compared to the cost of equity financing, which is not usually granted a similar deduction. The tax advantage of debt, however, declines as companies become tax-exhausted. This might occur as a consequence of current operating losses, non-debt tax deductions (like the carry-back and carry-forward of losses or depreciation allowances), and interest deductions from already-existing debt.

The most adequate measure of the tax advantage of debt should be a forward-looking indicator that takes account of the present status and future profitability of the company, the presence of other tax deductions or credits that might reduce the advantage of interest deduction, and the details of tax legislation on the carry-back and forward of losses. Ideally, one should take into account all interactions at the company level by using a unique measure, rather than separate variables (Graham, 2003). However, an effective tax rate of this type is not available, since it is

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[2] In particular, the "losers" from the 1998 reform were companies with losses, highly levered, and paying low social contributions, see Bontempi et al. (2001).

based on unknown managers' expectations of the future tax status of the company (Shevlin, 1990). As a result, empirical studies adopt alternative approaches, all of which have pros and cons.

In their debt regressions, a number of authors (*e.g.* Titman and Wessels, 1988) try to encapsulate fiscal effects by including non-debt tax shields only. One problem with this fiscal indicator is the often-estimated wrong sign. Instead of a tax substitution effect (tax shields against interest deductions), non-debt tax shields, in the form of depreciation allowances for example, capture the presence of highly profitable investments and greater guarantees (securability effect). The estimation of the substitution effect between interest deductions and non-debt tax shields requires either particular measures to be taken (for example, loss carry-forwards only) or that non-debt tax shields, especially when they consist of investment tax credits or depreciation allowances, interact with a variable which identifies those companies near to tax exhaustion (see *e.g.* MacKie-Mason, 1990). Therefore, in addition to non-debt tax shields, Graham (1996a) introduces the estimated marginal tax rate (MTR) into his debt regressions. This effective tax rate measures the present value of current and expected future taxes paid on an additional unit of income earned today. Expected future taxes are computed by assuming that managers forecast future taxable income using a random walk model with drift, and by accounting for the present features of the tax legislation. Despite the considerable appeal of this particular indicator, it may present both conceptual and empirical limitations. From the behavioral point of view, it is reasonable to assume that "some managers make decisions based on their firm's current statutory tax status", and that "not all firms simulate marginal tax rates" (Graham, 1996a, pp. 55, and 62). From the statistical point of view, the forecast of expected taxable income requires a considerable time span *before* the period of MTR computation. For example, the MTR estimation for 1990 requires a stream of future incomes expected in 1990, which can only be forecasted on the basis of past company earnings (prior to 1990). The forecast horizon depends on carry-back and carry -forward provisions.

In the specification of our empirical MPO model, we adopt Graham's approach (1996a), since we include both non-debt tax shields and simulated effective tax rates in the *trade* vector of equation (4). However, our approach differs in two ways. Firstly, we do not adopt a specific measure of non-debt tax shields, but implement different measures to check the robustness of the MPO model estimates to alternative specifications (see Section 4). Secondly, our effective tax rates derive from a micro-simulation model (MATIS) based on the detailed accounting items reported by the companies in our sample.[3] The MATIS calculates the taxes due on present income, and is not based, therefore, on the expected stream of taxable income. This choice is due to the short time span of our sample (1982-1999), which does not allow for a reliable representation of the stochastic process of future profitability, and hence the MTR's computation. However, for a sub-sample (1982-1994), we can estimate the perfect foresight marginal tax rate (Graham, 1996b), *e.g.* the expected effective tax rate based on realized taxable income rather than on forecasts of future income. A comparison between the performance of our simulated tax rates and the perfect foresight MTR is in Section 4.

Our simulated tax rates possess a number of positive features. The MATIS takes into account the complex interaction of the various aspects of tax law, *e.g.* the tax code treatment of net operating losses and tax credits. Even though there are differences between accounting and taxable profit (the latter could only be properly measured using individual data for tax returns, see Plesko, 1999), the wealth of accounting information in our sample, together with the details of the legislation included in the MATIS model, allow us to imitate tax-code formulas to a rather precise degree (Bontempi, Giannini and Golinelli, 2004).

By using the MATIS simulated tax rates we subsequently calculated the relative cost of capital variable (*ccnsitd*) as the ratio between the user cost of capital under debt and that under

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[3] Details on the functioning of MATIS microsimulation model are in Bontempi et al. (2001). An analysis of MATIS predictive ability is in Bontempi, Giannini and Golinelli (2004).

