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Complex organizations, tax policy and financial stability

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Complex organizations, tax policy and financial stability[*]

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Abstract

This paper develops a theory of corporate ownership and leverage of multiple firms under a tax-bankruptcy trade-off, allowing for internal bailouts. It then questions whether tax policy contributes to the default of the resulting complex organization. Absent other taxes and non-financial synergies, ownership is irrelevant to firm value. With Intercorporate Dividend Taxes, SPV-like subsidiaries or horizontal groups are optimal as they avoid double-taxation while preserving the tax benefits of debt. Adding Thin Capitalization rules makes complex organizations more stable than stand-alone firms. These results suggest to extend both corrective taxes to SPVs so as to promote financial stability.

JEL Classification: G32, H25, H32, L22.

Keywords: ownership structure; default; dividend taxes; Thin Capitalization; parent subsidiary; debt shifting; securitization.

1 Introduction

Interest deductions from taxable income provide an incentive to rely on debt financing. The capital structure of complex organizations, such as financial conglomerates or family groups, is especially sensitive to such tax incentives. Their internal capital market allows for the bail-out of subsidiaries, making both their leverage and tax shield higher than in independent companies. It is therefore possible that tax policy contributes to the insolvency of highly leveraged firm combinations. Such possibility is relevant not only in a corporate finance perspective, but from a welfare point of view as well since the default of just one such organization (Lehman Brothers) triggered financial instability.[1] An assessment of tax policy should however consider other tax provisions that target groups, along with interest deductions. On the one hand, Intercorporate Dividend Taxation (IDT) taxes profits distributed by subsidiaries to their parent company, resulting in a double tax on dividends to ultimate shareholders that may dismantle groups (Morck, 2005). On the other hand, Thin Capitalization rules cap interest deductions in subsidiaries. This paper examines whether these additional tax provisions are able to contain the default costs of a complex organization, in a second best setting.

To this end, this paper must first fill a vacuum in corporate finance theory, shedding light on the nexus between corporate ownership and capital structure.

We model the choice of a controlling entity (an "entrepreneur") who owns two cash-flows ("firms") and selects debt in each firm as well as their intercorporate links to maximize their overall value. As in Leland (2007), there are no real synergies associated with the group structure and each firm is subject to the tax-bankruptcy cost trade-off. Debt provides a tax shield since interests are tax-deductible; at the same time, higher debt increases the likelihood of costly default. The entrepreneur also decides the ownership structure of the firm combination. If the parent owns equity in its affiliate, it will receive subsidiary profits as intercorporate dividends, proportionally to its ownership share. We also allow the parent to commit to bail-out its insolvent but profitable affiliate, if it will have sufficient funds ex-post [2]. We finally assess the sensitivity of the resulting organi-

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[1] Most systemically relevant financial firms have hundreds of subsidiaries. As of 2007, the most extreme example was Citigroup with over 2400 subsidiaries, but 15 other financial conglomerates had more than 260, see Herring and Carmassi (2009). Lehman Brothers Holding Inc. had 433. A stylized representation of its group structure is available in the Chapter 11 Proceedings Examiner Report. Also several groups in manufacturing defaulted on their debts. Penati and Zingales (1997) describe the structure and leverage of an early example of a family group default.

[2] Formal and informal bail-out commitments are common, see Bodie and Merton (1992) and Boot Greenbaum and Thakor (1993).

zation to tax policy.

Absent group-specific tax policies, we show that the parent fully commits to bail-out its subsidiary. This is more effective than a partial commitment and allows the parent company to become unlevered, while the subsidiary increases its own leverage and tax shield. Intercorporate ownership is instead irrelevant to group value. That is, the optimal complex organization may have no intercorporate ownership, as the entrepreneur owns the subsidiary directly in a horizontal group or outsiders fully fund it as in a Special Purpose Vehicle (SPV). At the other extreme, it may be a hierarchical group with either full or partial intercorporate ownership as in a pyramid, so that both the entrepreneur and outsiders own subsidiary shares. Irrelevance of ownership follows from the irrelevance of dividend transfers across units, which occurs because the parent is optimally unlevered. In such case, dividends do not help parent solvency and do not affect the expected default costs of the group.

Against this background, our structural approach allows an analysis of corrective taxes targeted to complex organizations. Introducing Intercorporate Dividend Taxes, one expects to both discourage indirect ownership - as suggested by Morck (2005) - and increase leverage, by adding an additional tax layer to equity financing. Our results confirm the first conjecture. The entrepreneur in a hierarchical group strictly prefers not to be taxed twice and the optimal ownership avoids any intercorporate dividend. Accordingly, the entrepreneur will directly own both units in a horizontal group, possibly sharing their ownership with outside shareholders. Alternatively, it will relinquish subsidiary ownership to outsiders while keeping the parent bail-out guarantee in place. The value of the organization is unchanged, as well as default costs and welfare. It follows that intercorporate dividend taxes are unable to improve on financial stability.

Thin Capitalization rules explicitly aim at preserving tax payments of subsidiaries by containing their leverage. Indeed, the cap imposed on the subsidiary causes debt shifting towards the parent company, which is levered if the cap is sufficiently low.[3] Our model highlights that even when the cap is set to constrain subsidiary leverage to the stand alone level, it may fail to contain expected default costs of hierarchical groups to the stand-alone level. [4] We show, instead, that a calibrated combination of both Thin Capi-

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[3]The association between larger intercorporate dividend payments with parent debt financing is visible in France, where TC rules are in place but there are no taxes on intercorporate dividends (De Jong, De Jong, Hege and Martens, 2012).

[4]Consistent with debt shifting, affiliates' leverage responds to the introduction of Thin Cap rules in US multinationals while consolidated leverage does not (Blouin, Huizinga, Laeven and Nicodème, 2014).

talization rules and IDT lowers expected default costs in the complex organization below the ones of stand-alone firms. Caps on interest deductions restore the stabilizing effects of internal bail-outs on subsidiaries. In turn, IDT avoids debt shifting onto the parent company.

Our simulations, that follow the parametrization of Leland (2007), show that combining the two tax policies reduces expected default costs in the group to $1.02 for every 100$ of expected cash-flow, as opposed to $8.13 without IDT and Thin Cap rules and $1.78 for two independent firms.[5] IDT and Thin Cap Rules correspondingly increase the tax burden of the group to $35.57, up from $25.37.[6] This compares to $35.40 for two independent companies.

Results concerning the "no bail-out" case provide insight concerning the effect of new prudential provisions, implied by the Volcker rule, that ban bail-outs of SPVs by bank conglomerates. In such "no bail out" case, it is optimal for the parent to lever up, as there are no reasons not to exploit its tax shield. Subsidiary dividends help the levered parent to repay its debt when it would otherwise be insolvent. Thus its leverage is higher than that of a comparable stand alone firm and optimal intercorporate ownership is 100%, when there are no corrective taxes in place. The introduction of IDT may then reduce intercorporate ownership and dividend support, thereby leading to lower optimal leverage. As far as financial stability is concerned, we show that even a lower overall leverage may deliver higher expected default costs due to distortions in the optimal allocation of debt across firms - that is too much leverage in the subsidiary relative to the no-IDT allocation.