equity financing.[4] The following formulas illustrate the changes in tax legislation over our sample period (1982-1999):

$$ccnsitd_{82-91} = 1 - t_{sc} \tag{5}$$

$$ccnsitd_{92-95} = \frac{1 - t_{sc}}{1 + \frac{t_{spat}}{ieq}} \tag{6}$$

$$ccnsitd_{96} = \frac{1 - t_{sc}}{nsitd + (1 - nsitd)(1 + \frac{t_{spat}}{ieq})} \tag{7}$$

$$ccnsitd_{97} = \frac{1 - t_{sc}}{nsitd(1 - agev) + (1 - nsitd)(1 + \frac{t_{spat}}{ieq} - agev)} \tag{8}$$

$$ccnsitd_{98-99} = \frac{1 - t_{sirpeg}}{1 - agev} \tag{9}$$

In equations (5)-(8), $t_{sc} = t_{silor} + (1-\beta\ t_{silor})t_{sirpeg}$, where t_{silor} and t_{sirpeg} are the MATIS simulated tax rates for local income tax on profits (Ilor) and national corporation tax (Irpeg) respectively, and β is the share of Ilor deductible from the Irpeg tax base (see Table 1). These MATIS simulated tax rates take into account the carrying forward of losses, granted for five years under Italian legislation (no carry back is allowed). Compensation of losses is allowed against Irpeg, but not against Ilor. Since no information is available about losses prior to the first year of our sample, we have assumed that they are equal to zero during the initial period; this means that, during the first five years, the simulated effective tax rate may overestimate the true effective tax rate.

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[4] The user cost of capital is derived from a model of market equilibrium with no arbitrage opportunities and ignoring risk, so that investors earn the same net return on debt and equity investment. Given that data on firms tax clienteles are not available, personal taxation on capital gains, dividends, and interests is proxied by statutory – thus constant over individuals – tax rates. Then, we preferred to capture personal taxation with the individual effects of our panel estimation (see section 4), instead of complicate the relative cost of capital formulation with weighted averages of between-firm *constant* tax rates.

In equation (6), valid for the 1992-1995 period, the denominator is greater than one because of the presence of the tax on net company wealth (levied at the MATIS simulated rate t_{spat}). This tax increased the cost of equity (both retained earnings and new share issue). To transform the tax rate on net wealth into a corresponding rate on income suitable for inclusion in the cost of capital formula, the former is discounted by the Treasury bills interest rate, *ieq*.

From 1996 onwards, the tax on net wealth was not due if the marginal source of finance was the new subscription of capital. In order to account for this change in tax codes, equations (7) and (8) weight the two different sources of equity financing with *nsitd*, the percentage of financing by new share issues over the total financing by new equity.

Both the net wealth tax and the local tax were abolished in 1998 by a wide tax reform that also introduced a new regional tax (Irap) levied on a measure of value added of the net-income type.[5] This tax is neutral with respect to different financing choices and therefore it does not appear in the relative cost of debt and equity capital, see Bordignon, Giannini and Panteghini (1999).

Moreover, in 1997 a new allowance on equity capital was introduced in order to reduce the wide gap between the tax costs of debt and equity capital and stimulate the capitalization of Italian firms, see Bordignon, Giannini and Panteghini (2001). The original reform was incremental: only new equity financing from 1996 onwards was eligible for the allowance. While this restriction reduced the impact of the reform on net cash flow (and symmetrically tax revenue), it did not adversely affect the impact of the reform on the relative cost of debt and equity capital.

According to the new equity allowance, corporate income is divided into two components. The first component, called "ordinary income", is computed so as to approximate the opportunity cost of new financing with equity capital. To do so, a notional interest rate, set yearly by the government on the basis of the market interest rate, is applied to new equity financing (new subscriptions and

[5] In the manufacturing sector, the tax base is computed as the difference between revenue from sales on the one hand, and costs for intermediate goods and services and depreciation, on the other. Neither labour costs nor interest payments are deductible from the Irap tax base.

retained earnings from 1996 onwards). This "ordinary return" (normal profit) is taxed at the reduced rate of 19%. The remaining profits are taxed at the statutory Irpeg rate (37% when the allowance was originally introduced). The tax saving due to this allowance is $agev = (0.37 - 0.19)\frac{IMP_{Dit}}{RO + RIP_{Dit}}$.

The difference between statutory and reduced tax rates is multiplied by the ratio $\frac{IMP_{Dit}}{RO + RIP_{Dit}}$ to account for the possibility of tax exhaustion, which might prevent the firm benefiting from this allowance. To be more precise, the term $RO+RIP_{Dit}$ represents the amount of income that in theory may be taxed at the reduced tax rate (19%): *RO* is the opportunity cost of shareholders' funds; RIP_{Dit} is the carry-forward of the fiscal allowance not utilized because of earnings' exhaustion; IMP_{Dit} is the amount of Irpeg-taxable income that actually benefits from the reduced tax rate. All these values are simulated by the MATIS model. The variable *agev* ranges form a minimum of zero - when firms are not able to exploit the Dit advantage - to a maximum of 18% - when firms can use the Dit advantage to the full.

As a consequence of the abolition of the net wealth tax and of the local profit tax (Ilor), along with the introduction of the new regional tax (Irap) and of the allowance for additional corporate equity, the relative cost of capital of debt versus equity for the non-exhausted median company increased in one shot from 0.43 in 1996 to 0.77 in 1998. In the previous period it went in the opposite direction: it was 0.61 in 1982 and progressively decreased up to 0.43 per cent in 1996. The 1997-98 reform was successful in making the tax system more neural with respect to different sources of finance and this mainly occurred by reducing the cost of equity, with respect to debt finance.

4. The empirical assessment of the debt ratio determinants

The empirical implementation of the MPO equation (4) requires two major specification choices: the selection from the available database of adequate measurements for all the alternative

MPO determinants, and the choice of the more appropriate econometric approach. Both steps are discussed in Section 4.1. Section 4.2 reports the estimation results.

4.1 The choice of the variables and econometric methodology

The source of data for this study is drawn from the Company Accounts Data Service (CADS), a large database with information on the balance sheets and income statements of more than 50,000 Italian companies operating in the entire range of industrial sectors, from 1982 to 1999. A further description of the CADS is in Bontempi, (2002). Our selection rules include: all manufacturing industries; only those companies whose data are available for at least four consecutive years; only those companies who comply with our clearing criteria (*i.e.* no inconsistencies in the accounting items, no strong outliers of any of the interest variables)[6] The resulting sample is an unbalanced panel of 24,796 companies (overall, we have 225,333 individual observations).

The variable explained by the MPO empirical specification in equation (4) is the first difference of the ratio between bank-debt and net assets (see the Appendix). This variable measures the TO theoretical dependent variable (debt variation), and closely approximates the PO theoretical dependent variable (new debt issues).[7] This is fundamental to nest the two theories in the MPO specification. The choice of bank-borrowing for measuring Δd_{it} is suggested by the extensive demand for this type of debt from Italian manufacturing companies.[8]

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[6] Details of the selection rules are available from the authors.

[7] Debt variation represents new debt issues net of debt repayments, but the current portion of long-term outstanding debt which has to be repaid during each period is almost irrelevant in Italy because short-term debt amounts to 80% of total debt.

[8] Bank-debt represents about 90% of total financial debt, bonds account for 5%, loans from subsidiaries, affiliates and parent companies account for 3%, and shareholder loans account for 2%. This is principally due to the Italian institutional and legal system, which failed to encourage active public participation in the capital bond markets, and to the long-term ties between major banks and their client firms. For a discussion of this issue, see Bontempi (2002).

As far as the measures of the theoretical MPO determinants in the *fcf* and *trade* vectors of equation (4) are concerned, we acknowledge that the theories surveyed in Section 2 do not explicitly say which explanatory variables belong to the "true" regression. In fact, theories simply suggest a number of potentially influential effects classified as PO and TO debt-ratio determinants, instead of fully specifying the empirical model. Thus, there is a substantial risk of selecting some explanatory variables that are imperfect or mixed measures of the "ideal" determinants. For example, the possible measurement errors involved in the proxy for non-debt tax shields may alter the sign and significance of the estimated coefficients of tax variables and/or of guarantees (as discussed in Section 3).

Table 2 illustrates a number of different empirical measures used in the literature for representing the alternative theoretical effects. The first column lists the theoretical debt-ratio determinants included in the *fcf* and *trade* vectors (see also Section 2). The second column reports the parameter labels (*e.g.* c_1 is the first parameter in vector c, and measures the effect of cash flow on debt-ratio). The subsequent columns list alternative measures that are available for each effect.[9]

Table 2 here

Cash flow and the relative debt/equity cost of capital are the only variables without alternative measures. PO theory is quite accurate in defining what are the internal funds to be considered in the cash flow measure (*casha*). Our relative debt/equity cost of capital "focus measure" (*ccnsitd)* is MATIS-simulated by equations (5)-(9) of Section 3. However, in order to test for the robustness of our outcomes to the use of the perfect foresight MTR instead of MATIS-simulated tax rates, the last part of section 4.2 reports alternative estimation results with MTR.

In order to tackle the measurement issue, we split the explanatory variables of equation (4) into two groups: the "focus" and the "control" variables, as required by Leamer (1985) extreme bound analysis (EBA). Given our objective of assessing the effect of taxes on debt policy, *casha*,

[9] Detailed definitions and descriptive statistics of these variables are given in the Appendix; for a survey of the explanations of each theoretical effect see Harris and Raviv (1991).

ccnsitd and d_{it-1} are the focus variables since they are the direct transmission channels of tax instruments on corporate borrowing, plus its dynamics. The other seven variables, belonging either to *fcf* or *trade* vectors in Table 2, are the control variables: they are of interest in as far as their alternative measurements might imply different estimates of the focus variables parameters. These differences are bigger the lower is the correlation between alternative measurements of the control variables.[10]

EBA consists in varying the measures of the control variables in order to find the widest range of c_1, b_1, a parameter estimates. The effects played by the focus variables on the debt choices are considered to be robust in the sense of Leamer if their parameter estimates are significantly of the same sign, regardless of any alteration in the specification of the conditional information set of the control variables.

The specification of empirical corporate debt models does not only entail measurement problems, but is also subject to the risk of omission of relevant variables. The latter problem may arise because "variables traditionally used to control for taxes do not appear to sufficiently disentangle taxes from numerous other factors related to firm behavior". Hence, "inferences based solely on the estimated coefficients of the tax proxies and few other variables may be incorrect" (Plesko (1999, p. 29). For example, a profitable firm with a considerable debt tax advantage may borrow less than would be predicted by a pure TO model, as a result of PO behavior.