This insight on non-neutral IDT applies to other circumstances that make intercorporate ownership optimal, such as tax consolidation benefits or production synergies. In such cases, it does not pay to dismantle a hierarchical structure unless the tax rate is sufficiently high.

This paper contributes to the theory of corporate ownership. Ownership irrelevance was first put forward by Demsetz and Lehn (1985), who observed that firm value is insensitive to agency costs associated with ownership dispersion. Previous models of complex organizations also focus on dispersed shareholders. In Almeida and Wolfenzon (2006b), the entrepreneur prefers a pyramidal structure to a horizontal group when the

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[5]This estimate overlooks the reduction in risk taking and externalities stemming from lower leverage and default. However, it posits enforcement of tax rules.

[6]The use of non-debt tax shelters by the parent (as in De Angelo and Masulis (1980) and Graham and Tucker (2006)) may increase these tax gains. Multinationals may additionally exploit the different tax jurisdictions of subsidiaries (Altshuler and Grubert, 2003; Desai, Foley and Hines (2007); Huizinga, Laeven and Nicodème, 2008), while our model assumes equal tax rates so as to focus on an additional tax arbitrage.

affiliate has lower net present value, so as to involve outsiders in its funding. Our paper shifts the focus from agency and dispersed shareholders onto default and intercorporate ownership. Our model implies that the entrepreneur is indifferent to the structure of ownership unless there are additional frictions (on top of the debt tax shield) such as Thin Capitalization Rules, real synergies or limits to bail-outs. With such frictions, we show that both firms are levered. Otherwise, the specialized capital structure derived by Luciano and Nicodano (2014) for a wholly-owned subsidiary holds with any group ownership. Our results thus provide a rationale for zero leverage companies (Strebulaev and Yang, 2013).

To our knowledge, this is the first model of IDT and Thin Cap.[7] Morck (2005) argues that the introduction of IDT, which is still present in the US tax code, improved on corporate governance during the New Deal by discouraging pyramidal groups. Our model shows that the introduction of IDT dismantles hierarchical groups if ownership irrelevance holds. This change in ownership structure is however welfare neutral, in a world without governance concerns, being unable to affect default costs. If other synergies or a ban on bail-outs break irrelevance, IDT provides the incentive to transform a wholly-owned subsidiary into a partially owned one only if the tax rate is sufficiently high. Thus, IDT may give rise to a pyramid, unless the tax rate decreases in the ownership share of the parent company - a feature of the US tax code.

Our insights on value, ownership and internal bail-outs of complex organizations apply well to financial conduits, that do not appear to be subject to Thin Capitalization Rules. In the IDT scenario of our model, outsiders entirely finance the subsidiary whose debt value is enhanced by the parental guarantee. This way the subsidiary circumvents IDT and still enjoys interest deductions. In SPVs, the sponsoring firm and investors agree upon the state contingent subsidization of the vehicle, beyond the sponsor's formal obligations. Conduits, that can be incorporated either as a proper subsidiary or as an orphan Special Purpose Vehicle, are structured to be tax neutral as they would otherwise be subject to double taxation (see Gorton and Souleles, 2006).

This interpretation of our results is supported by two additional observations. First, securitization increases with the corporate tax rate, i.e. with incentives to exploit the

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[7]Several papers analyze the effect of personal dividend taxes on corporate choices. They focus on their impact on dividend payout, investment and equity issues (see Chetty and Saez, 2010, and references therein), but ignore intercorporate links and leverage. On the contrary, we fix payout, investment and equity issues and analyze how IDT affect intercorporate links and leverage. Our limited understanding of complex organizations, as well as their prevalence among multinationals, family firms and financial intermediaries, provide support to our approach.

tax shield (Han, Park and Pennacchi, 2015). Second, Gropp and Heider (2009) find that deposit insurance and capital requirements fail to explain bank capital structure which instead responds to the tax-bankruptcy trade-off in non-financial firms, albeit with a surprisingly higher leverage. Our model points to the bail-out commitment as the explanation for the higher tax benefits of banks, relative to non-financial firms, that explains their surprisingly higher leverage.[8]

This is not the first paper pointing to an association between tax policy, leverage and financial instability. De Mooji, Keen and Orihara (2013) simulate the effects of new tax measures that contain aggregate bank leverage. With a similar motivation, this paper develops a micro analysis of firm/bank incentives to lever up. A policy implication of our analysis is that extending Thin Capitalization rules to SPVs should contain the default probability of systemic banks and increase welfare.

The rest of the paper is organized as follows. Section 2 presents the model and characterizes optimal intercorporate ownership, credibility and leverage choices without IDT. Section 3 examines corrective tax tools. It proves the welfare neutrality of IDT and studies Thin Capitalization rules. A discussion of IDT with either tax consolidation or a ban on bail-outs follows. Section 5 concludes. All proofs are in the Appendix. The Appendix also contrasts IDT in the US and in the EU, while we refer to Webber (2010) and OECD (2012) for worldwide Thin Cap rules.

2 The model

This section describes our modeling set-up, following Leland (2007).

At time 0, an entrepreneur owns two firms, $i = P, S$.[9] Each unit has a random operating cash flow X_i which is realized at time T. We denote with $G(\cdot)$ the cumulative distribution function and with $f(\cdot)$ the density of X_i, identical for the two units and with $g(\cdot, \cdot)$ the joint distribution of X_P and X_S. At time 0, the entrepreneur selects the face value F_i of the zero-coupon risky debt to issue so as to maximize the total arbitrage-free value of equity, E_i, and debt, D_i:

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[8]We do not investigate the mechanism ensuring full commitment. These range from courts to a sufficiently large entrepreneur's ownership stake. In the case of financial conduits, the mix of cash-flow pooling, tranching and the repurchase of the junior tranche by the sponsoring parent contribute to overcome information asymmetries (De Marzo and Duffie, 1999).

[9]The subsidiary, S, can be thought of as the consolidation of all other affiliates.

$$\nu_{PS} = \max \sum_{i=P,S} E_i + D_i. \tag{1}$$

At time T, realized cash flows are distributed to financiers. Equity is a residual claim: shareholders receive operational cash flow net of corporate income taxes and the face value of debt paid back to lenders. A unit is declared insolvent when it cannot meet its debt obligations. Its income, net of the deadweight loss due to default costs, is distributed first to the tax authority and then to lenders.