Our MPO dynamic specification (4), with both individual (μ_i) and temporal (λ_t) fixed-effects panel approach, should avoid such problems. In fact, MPO specification nests both theories, individual effects μ_i account for the influence of almost time-invariant omitted variables, and time

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[10] Though alternative measures of the same economic effect cannot be orthogonal, low sample correlation among measures makes it possible that, *a priori*, the use of a measure instead of another affects the estimation results for the focus parameters. This is our case, because the sample correlation coefficient of the control variables often ranges between 0.25-0.45 (in absolute value), due to high individual variability.

effects λ_t allows for a degree of dependency across individuals due to collectively significant effects (*e.g.* widespread optimism or pessimism).

In dynamic panel models, the presence of individual effects implies that the lagged dependent variable is correlated with the equation error. Expressing equation (4) in first differences, *i.e.*:

$$\Delta\Delta d_{it} = c'\,\Delta fcf_{it} + a\,\Delta d_{it-1} + b'\,\Delta trade_{it-1} + \lambda_t + \Delta\varepsilon_{it} \qquad (10)$$

removes the individual effect μ_i Nevertheless, OLS estimators on (10) is still inconsistent because Δd_{it-1} is correlated with $\Delta\varepsilon_{it}$.

Moreover, MPO specification (10) is probably affected by endogeneity problems that are not confined to the lagged dependent variable, but also involve the other explanatory variables. In fact, theory assumes that when choosing their form of financing, companies are faced with various capital market imperfections and agency costs, which would imply the reciprocal influence of the availability of internal funds, investment decisions and borrowing. Moreover, the effective tax rate against which interests can be deducted is a decreasing function of borrowing.

The endogenous explanatory variables of equation (10) must be instrumented in order to obtain consistent parameter estimates. It is well known that the performance of estimators that exploit information of instruments (such as instrumental variables, IV, and generalized method of moments, GMM estimators) crucially depends on the degree of instruments relevance, *i.e.* the correlation between instruments and endogenous-explanatory variables of the structural model. In fact, low instruments relevance can cause both the bias of parameters estimation in finite-samples, and the finite-sample distribution to depart from the asymptotic normal. Further, the “weak instruments” related problems apply even in samples of considerable size (see Bound, Jaeger and Baker, 1995).

In order to check for instrument relevance, we performed the Bound, Jaeger and Baker (1995) partial R^2 and the Shea (1997) R^2 measures of instruments explanatory power. In general, our results suggest the reliability of instruments: highly significant partial R^2 associated with similar

Shea's measures. All our explanatory variables are ratios or rates (see the Appendix) and the cross-section variability of our individual data is huge: these facts probably prevent the occurrence of invalid instruments in levels due to their almost random walks statistical behaviors (about this topic, see *e.g.* Bond, 2002).

From a theoretical point of view, the GMM approach to dynamic panel models (from the "GMM-diff" of Arellano and Bond, 1991, to the "GMM-sys" of Blundell and Bond, 1998) is more efficient than the IV approach. In fact, the GMM estimator exploits for each time-period all the available instruments (*i.e.* more identification restrictions than IV). However, a number of drawbacks emerge when GMM approach is applied to our case.

First, when the sample dimension is large, the GMM approach is computationally very complex, and some theoretically appealing options (like the GMM-sys) are infeasible. In addition, since our implementation of the EBA analysis is heavily time consuming, it is preferable to use a computationally tractable estimation method.[11]

Second, results of asymptotics in GMM are somewhat incomplete when the datasets are unbalanced. Our panel is strongly unbalanced since the average time-period is seven years.

Third, as shown by Ziliak (1997), many over-identifying restrictions may raise a trade-off between bias (due to weak instruments) and efficiency of GMM estimator.

Because of the reasons listed above, in this paper we followed the IV approach suggested by Anderson and Hsiao (1981) and by Arellano (1989) by instrumenting all the explanatory variables in equation (10) with the corresponding two-period-lagged levels. In order to make correct inferences though potential residual heteroschedasticity, we estimated a variance-covariance matrix for the IV estimators that is robust to generic for the presence of heteroschedasticity.[12]

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[11] Note also that inefficiency problems inherent to the IV approach can be overshadowed by the size of our sample.

[12] Stata (the software we used in this paper) computes the Eicker-Huber-White "sandwich" robust estimator, see Baum, Schaffer and Stillman (2003). We acknowledge the Stata implementations of the three previous authors whose efforts greatly simplified our work.

Finally, our IV choice for the full sample is corroborated by quite similar estimation and inference results for the focus parameters of equation (10) by using IV, GMM-diff, and GMM-sys approaches in the balanced sub-panel (about 1,500 companies).

4.2 Estimation results

Our application of EBA to equation (10) implies the estimation of all the possible combinations of the alternative explanatory variables (see the list in Table 2), and produces 2,880 IV estimates of the three focus parameters. Estimation results are summarized in Table 3.

Table 3 here

The cash flow parameter c_1 estimates are always negative, as predicted by PO theory; their distribution suggests a significant effect on companies' leverage, since a further percentage point in the cash flow/assets ratio leads to an average reduction of _ in the debt ratio. The dispersion of results is rather limited, with a standard deviation of 0.026.

The dynamics parameter *a* estimates, in the last column of Table 3, are even less dispersed, and suggest a speed of adjustment of about 1.2 years to reduce half the deviation between actual and target debt-ratios.

The relative cost of capital parameter b_1 estimates is always negative, as predicted by TO theory; if *ccnsitd* doubles, firms reduce their debt-ratios by an average of approximately 0.15%.[13]. Though statistically significant, the relative cost of capital seems of less economic importance than cash flow in explaining borrowing. However, the comparison between these two parameter estimates is difficult, given their different units of measurement. The economic relevance of the two transmission channels of taxes on financial behavior is assessed by using alternative fiscal policy scenarios in Bontempi, Giannini and Golinelli (2004).

In order to label our estimates as "robust" (in the Leamer's EBA sense), MPO predictions and the stability of dynamics condition require that all c_1, b_1, and a estimates be significantly

[13] In fact, -0.0305*0.4855 = 0.00148, where 0.4855 is the mean value of *ccnsitd* (see the Appendix).

negative. The three histograms in Figure 1 allow for a visual inspection of the robustness of the estimates of our focus variables: they show the distribution of test-statistics for the null hypothesis that the parameters are either equal to, or greater than, zero.

Figure 1 here

The statistics always reject the null hypothesis that c_1 and a parameters are either zero or positive, whereas as far as the b_1 parameter is concerned, the null hypothesis is not rejected but in a very limited number of cases (96 out of 2,880). Strictly speaking (*i.e.* in EBA terms), only c_1 and a are robust, whereas b_1 is not. However, as Sala-I-Martin (1997) noted, the EBA approach is often too strong for any variable to pass the test. For this reason, he proposes a less "extreme" approach in order to assign some level of confidence to the variables under scrutiny, based on the complete distribution of the parameter estimates, instead of the EBA zero-one labeling of "robust" vs. "non-robust".

The procedure adopted here is a slight variation on the Sala-I-Martin proposal. We have constructed the mean estimate and the average standard error of each parameter of interest by using all 2,880 regressions; each mean estimate is a weighted average of all individual estimates, where the weights are proportional to the generalized R^2 (*i.e.* the R^2 of the second-stage IV regressions, see Pesaran and Smith, 1994) of each individual case. In keeping with seminal Theil's (1971) criterion of model selection, the reason for using this weighting scheme is to give greater weight to the regressions characterized by a better fit (the implicit hypothesis is that the better the fit, the higher the probability of the model being true). Moreover, compared to the Sala-I-Martin proposal (1997), problems of a spurious good fit due to endogenous regressors were avoided by instrumenting all the explanatory variables instead of using OLS.

The last two rows of Table 3 show the results obtained by averaging out the entire distribution of all 2,880 outcomes. Given that each average parameter estimate is (in absolute value) well above twice its average standard error, previous EBA results for cash flow and dynamic parameters are confirmed. In addition, we can be confident about the significance of the relative cost of capital too: the average estimate over the average standard error is 2.46, and falls within the range whereby the null hypothesis is 5% rejected.

The validity of our measure of relative cost of capital can be assessed by three alternative estimation experiments. Results comparability is ensured by using a common 1982-1994 estimation period. The reason for using this sub-period is the 5-year loss carrying-forward provision of Italian tax legislation, which requires knowledge of future taxable income for a period of at least five years in order to simulate the MTR-based relative cost of capital. In the definition of the perfect-foresight relative cost of the capital, the perfect foresight MTR replaces t_{sc} in equations (5) and (6).

In the first experiment, we added to the MPO specification an explanatory variable that measures the difference between two relative costs of capital: one includes the perfect foresight MTR, while the other includes our MATIS simulated average effective tax rate. If the associated coefficient is significantly negative, then this indicates that expected tax status, and not only current tax status, partly explains borrowing (for a similar approach, see Graham, 1996a, p. 55). In the second experiment the MPO model was estimated by measuring the relative cost of capital only on the basis of the perfect foresight MTR, while the third experiment uses the previous MPO specification (results in Table 3), but estimated over the common sub-sample 1982-1994.

Results from three sets of 2,880 estimates can be summarized as follows.

First, the difference between the two relative costs of capital has a significantly negative effect on debt ratio in a very limited number of cases (less than 10%). These results are from the first estimation experiment.

Second, the relative cost of capital calculated using perfect foresight MTR only (from the second estimation experiment) lacks robustness to the use of alternative MPO specifications and instruments.[14].

[14] Since lagged values of the MTR cost of capital may only be used as instruments for lags greater than 6, we use more parsimonious lags of before-tax earnings and of interest expenses. Other possible instruments (such as lags of sales or estimated taxable income, and further lags of cash flow) would have worsened the MTR cost of capital estimation results.

Third, our MATIS-simulated cost of capital parameter estimates (from the third estimation experiment) appear remarkably stable and robust in the 1982-1994 sub-sample (the average estimate and t-statistic are -0.0043 and -1.71 respectively).

Fourth, the average R^2 of our model specifications in Table 3 is 0.200; in the sub-sample up to 1994 it is 0.174 (from the third estimation experiment); it drops to 0.135 if we use the perfect foresight MTR instead of the MATIS effective average tax rate (from the second estimation experiment).[15]

Although confined to the sub-sample up to 1994, these outcomes, which would appear to discourage the use of the perfect foresight MTR cost of capital, probably reflect the difficulty of modeling the managers' expectations of taxable income. During the period focused on in our analysis, the Italian economy was characterized by a considerable degree of uncertainty, which exacerbated the difficulties encountered in trying to model expected-income. An additional reason which might explain the poor explanatory power of the perfect foresight MTR is its high similarity to the average effective tax rates simulated by MATIS, mainly due to: the absence of carry-back of losses and the short period for carrying losses forward (five years only); the large percentage of our sample companies with positive taxable income (approximately 78%); and the high tax status-persistence probabilities (companies with positive taxable income will also have a 89.6% probability of positive income).