The firm pays a flat proportional income tax at an effective rate $0 < \tau_i < 1$ and suffers proportional dissipative costs $0 < \alpha_i < 1$ in case of default. Interests on debt are deductible from taxable income.[10] The presence of a tax advantage for debt generates a trade-off for the firm: on the one side, increased leverage results in tax benefits, while on the other it leads to higher expected default costs since – everything else being equal – a highly levered firm is more likely to default. Maximizing the value of debt and equity is equivalent to minimizing the cash flows which the entrepreneur expects to lose in the form of taxes (T_i) or of default costs (C_i):

$$\min \sum_{i=P,S} T_i + C_i. \tag{2}$$

The expected tax burden of each firm is proportional to expected taxable income, that is to operational cash flow X_i, net of the tax shield X_i^Z. In turn, the tax shield coincides with interest deductions, which are equal to the difference between the nominal value of debt F_i, and its market value D_i: $X_i^Z = F_i - D_i$. The tax shield is a convex function of F_i.

Absent any link between units, the expected tax burden in each unit separately – each taken as a stand-alone (SA) firm – is equal to (see Leland (2007)):

$$T_{SA}(F_i) = \tau_i \phi \mathbb{E}[(X_i - X_i^Z)^+], \tag{3}$$

where the expectation is computed under the risk-neutral probability[11] and ϕ is the discount factor. Increasing the nominal value of debt increases the tax shield, thereby reducing the tax burden because the market value of debt, D_i, increases with F_i at a decreasing rate (reflecting higher risk).

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[10]No tax credits or carry-forwards are allowed.

[11]This allows to incorporate a risk premium in the pricing of assets without having to specify a utility function.

Similarly, expected default costs are proportional to cash flows when default takes place, i.e. when net cash flow is insufficient to reimburse lenders. Default occurs when the level of realized cash flows is lower than the default threshold, $X_i^d = F_i + \frac{\tau_i}{1-\tau_i}D_i$:

$$C_{SA}(F_i) = \alpha_i \phi \mathbb{E}\left[X_i 1_{\{0 < X_i < X_i^d\}}\right]. \tag{4}$$

Default costs represent a deadweight loss to the economy, as they do not represent a redistribution among firm stakeholders. They increase in the default cost parameter, α_i, as well as in (positive) realized cash flows when the firm goes bankrupt. A rise in the nominal value of debt, F_i, increases the default threshold, X_i^d, thereby increasing expected default costs.

The sum of the levered firm value and the tax burden of each unit is a measure of the welfare generated by this representative organization:

$$W = \nu_{PS} + \sum_i T_i. \tag{5}$$

W represents the total value created by the firm and distributed to its stakeholders: lenders, shareholders and tax authorities (after paying workers, suppliers etc). The change in welfare, in response to tax policy, is equal to the difference in default costs with opposite sign: $\Delta W = -\Delta C$. In our setting, the expressions "welfare increase" and "reduction in default costs" are equivalent, and capture the notion that financial stability improves on welfare.

The default of levered organizations triggers the default of other lending organizations, generating additional bankruptcy costs. This externality is not captured by the above set-up. Moreover, our full information set up with exogenous cash-flow distributions does not account for excess risk taking induced by leverage. Thus, the default costs above should be considered a lower bound to the welfare costs of financial instability.

2.1 Intercorporate Bail-Outs and Ownership

This section provides details on intercorporate linkages. We first model intercorporate ownership and bail-out transfers that characterize complex organizations. Next, we assess how the two impact on both the tax burden and default costs of the group, given exogenous debt levels.

The parent owns a fraction, ω, of its subsidiary's equity. The subsidiary distributes

its profits after paying the tax authority and lenders, $(X_S^n - F_S)^+$, where X_S^n are its cash flows net of corporate income taxes. Assuming a unit payout ratio, the parent receives a share ω of the subsidiary profits at time T. [12] Let the effective (i.e. gross of any tax credit) tax rate on intercorporate dividend be equal to $0 \leq \tau_D < 1$. Intercorporate dividend taxes are thus equal to a fraction $\omega \tau_D$ of the subsidiary cash flows. The expected present value of the intercorporate dividend net of taxes is thus equal to

$$ID = \phi \omega \mathbb{E}\left[(1 - \tau_D)(X_S^n - F_S)^+\right]. \tag{6}$$

The cash flow available to the parent, after receiving the intercorporate dividend, increases to

$$X_P^{n,\omega} = X_P^n + (1 - \tau_D)\omega(X_S^n - F_S)^+. \tag{7}$$

Equation (7) indicates that dividends provide the parent with an extra-buffer of cash that can help it remain solvent in adverse contingencies in which it would default as a stand-alone company. It follows that the dividend transfer generates an internal rescue mechanism within the firm combination, whose size increases in the parent ownership, ω, and falls in the dividend tax rate, τ_D, given the capital structure.

We do not analyze personal dividend and capital gains taxation levied on shareholders (other than the parent). We therefore assume that the positive personal dividend (and capital gains) tax rate are already included in τ, which is an effective tax rate. We also that the personal tax rate on distributions is equal across parent and subsidiary, so as to rule out straightforward tax arbitrage between the two. Similarly, we focus on the entrepreneur's choice of direct versus indirect ownership without explicitly involving minority shareholders.

As for the internal bail-out promise, we model it following Luciano and Nicodano (2014). The parent commits to transfer cash to the other, in order to prevent its default, if it will have sufficient funds. This promise implies a transfer equal to $F_S - X_S^n$ from the parent to its subsidiary, if the subsidiary is insolvent but profitable $(0 < X_S^n < F_S)$ and if the parent stays solvent after the transfer $(X_P^n - F_P \geq F_S - X_S^n)$. Lenders perceive the promise as being honored with probability π. [13]

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[12] Results below are qualitatively unchanged as long as the payout ratio is positive and inflexible. The evidence on the tax sensitivity of dividend payouts for corporate shareholders suggests that they do not adjust to corporate tax clienteles (Barclay et al, 2009; Dahlquist et al. (2013), at least completely (Holmen et al. (2008)).

[13] The parent has an option, but not an obligation, to transfer funds to its subsidiary. This bail-out promise differs, in this important respect, from both internal loans and contractual guarantees. Both

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We can now show how dividends and the bail-out promise affect default costs and the tax burden of the group.

2.2 The Tax - Bankruptcy Trade-Off in Complex Organizations

We now analyze how the tax-bankruptcy trade-off changes due to intercorporate links, i.e. the presence of a bail-out promise from the parent to its subsidiary and intercorporate ownership, ω, given the debt levels F_P, F_S. Equations (3) and (4) respectively define the expected tax burden, $T_{SA}(F_i)$, and default costs $C_{SA}(F_i)$ for each unit as a stand-alone firm. These coincide with group values when there is zero intercorporate ownership ($\omega = 0$) and no bail-out promise ($\pi = 0$). Default costs in the subsidiary, C_S, are lower due to the bail-out transfer from the parent. Such reduction in expected default costs (Γ) is equal to

$$\Gamma(F_P, F_S, \pi) = C_{SA}(F_S) - C_S(F_P, F_S, \pi) = \pi \alpha_S \phi \mathbb{E}\left[X_S 1_{\{0 < X_S < X_S^d, X_P \geq h(X_S)\}}\right] \geq 0. \tag{8}$$

Subsidiary expected default costs are lower the higher the credibility of the bail-out promise and the greater the ability of the parent to rescue its subsidiary. The indicator function $1_{\{.\}}$ defines the set of states of the world in which rescue occurs, i.e. when both the subsidiary defaults without transfers (first term) and the parent has sufficient funds for rescue (second term). The function h, which is defined in the Appendix, imply that rescue by the parent is likelier the smaller the parent debt, F_P.

Subsidiary dividends impact on the parent's default costs, as follows. The cum-dividend cash flow in the parent – defined in equation (7) – is larger the larger is intercorporate ownership, ω. Such additional cash flow raises both the chances that the parent is solvent and lenders' recovery rate in insolvency. Expected default costs saved by the parent, ΔC, are equal to:

$$\Delta C(F_P, F_S, \omega) = C_{SA}(F_P) - C_P(F_P, F_S, \omega) = \alpha_P \phi \mathbb{E}\left[X_P \left(1_{\{0 < X_P^n < F_P\}} - 1_{\{0 < X_P^{n,\omega} < F_P\}}\right)^+\right] \geq 0. \tag{9}$$

The first (second) term in square brackets measures the parent's cash flows that is lost in default without (with) the dividend transfer. It is easy to show that the parent default costs fall in dividend receipts net of taxes. These in turn increase in $\omega(1 - \tau_D)$ and fall in subsidiary debt.

Finally, when intercorporate dividends are taxed, the group tax burden increases

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help the subsidiary service its debt, but may impair the parent's service of debt.

relative to the case of two stand-alone firms. We denote this change as ΔT:

$$\Delta T(F_S, \omega) = T_S(F_S, \omega) + T_P(F_P, \omega) - T_{SA}(F_P) + T_{SA}(F_S) = \phi \omega \tau_D \mathbb{E}[(X_S^n - F_S)^+] \geq 0. \tag{10}$$

This is positive, and increasing in subsidiary's dividend. In turn, dividend increases in profits after the service of debt, $(X_S^n - F_S)^+$, and in intercorporate ownership, ω.

2.3   Optimal Intercorporate Links and Leverage

This section determines the optimal firm organization, without dividend taxes, that minimizes total default costs and tax burdens (as in equation (2)):

$$\min_{F_S, F_P, \omega, \pi} T_S(F_S, \omega) + T_P(F_P) + C_S(F_P, F_S, \pi) + C_P(F_S, F_P, \omega), \tag{11}$$

through the choice of its capital structure (F_P and F_S) and of its intercorporate links (π, ω). We report the Kuhn-Tucker conditions associated to this program at the beginning of Appendix B. The value-maximizing organization may result in two stand-alone firms, with no links ($\pi^* = 0, \omega^* = 0$). It may instead be a complex hierarchical group, with both intercorporate ownership and a bail-out mechanism ($\pi^* > 0, \omega^* > 0$); in an organization with internal bail-outs but no intercorporate ownership ($\pi^* > 0, \omega^* = 0$) as in horizontal groups or in subsidiaries fully financed by outsiders; or in a structure with partially-owned subsidiaries but no bail-out promises ($\pi^* = 0, \omega^* > 1$)[14]. Before proceeding, we introduce the following lemma that summarizes the properties of ΔC and ΔT with respect to debt levels:

Lemma 1 *The reduction in default costs due to the intercorporate dividend transfer, ΔC, are decreasing in subsidiary debt, F_S, and increasing in intercorporate ownership ω. The additional tax burden due to intercorporate dividend taxation ($\tau_D > 0$), ΔT, is decreasing in subsidiary debt, insensitive to parent debt, F_P, and non-decreasing in intercorporate ownership ω.*

The higher is subsidiary debt, the lower are subsidiary dividends - given its exogenous cash flows. This implies both reduced support to the parent and lower IDT burden. As for ownership, the higher the share ω the lower the default costs in the parent thanks

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[14]For simplicity we assume that there is no "piercing of the corporate veil" when intercorporate ownership reaches 100%, i.e. the parent enjoys limited liability vis-á-vis its subsidiary's lenders also when it is the sole owner of its subsidiary.

to the dividend payment from its subsidiary. However, the tax burden associated with intercorporate dividend increases, for a positive IDT tax rate.

The proposition below deals with the joint determination of leverage and ownership structure, given the bail-out promise:

Lemma 2 *Let $\tau_D = 0$. If the sum of the tax burden and default costs in each unit is convex in the face values of debt, then there exists a $\bar{\pi} > 0$ such that*
(i) if $\pi > \bar{\pi}$, then parent is unlevered ($F_P^* = 0$), the subsidiary is levered and the optimal intercorporate ownership share is indefinite; (ii) otherwise, both firms are levered and the parent fully owns its subsidiary.

Lemma 2 states that a sufficient commitment frees the parent firm from debt and the associated default costs. The value of the firm combination is therefore insensitive to intercorporate ownership and dividend receipts, as they do not affect the tax-bankruptcy trade-off.

Absent a sufficiently credible bail-out mechanism, part (ii) of Lemma 2 indicates that the value maximizing intercorporate ownership is 100%, because subsidiary dividends help servicing debt of the parent thereby allowing it to increase its own tax shield. Setting up two stand-alone firms ($\omega = 0; \pi = 0$) is therefore sub-optimal for the entrepreneur. It is also suboptimal for the entrepreneur to own directly shares in the subsidiary, and/or to allow outside shareholders to buy subsidiary shares ($\omega < 1$).

It is now straightforward to characterize the optimal intercorporate ownership, the credibility of the bail-out promise and the associated capital structure.

Theorem 1 *Assume $\tau_D = 0$. Then the bail-out promise is fully credible ($\pi^* = 1$) and intercorporate ownership (ω^*) is indefinite. Moreover, optimal debt in the complex organization exceeds the debt of two stand-alone companies if and only if the ratio of percentage default costs to the tax rate $\frac{\alpha}{\tau}$ is lower than a constant Q.*

We know that a subsidiary has higher leverage and value than two stand-alone companies if debts are backed by a maximally credible guarantee and if the subsidiary is wholly-owned (Luciano and Nicodano, 2014). The theorem 1 shows that such extreme capital structure carries over to any intercorporate ownership, and that full commitment to bail-out is value maximizing. This is is because the bail-out guarantee prevents default costs from rising faster than tax savings the more, the firmer the commitment.[15]

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[15]As debt shifts from the parent towards its subsidiary, the subsidiary's tax burden increases at an increasing rate. The interest rate required by lenders grows as they recover a lower share of their debt

This result provides a rationale to the zero leverage puzzle (Strebulaev, 2013).[16] Theorem 1 is an ownership-irrelevance proposition. Due to the bail-out commitment, the entrepreneur is indifferent between sharing ownership with outsiders (by setting up a pyramidal group with partial intercorporate ownership and partial outsiders' ownership in the subsidiary; or a horizontal group with partial outsiders' ownership), keeping full ownership in the affiliate (through either 100% intercorporate ownership or 100% direct ownership), or funding the guaranteed subsidiary through outside financiers. Such irrelevance may break down in the next sections due to the presence of corrective tax measures, a ban on bail-outs or real synergies arising from intercorporate ownership.