5. Concluding remarks

The analysis undertaken in this paper shows that both PO and TO tax variables, i.e. net-of-tax cash flow and the relative cost of capital, provide valid explanations of company borrowing within the Italian context. In fact, our results show that the tax effects on debt-ratio are robust and significantly have the right signs even when we allow for model specification indeterminacy by means of a "reasonable EBA" analysis. In addition, the comparison between simulated average

[15] Detailed results are available upon request.

effective tax rate and the perfect foresight marginal tax rate suggests the better performance of the former in explaining the leverage of Italian firms.

Therefore, both the two routes through which corporate taxation affects financing decisions - on the one hand the relative price of debt and equity finance, and on the other net-of-tax cash flow - turn out to be significant.

Our results are founded on two pillars: a general econometric specification, and the richness of the available sample information at firm level over a period of relevant variability of the tax code. In fact, the dynamic MPO econometric specification is able to nest both the PO and TO theoretical determinants and, in this way, to lower the risk of bias in estimating the relationship between borrowing and the tax variables. The large time span and the huge cross-section dimension of our sample provide enough information to disentangle tax influences on firms debt choice, and to supply a number of alternative measures for the same theoretical determinant to take into account of the specification indeterminacy.

In order to deepen the economic significance of fiscal factors in explaining firms leverage, the MPO model estimates can be used to disentangle the cash flow and relative price effects of two relevant Italian tax reforms: the 1997-98 reform, and the new (and only partially implemented) tax reform announced by the government in 2001. These analyses are reported in a related research, see Bontempi, Giannini and Golinelli (2004).

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Appendix: Alternative explanatory variables of the MPO model

Key of the variables in Table 1 (with the exception of the relative cost of capital, all the variables are scaled by net assets)

Label	Measures	first decile	median	mean	last decile	standard deviation	pseudo stan. deviation
Δd	First difference in the book value of long- and short-term debt versus banks and quasi-bank intermediaries (such as factoring and leasing).	-.0966	.0007	.0061	.1150	.0944	.0717
casha	Operative earnings before depreciation, non-operative and extraordinary items, and other non-cash expenses, net of total interest expenses, taxes, and dividends paid.	.0087	.0651	.0719	.1551	.0735	.0527
iinva	Investment in advertising, R&D and other intangibles, not tax-deductible in the accounting year.	0	.0007	.0067	.0177	.0193	.0038
iinva1	iinva plus auxiliary expenses necessary to investment operations.	0	.0007	.0070	.0188	.0199	.004
iinvna	Net investment in intangibles (investment minus disinvestment).	-.0006	.0004	.0048	.0157	.0211	.0032
iinvna1	iinvna plus auxiliary expenses necessary to investment operations.	-.0006	.0005	.0051	.0168	.0216	.0034
iinvna2	First difference in the net stock of R&D, advertising, and other intangible assets.	-.0008	0	.0004	.0010	.0142	0
inva	Investment in plant, equipment, buildings and land.	.0043	.0344	.0567	.1330	.0711	.0442
invna	Net investment in tangibles (investment minus disinvestment).	.0017	.0309	.0497	.1265	.0766	.0429
vnwc	First difference in net working capital, computed as total current assets (inventories, short-term trade and financial credit, cash and other marketable securities) minus short-term trade and non-financial debt.	-.1130	.0338	.0299	.1782	.1570	.0999
vnwc1	First difference in net working capital, computed as total current assets minus total current liabilities (excluded short-term bank debt but included short-term bonds, shareholder loans and loans from subsidiary, affiliated and parent companies).	-.1156	.0332	.0289	.1778	.1573	.1005
ccnsitd	Ratio between cost of debt and equity funds. Corporate tax rates are the MATIS-simulated tax rates; the weights for the two types of equity financing are the percentages of new share issues and retained earnings in total equity financing.	0	.4410	.4855	.796	.2740	.0769
ndts	Depreciation allowances on tangible and intangible assets, including accelerated depreciation.	.0126	.0372	.0452	.0876	.0332	.0279
ndtsr	ndts plus advertising and R&D expenses tax-deductible in the accounting year.	.0139	.0407	.0502	.0969	.0394	.0306
ndtsrof	ndtsr plus interest expenses on pre-existing non-bank debt.	.0153	.0438	.0532	.1015	.0404	.0319
ndtsrrof	ndtsrof plus net operating loss carry-forwards simulated by MATÌS and lagged one period.	.0174	.0516	.0734	.1385	.0938	.0415
ndtstw	Difference between theoretical fiscal charge (computed on the basis of pre-financing taxable income, i.e. earnings before taxes, depreciation and interest on bank debt) and Irpeg charge simulated by MATÌS.	.0069	.0411	.0516	.1059	.0463	.0353
ndtstw1	Difference between theoretical fiscal charge (computed on the basis of post-financing taxable income, i.e. earnings before taxes and depreciation) and Irpeg charge simulated by	.0083	.0440	.0543	.1101	.0472	.0366