Agency costs of intercorporate ownership vis-à-vis outside financiers can also subvert ownership irrelevance. For instance, a large literature argues that the cost of outside equity increases with intercorporate ownership when the entrepreneur correspondingly increases the control wedge. In such a case, the entrepreneur of Theorem 1 is indifferent between all ownership configurations but pyramidal groups. Pyramidal groups may still be value maximizing if the entrepreneur derives a compensating amount of private benefits from intercorporate ownership per se, rather than from the separation of ownership and control.

3 Tax Policy, Ownership Structure and Financial Stability

This section analyzes the effects of additional tax policies on the financial stability of complex organizations. Such provisions may effectively address the incentives to lever up provided by interest deductibility. The analysis starts from IDT, as it may be able to dismantle complex organizations altogether (Morck, 2005) through the double-taxation of dividends. It then studies the effects of "Thin Capitalization" rules, that directly cap interest deductions in subsidiaries, thereby putting an upper bound on subsidiary's incentives to lever up (Blouin et al, 2014). This section proves that these measures do not achieve the welfare level provided by stand-alone firms, unless they are combined.

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in default. At the same time the bail-out transfer from the unlevered parent contains the increase in the subsidiary's default.

[16]As for financial conglomerates, the Joint Administrators' progress report (PWC, 2009, p.7) reveals the leverage position of its main European subsidiary. The net equity of Lehman Brothers International Europe was equal to just 1.3% of the gross book value of market positions at September 2008, and an even smaller proportion of nominal outstanding positions. The parent company was guaranteeing this subsidiary along with 16 others.

We also discuss the effects of synergies deriving from tax consolidation. Finally, we explore the consequences of a ban on bail-outs inside the group.

3.1   Neutrality of Intercorporate Dividend Taxes

So far, we assumed no other tax provision but corporate income taxes and interest deductibility. The following theorem characterizes optimal intercorporate links and capital structure in presence of IDT.

Theorem 2 *When the tax rate on intercorporate dividend becomes positive ($\tau_D > 0$), optimal intercorporate ownership is zero ($\omega^* = 0$) while the capital structure and commitment to bail-outs are unchanged.*

Absent IDT, Theorem 1 shows that the parent may own up to 100% of subsidiary shares, as observed in EU family firms (Faccio and Lang, 2012). Theorem 2 proves that IDT discourages full intercorporate ownership, consistent with intuition. As soon as the tax rate τ_D is non-null, optimal intercorporate ownership drops to zero so as to avoid the double taxation of dividends. A fully credible guarantee - and the associated capital structure - remains optimal. Indeed, the guarantee still ensures the optimal exploitation of the tax bankruptcy trade-off.

A real-world counterpart of the complex organization envisaged by Theorem 2 is a sponsor with its orphan SPV. In such organization, the sponsoring parent and investors agree to the state contingent subsidization of the SPV, beyond the sponsor's formal obligations (see Gorton and Souleles, 2006).[17] This ensures the SPV exploits the tax-bankruptcy trade-off effectively, paying no intercorporate dividend and therefore no IDT.

Another complex organization implied by this theorem is a horizontal group.[18] The entrepreneur and, possibly, outside shareholders directly buy shares in both the former parent and the former subsidiary. The latter exploits the interest deductions thanks to a bail-out guarantee from its former parent.

The following corollary, which follows from the previous theorem, summarizes the effects of IDT on welfare.

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[17]Guarantees may take several forms - from recourse ones, to short-term loan commitments, to written put options. Sponsoring banks typically choose indirect credit enhancement methods that minimize capital requirements (see Jones, 2000). For instance, the junior tranche acts as guarantee for all senior tranches. When the sponsor bank retains recourse to this tranche, which is often less than 8% of the pool, the capital requirement is proportional to the junior tranche only and rating agencies attribute a AAA rating to the senior tranche.

[18]The prudential regulation arbitrage in this context explains why banks prefer SPVs to horizontal groups.

Corollary 1 *The introduction of a tax on intercorporate dividend leads to the dismantling of the hierarchical group. However, it affects neither value nor financial stability.*

In line with Morck (2005), Corollary 1 highlights the ability of IDT to dismantle hierarchical groups, when the payout is inflexible and there are no real synergies deriving from the hierarchical structure. In our setting, that abstracts from moral hazard, Corollary 1 points out that dismantling the hierarchical structure (either pyramidal or with fully owned subsidiaries) is welfare neutral.

A few remarks are useful. First, this neutrality result is reinforced if the subsidiary payout ratio is set to zero and the parent receives subsidiary's profits in other ways. In such a case, dismantling the hierarchical group is unnecessary. One way is a subsidiary share repurchase programme, that generates a capital gain instead of a dividend - provided the tax rate on gains is lower. Another way is the parent sale of assets to its subsidiary. A third way is an inter-company loan to the parent, at below-market rates.[19]

Second, recall that we collapsed the personal dividend tax into the effective corporate income tax to avoid cumbersome notation, and we set equal tax rates for parent and subsidiary. Theorem 1, and thus the previous corollary, hold as long as the personal tax rate on dividends from the parent is the same as the one on dividends from its subsidiary. Otherwise, the shift from intercorporate ownership to direct ownership may no longer be neutral.

Third, so far there are no costs associated with ownership transformations. These can be sizeable when real synergies explain group structure. We discuss this case after considering Thin Capitalization rules.

Finally, IDT neutrality hinges on the reliability of the bail-out promise. In our full information context, courts or the central bank may enforce the bail-out promise even if the parent's ex-post incentives to honor the bail-out promise are weak. In section 3.5 we will characterize intercorporate ownership when such external mechanisms fail and the parent is unable to credibly commit to bailing out its subsidiary.

3.2 Thin Capitalization rules

Tax authorities know that guaranteed subsidiaries may have too little equity capital (that is, too high leverage), due to the exploitation of the tax shield. This is why they

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[19]Related-party transaction regulation restricts the transfer of funds from the subsidiary through non-dividend distributions. For an overview of EU member states approach see European Commission (2011), p.60. Central banks also freeze the transfer of funds from domestic bank subsidiaries to the foreign holding company.

limit the fiscal deductibility of subsidiary interests through "Thin Capitalization" rules. These measures, which directly cap interest deductions in subsidiaries or indirectly restrict them by constraining debt/equity ratios below a certain level, cause a departure from the optimal capital structure we described in previous theorems. We now characterize the optimal capital structure following the introduction of Thin Capitalization rules.

Theorem 3 *When the leverage constraint in the subsidiary is binding, that is $F_S^* = K$, then: a) the parent is optimally levered, as long as $K \leq \bar{K}(\alpha_S)$ and $\omega^* = 1$ when $\tau_D = 0$; b) the introduction of IDT lowers parent debt when $\tau_D > \bar{\tau}_D$.*

Part (a) shows that debt shifts to the parent, if debt in the subsidiary is constrained to be lower than a level, $\bar{K}$, that depends on proportional default costs. The forced reduction in subsidiary debt makes an unlevered parent sub-optimal. Forgone gains from using the tax shield are no longer offset by tax shield gains accruing to the subsidiary thanks to a more credible guarantee. In turn, full intercorporate ownership ensures higher intercorporate dividends. These help the parent repay its obligations, increasing optimal parent leverage.