	MATÌS[16].						
matna	Net stock of all tangible assets, including those leased.	.0542	.2098	.2388	.4631	.1612	.1572
terna	Net stock of buildings and land.	0	.0628	.0862	.2072	.0927	.0876
termacna	terna plus net stock of plant and equipment	.0195	.1862	.2136	.4371	.1625	.1597
garna	Suretyships, warranties, and real guarantees received by controlled and associated companies, by others, and by banks and quasi-bank intermediaries, minus those laid down by the firm.	-.0382	0	-.0097	.0017	.2703	0
imatna	Net stock of all intangible assets.	0	.0052	.0176	.0465	.0353	.013
redna	Net stock of R&D, patents of invention, licences, concessions, and registered trade-marks.	0	0	.0042	.0072	.0194	.0004
redplana	redna plus net stock of plant expenses (technology expenses and soft capital inputs).	0	.0051	.0174	.0458	.0351	.0127
nwc	Net working capital, computed as total current assets minus short-term trade and non-financial debt.	.1293	.3759	.3661	.6028	.2093	.1825
nwc1	Net working capital, computed as total current assets minus total current liabilities (excluding short-term bank debt but including short-term bonds, shareholder loans and loans from subsidiary, affiliated and parent companies).	.1204	.3708	.3600	.5988	.2121	.1841

The PO vector of explanatory variables (*fcf*) includes all the components of free cash flow: profitability (casha) with envisaged negative sign on borrowing, together with alternative measures of growth opportunities (iinva, iinva1, iinvna, iinvna1, iinvna2, inva, invna, vnwc, vnwc1) with envisaged positive sign. The variations in net working capital (vnwc and vnwc1) point to the firm's attempts to build up financial slack (cash, liquid assets and marketable securities, unused borrowing power).

The TO vector of explanatory variables (*trade*) includes fiscal factors other than the relative cost of capital (ndts, ndtsr, ndtsrof, ndtsrrof, ndtstw, ndtstw1), failure factors (matna, terna, termacna, garna), agency factors (imatna, redna, redplana) and signalling factors (nwc, nwc1).

Tangible assets (matna, terna, termacna) increase a company's debt capacity, because they are readily marketable and more valuable in a situation of short-notice liquidation. The same thing goes for the guarantees (garna).

The value of intangible assets such as technology, human capital, trade marks and patents (imatna, redna, redplana) is something that managers prefer not to reveal because the secrecy surrounding corporate strategy is of crucial importance to competitive advantage. Thus, intangibles offer considerable opportunities for the discretionary behaviour of managers, which might be mitigated by increased borrowing.

Finally, the widespread use of multiple borrowing by Italian companies may lead to serious informational problems for banks and to free-riding problems. Liquid assets (nwc, nwc1) mitigate moral hazard and adverse selection problems in loan contracting. In fact, they proxy for those various financial services (such as letters of credit, deposits, check clearing and cash management services) which can increase the customer-specific information available to intermediaries beyond that information readily available to the public, and which can reduce the problem of asymmetric information resulting from multiple borrowing.

[16] In other words, ndtstw and ndtstw1 include tax credits scaled by the MATIS simulated Irpeg tax rate in order to transform them into a deduction from taxable income. Tax credits on dividends are excluded because they may create positive taxable income when the firm has net operation losses, thus allowing for interest deductions.

Tab. 1 - Major tax parameters and legislation changes in Italy over the 1982-1999 period.

Year	*Major tax parameters and tax changes*
1982	The corporate tax rate was 27 per cent and in addition there was a local tax (Ilor) with a rate of 16.2 per cent. Ilor was deductible from the corporate tax base. The overall tax rate on corporate profit was 38.8 per cent.
1983	The corporate tax rate increased from 27 to 36 per cent.
1991	Ilor was made deductible from the corporate tax base only at 75%.
1992	Ilor was made entirely non deductible from the corporate tax base. A net wealth tax was introduced, with a tax rate of 0.75 per cent. Both retained earnings and subscription of new equity capital were included in the tax base.
1995	The corporate tax rate increased from 36 to 37 per cent.
1996	Subscription of new equity capital was made deductible from the tax base of the net wealth tax.
1997	A new dual income tax system was introduced according to which the opportunity cost of capital in case of new equity financing and retained earning was taxed with a preferential rate of 19 per cent.
1998	Several taxes on companies were abolished, mostly important: the local income tax (Ilor), the net wealth tax and a social contribution specifically levied on labour income to finance health expenditure. A new regional tax (Irap), levied on a a measure of value added of the net income type, was introduced, with a rate of 4.25 per cent. The overall tax rate on profits dropped from 53.2 in 1996 to 37-27 per cent range in 1998.

Tab. 2 - The structure of equation regressors in *trade* and *fcf* vectors

Theoretical effects	Parameter	Alternative measures (explanatory variables) by effect ([1])					
Dynamics	a	d_{it-1}					
PO (*fcf* vector):							
Cash flow	c_1	$casha_{it}$					
Investment needs:							
- intangibles	c_2	$iinva_{it}$	$iinva1_{it}$	$iinvna_{it}$	$iinvna1_{it}$	$iinvna2_{it}$	
- tangibles	c_3	$inva_{it}$		$invna_{it}$			
Financial slack	c_4	$vnwc_{it}$	$vnwc1_{it}$				
TO (*trade* vector):							
Fiscal:							
- relative cost of capital	b_1	$ccnsitd_{it-1}$					
- non-debt tax shields	b_2	$ndts_{it-1}$	$ndtsr_{it-1}$	$ndtsrof_{it-1}$	$ndtsrrof_{it-1}$	$ndtstw_{it-1}$	$ndtstw1_{it-1}$
Failure	b_3	$matna_{it-1}$	$terna_{it-1}$	$termacna_{it-1}$	$garna_{it-1}$		
Agency	b_4	$imatna_{it-1}$	$redna_{it-1}$	$redplana_{it-1}$			
Signalling	b_5	nwc_{t-1}	$nwc1_{t-1}$				

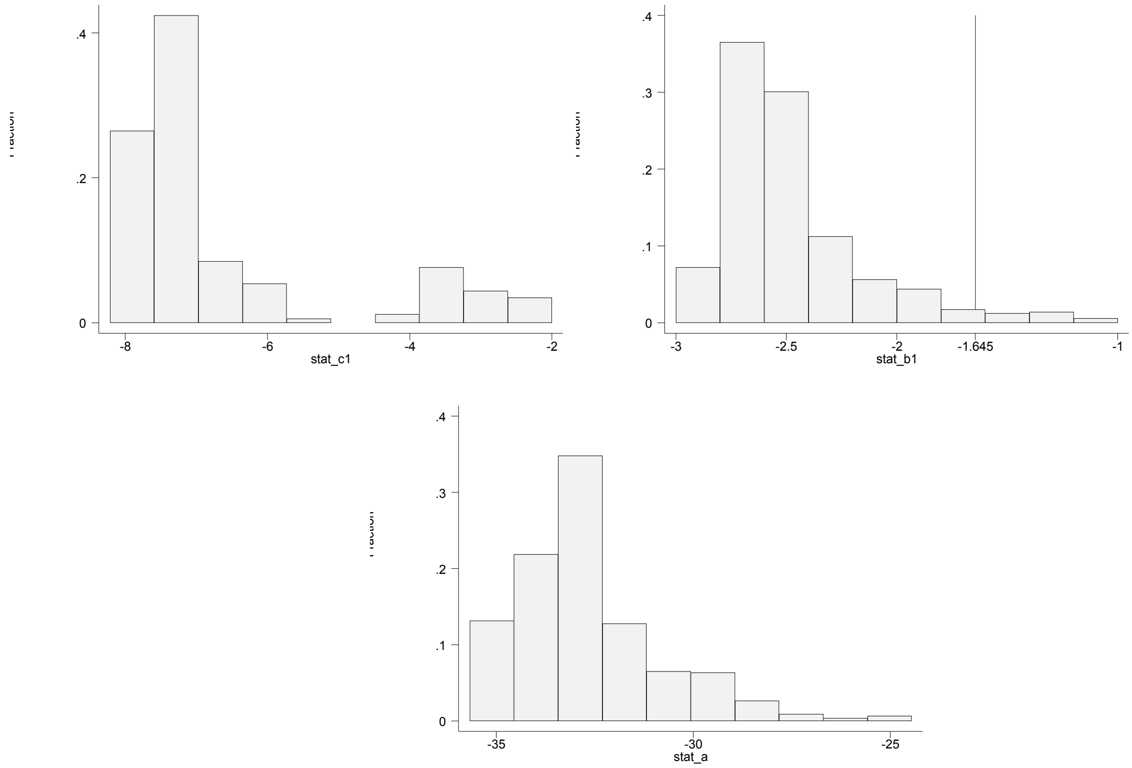
([1]) The reasons for the choices we made and a description of each label are to be found in the Appendix.

Tab. 3 - A synthesis of the 2,880 estimates

	$\hat{c}_1$	$\hat{b}_1$	$\hat{a}$
Summary statistics:			
Mean	-0.259	-0.00305	-0.427
Standard deviation ([1])	0.026	0.00040	0.008
Minimum	-0.367	-0.00429	-0.447
1st quartile	-0.267	-0.00326	-0.431
Median	-0.255	-0.00309	-0.426
3rd quartile	-0.244	-0.00290	-0.422
Maximum	-0.201	-0.00160	-0.408
Weighted averages: ([2])			
Estimate	-0.260	-0.00305	-0.427
Standard error ([3])	0.048	0.00124	0.013

([1]) Standard deviation in the 2,880 parameter estimates
([2]) Weights are based on the generalized R^2 of each regression.
([3]) Weighted average of the 2,880 standard error estimates

Fig. 1 - The distribution of the test-statistics of parameters of interest (*)



(*) The vertical line at 1.645 is the critical value at one-tail 5% significance level: the statistics that fall to the right of the critical values suggest the corresponding estimates are not robust (the line is not plotted if the critical value falls outside the right-hand side of the histogram).