The introduction of IDT increases the cost of paying out dividends.[20]

As for the effects on financial stability, a carefully calibrated mix of thin capitalization rules and IDT increases welfare delivered by groups above the level achieved by stand-alone companies. The following theorem indicates that this is true for certain levels of the tax rate on intercorporate dividend, τ_D, when subsidiary debt is constrained to the stand-alone level.

Theorem 4 *When the leverage constraint in the subsidiary is binding to the stand-alone level, $F_S^* = F_{SA}^*$, and $\tau_D > \bar{\tau}_D$, the default costs of a group do not exceed those of two stand-alone firms. Moreover, the group shows both lower default costs and higher value than the stand-alone organization.*

The result of the previous theorem obtains because the parent optimal debt falls while subsidiary debt is capped. As a direct consequence, default costs are lower than in the stand-alone case. Moreover, the group remains more valuable than the stand-alone organization.

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[20]Indeed, optimal intercorporate ownership and dividends fall. In turn, this reduces the parent debt for several parametric combinations. In particular, simulations show that this always happens when τ_D is high enough to drag optimal intercorporate ownership to 0, down from 100% without IDT.

Thus, Theorem 4 suggests that a mix of the two tax policies makes the privately optimal choice, the group, also (second-best) welfare optimal. In order to examine the robustness of this conjecture, we extend our comparative analysis to the Merger (M) using a numerical exercise proposed in Leland (2007).

Table 1: Base-case parameters	
Parameter	**Value**
Cash flow actual mean (μ)	100
Annual cash flow volatility (σ)	22%
Default costs (α)	23%
Effective tax rate (τ)	20%
Intercorporate dividend tax rate (τ_D)	7%
Discount rate (ϕ)	0.7835

Table 1: This table reports the set of base-case parameters we use in all our numerical simulations, unless otherwise stated.

Table 1 collects the parameters in our numerical analysis.[21]

The two firms are assumed to have equally distributed Gaussian cash flows, and equal default cost rate and tax rate.

Table 2 and Figure 1 report the results for $\rho = 0.2$. The first column of the table refers to a merger, the second one to two stand-alone firms, while the last two columns refer to a group.

The Table shows that the welfare delivered by the merger exceeds the one of two stand alone companies. Such gains are due to diversification benefits, that reduce its default costs relative to stand-alone firms, from 1.78 to 1.23 for every 100\$ value of expected cash flow. Yet, the merger also has higher value, thanks to higher debt (117 instead of 114) that translate into higher tax shield.[22] Group default costs are equal to 1.56 when they are subject only to Thin Capitalization rules that constrain subsidiary debt to the stand-alone one level. Group default costs are lower than in stand alone firms, despite a much higher face value of debt (138). However, they are higher than in the merger

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[21]Parameters are calibrated following Leland (2007) on a BBB-rated firm. We fix the IDT tax rate, τ_D, to the lowest applicable rate in the US.

[22]This is not always true. Absent tax motives, mergers are less valuable when coinsurance gains are lower than contagion costs (Banal-Estanol et al., 2013). With a tax -bankruptcy trade-off, the merger is less valuable than stand-alone units when cash flow volatility is different across units and cash flow correlation is higher than a threshold level (Leland, 2007). The PS structure is more valuable than the merger in those circumstances, as well as in the case of perfect cash flow correlation (Luciano and Nicodano, 2014).

Table 2: Merger and PS					
	M	SA	PS, no tax policy	PS, TC no IDT	PS, TC+IDT
Value (ν)	163.14	162.94	166.59 (49.46; 117.13)	163.88 (120.81; 43.07)	163.36 (80.65; 82.72)
Ownership share (ω)	-	-	indefinite	100%	0%
Default costs (C)	1.23	1.78	8.13 (0; 8.13)	1.56 (1.12; 0.44)	1.02 (0.78; 0.24)
Tax burden (T)	35.43	35.40	25.40 (20.01; 5.39)	34.69 (16.85; 17.84)	35.57 (17.81; 17.76)
Welfare (W)	198.78	198.34	191.99	198.57	199.09
Face Value of Debt (F)	117	114	220 (0; 220)	138 (81; 57)	112 (55; 57)

Table 2: The first two columns of this table compare the optimal properties of a merger (M column) and of two stand-alone units (SA). The rest depict a PS structure with full commitment to bail-outs, when there are either no corrective taxes (PS, no tax); or Thin Capitalization ruleesonly (PS, TC no IDT) or both (PS, TC+IDT). Subsidiary debt in the last two columns is set to be lower than or equal the stand-alone one, $F_S^* \leq 57$. Optimal values of the parent and the subsidiary unit are reported in brackets. Equity of the subsidiary is net of dividend.

case (1.23), that therefore delivers higher welfare. Groups are the value maximizing organization, with 163.88 for every 100$ value of expected cash flow, thanks to a much lower tax burden (34.69).

When IDT is introduced along with Thin Capitalization rules (fourth column), debt capacity in the group is limited to 112 and its default costs fall to 1.02. Also the tax burden increases to 35.57, up from 34.69. Despite the combination of thin capitalization rules and IDT, the group remains the value maximizing choice for the entrepreneur, who can sell its activities at 163.36 for every 100$ value of expected cash flow, as opposed to 163.14 in the merger case.

In this case, the privately optimal organization is also second-best welfare optimal (delivering welfare equal to 199.09 versus 198.78 in the merger case).

Figure 1 represents the same firm combinations as the table, but adds the case of an unregulated group with internal bail-outs for comparison. This figure provides a rationale for corrective tax policies, reporting the extent of both subsidiary leverage (220) and its default costs (8.13) when there a no corrective tax tools. It clearly indicates that the enforcement of the combined tax tools is able to limit financial instability.

3.3 Tax Policy and Financial Stability

This section provides more details on losses borne by lenders upon subsidiary default. These are particularly important for welfare when the complex organization is a systemically relevant financial intermediary, that acts as guarantor for securitized obligations. Such losses may in fact trigger the default of a large number of financing outsiders,
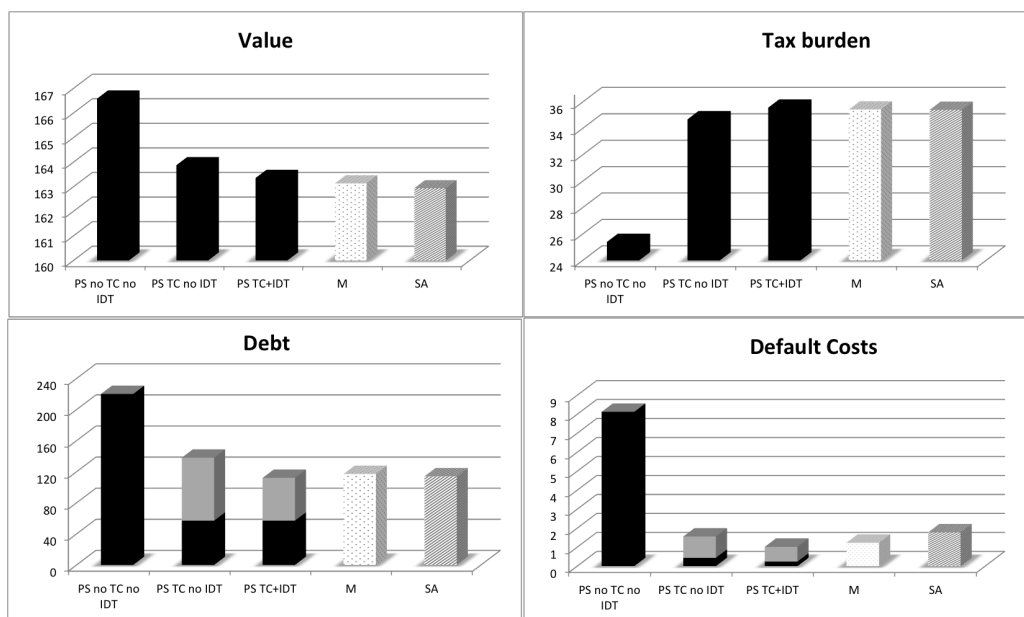
Figure 1: This figure reports value, tax burden, debt and default costs with reference to a group with internal bail-out and 1. neither Thin Cap rules nor IDT (PS no TC no IDT); 2.with Thin Cap Rules only (PS TC no IDT); 3. with both Thin Cap rules and IDT (PS TC+IDT) 4. a merger (M); 5. two stand-alone firms (SA). The light part of the bars displaying PS figures refers to the parent company.

thereby inducing the central bank to bail out the originator.[23] We keep on abstracting from prudential regulation of financial conglomerates (see Freixas et al., 2007), because capital requirements for SPVs were not present prior to the crisis. Moreover, their current discretionary, risk-based application (Board of Governors, 2013) need not restore tax receipts and contain the default costs we point to, as the latter are independent from agency issues.

Table 3 reports the endogenous default probabilities and losses upon default of Parent-Subsidiary structures, along with those of both optimal Stand Alone firms and Mergers. Without corrective taxes, the subsidiary enjoys bail-outs from its parent when the subsidiary is profitable and when the parent has sufficient cash-flows. Despite bail-outs, the subsidiary incurs into larger losses upon default (67.72%) with much higher probability (47.38%) than a stand alone firm (50.74% and 11.09% respectively).

Subjecting the subsidiary to Thin Capitalization rules helps correcting such distortions. Thanks to a more balanced capital structure and to the parent support, the subsidiary default probabilities falls below (6.29%) the ones of a stand alone firm. However,

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[23]Erel, Nadauld and Stulz (2014) find that banks with larger holdings of even highly-rated tranches had worse performance during the crisis.

Table 3: Tax policy and financial stability					
	M	SA	PS, no tax policy	PS, TC no IDT	PS, TC+IDT
Default Probability (*DP*)	6.40%	11.09%	0% (0%; 47.38%)	4.25% (9.51%; 6.29%)	1.94% (10.22%; 3.85%)
Loss Given Default (*LGD*)	43.55%	50.74%	(- ; 67.72%)	(46.86%; 56.81%)	(51.11%; 61.90%)

Table 3: This table contrasts default probabilities and loss given default in the optimal configuration of the Merger (M column), the Stand Alone (SA column) and in the PS structures when there is no specific tax policy (PS, no tax policy) when thin capitalization rules only are present (PS, TC no IDT) and when they are coupled with IDT (PS, TC+IDT). For PS, joint default probabilities of the two units are reported outside the brackets, which report parent and subsidiary bankruptcy likelihood respectively. Loss given default is provided for the two units separately only.

the lenders' loss given default (56.81%) is higher because the subsidiary never defaults when it is profitable. At the same time, the parent is less risky than its stand alone counterpart, despite its higher leverage, thanks to the receipt of subsidiary dividends.

Adding IDT to Thin Cap rules reduces debt issuance in the parent, allowing it to rescue more often its subsidiary. More support reduces the likelihood of default in the subsidiary to 3.85%, because the subsidiary goes bankrupt only in very adverse scenarios. This implies that loss given default is higher than in the absence of IDT (61.90% vs. 56.81%). Now bail-outs allow to remarkably reduce the likelihood of default with respect to equally leveraged stand alone companies.[24] However, conditional on a default the percentage losses incurred in by lenders of a well capitalized subsidiary are higher than in a stand alone firm with identical book leverage. This is a perverse effect of conditional bailouts that even Thin Capitalization rules and IDT cannot correct.

3.4 Hierarchical Group Synergies: Tax Consolidation

In previous sections, group affiliates exploit financial synergies only. They enjoy internal bail-out transfers and coordinated capital structure choices, that allow to optimize the tax shield. Other synergies, relating for instance to investment choices (see Stein (1997) and Matvos and Seru (2014)) or product market competition and workers' incentives (Fulghieri and Sevilir (2011)) may stem from intercorporate ownership, making it less responsive to changes in tax rates. A relevant group-related synergy is tax consolidation, by which a profitable parent can use subsidiary losses to reduce its taxable income, and viceversa. The consolidation option is valuable because it implies that the tax burden of the group never exceeds the one of stand-alone firms, and is typically smaller.

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[24]For instance, a stand alone company raising the debt of the SPV when no Thin Cap rules and IDT are present (220), would default 98.81% of the times instead of 47.38%.

The impact of consolidation on previous results depends on its design.[25] With a minimum prescribed threshold for consolidation, $\bar{\omega} > 0$, optimal intercorporate ownership can be equal to such threshold, instead of being indefinite. This outcome depends on the correlation between operating cash-flows. The higher is the cash flow correlation, the more valuable is the tax shield (and the associated capital structure) relative to the tax consolidation option (and the associated capital structure). Theorem 1 is likely to hold for sufficiently high cash flow correlation.

The presence of IDT, together with tax consolidation, generates a trade-off concerning the choice of ownership, ω. Increasing it up to the prescribed threshold, $\bar{\omega}$, lowers the tax burden through consolidation but increases taxes paid on intercorporate dividends. Zero intercoporate ownership is optimal unless tax consolidation synergies net of dividend taxes exceed gains from the tax shield. This outcome is likelier, for given cash flow correlation, the lower is the IDT rate.

In the US, the threshold for consolidation ($\bar{\omega} = 80\%$) also triggers a zero tax rate on intercorporate dividends.[26] Such tax design eliminates the above-mentioned trade-off associated with intercorporate ownership. Based on our tenet that corporate choices respond to IDT, we expect a discontinuity in the presence of hierarchical groups above this threshold, with larger subsidiary dividends and higher debt in parent companies. [27]

3.5   Prohibiting bail-outs: welfare diminishing IDT

This section analyzes the impact of IDT on financial stability when there is no bail-out mechanism between the parent and its affiliate. This analysis sheds light on the consequences of limited cash-flow verifiability by courts. It also represents the outcome of recent prudential rules, as both the Volcker Rule and the Vickers Committee limit the possibility for banking firms to bail-out their SPV affiliates.[28]

Lemma 2 indicates that the parent optimally raises debt when it does not consider bailing out its subsidiary in case of distress. This is because the credit risk spreads

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[25]Tax consolidation is an option at the Federal level in the US and in other EU jurisdictions such as France, Italy and Spain, provided intercorporate ownership exceeds some predetermined thresholds. It is forbidden in certain jurisdictions, such as the UK and some US states.

[26]A minority interest may however be sufficient for financial conduits.

[27]Consolidation benefits without IDT may explain the presence of wholly-owned subsidiaries in EU non-financial groups (Faccio and Lang, 2002) as well as larger debt raised by parent companies (Bianco and Nicodano, 2006). In contrast, IDT in the US may more frequently lead to direct ownership or horizontal groups (La Porta et al. (1999)), Morck (2005) and Morck and Yeung (2005), Amit and Villalonga, (2009)).

[28]See the discussion in Segura (2014).

required by investors without a guarantee from the sponsoring bank would not allow to raise sufficient debt, as observed by Jones (2000) in the case of securitization. Moreover, the parent fully owns its subsidiary when it is not subject to intercorporate dividend taxation. Full intercorporate ownership maximizes the flow of subsidiary dividend to the parent, which may use it to honor its debt obligations. Such "dividend support" is more valuable when cash-flow correlation is lower.

Table 4 numerically illustrates the case without IDT as cash-flow correlation varies (second to last column). Total debt is larger, implying a larger tax shield, as correlation falls. Yet default costs fall with correlation, despite higher debt. Default costs drop from 2.13 when $\rho = 0.8$ to 0.39 when $\rho = -0.8$. Correspondingly, total debt increases from 134 to 157. The reason is that subsidiary dividends tend to be larger, when the parent is less profitable, the lower the correlation. Anticipating this support, lower correlation is also associated with more debt shifting from the subsidiary onto the parent. Debt in subsidiary (parent) equals 47(87) when $\rho = 0.8$, while they respectively become 25(132) when $\rho = -0.8$.

The first column reports the case with IDT. A high enough dividend tax rate makes zero intercorporate ownership optimal. Given a ban on credible bail-outs, stand-alone firms emerge as the value maximizing organization for the entrepreneur. The introduction of IDT leads to a lower optimal debt in stand alone organizations, yet default costs are higher than in the complex organization unless cash flow correlation exceeds 0.5. For lower correlation, the support provided by subsidiary dividends to the parent leads to smaller expected default costs in the complex organization than in stand-alone firms.

This example suggests that enforcing a ban of sponsor guarantees leads to full intercorporate ownership and a more balanced capital structure. A comparison with the previous table reveals that this ban, per se, achieves default costs that are lower than the ones that groups generate under Thin Cap rules (for $\rho = 0.2$). Combining IDT with a ban, however, may increase financial instability if it leads the entrepreneur to prefer stand-alone firms, thus eliminating the dividend support mechanism.

4   Summary and Concluding Comments

This is the first model investigating the link between tax policy, ownership structure and the default of complex organizations.

Policy implications are clear-cut. One tax policy tool in isolation is unable to restore both their leverage and tax burden to the levels of stand alone firms. With IDT, a

Table 3: Welfare effects of IDT, $\pi = 0$								
	IDT	No IDT						
		Cash-flow Correlation (ρ)						
		-0.8	-0.5	-0.2	0	0.2	0.5	0.8
Value (ν)	162.94	165.19	164.47	164.01	163.84	163.71	163.55	163.59
Parent Debt (F_P)	57	132	108	100	96	90	86	87
Subsidiary Debt (F_S)	57	25	35	37	40	42	45	47
Default costs (C)	1.78	0.39	0.84	1.16	1.41	1.45	1.72	2.13

Table 4: This table reports the value, the debts and the total default costs of the complex organization without bail-out guarantee. In the first column the IDT tax rate is so high to make direct ownership optimal. In columns 2-8 the IDT rate is zero so that the subsidiary is wholly-owned.

horizontal group, or a sponsor-financial conduit structure, is able to preserve the high leverage of a hierarchical structure since it also relies on internal bail-outs to enhance the tax shield. Similarly, Thin Capitalization Rules alone result in debt shifting from the debt-capped subsidiary towards its parent company.

A combination of both Intercorporate Dividend Taxes and Thin Capitalization Rules effectively prevents debt shifting and contains total group leverage. Default costs in complex organizations may fall below the ones of stand-alone firms, as bail-outs are no longer targeted to increase the affiliates' tax-shield. This result offers a rationale for the presence of both tools in the design of US tax policy. Yet, it appears that financial conduits are effectively exempt, despite enjoying the favorable tax treatment of interest deductions. Our analysis implies that such favourable tax treatment contributes to triggering financial instability.

We also study the effects of a ban on subsidiary bail-outs, which appears in both the Volcker Rule and the UK Financial Services Act. Our analysis indicates that, absent bail-out guarantees, parent companies lever up and fully own their affiliates and capital structure is more balanced. In such a context, Intercorporate Dividend Taxation may impair the stabilizing effect of the ban and may deliver higher expected default costs even if overall debt falls.

Finally, our paper considers interest deductibility as the motivating distortion for our second best analysis. He and Matvos (2015) provide a welfare rationale for this privilege to debt, showing that it accelerates creative destruction in declining industries. Further research should shed light on alternative motivations that apply to systemically relevant complex organizations.

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Appendix A - Definition of the $h(\cdot)$ function

The function $h(X_S)$ defines the set of states of the world in which the parent company has enough funds to intervene in saving its affiliate from default while at the same time remaining solvent. The rescue happens if the cash flows of the parent X_P are enough to cover both the obligations of the parent and the remaining part of those of the subsidiary. The function $h(X_S)$, which defines the level of parent cash flows above which rescue occurs, is defined in terms of the cash flows of the subsidiary as:

$$h(X_S) = \begin{cases} X_P^d + \frac{F_S}{1-\tau} - \frac{X_S}{1-\tau} & X_S < X_S^Z, \\ X_P^d + X_S^d - X_S & X_S \geq X_S^Z. \end{cases}$$

When $X_S < X_S^Z$ the cash flow X_S of the subsidiary does not give rise to any tax payment, as it is below the tax shield generated in that unit.

Appendix B - Proofs

Kuhn-Tucker conditions of the minimum program

Before proving the results presented in the paper, let us provide the set of Kuhn Tucker conditions of the minimization program (11):

$$
\begin{cases}
\frac{dT_{SA}(F_P^*)}{dF_P} + \frac{dC_{SA}(F_P^*)}{dF_P} - \frac{\partial\Gamma(F_P^*,F_S^*)}{\partial F_P} - \frac{\partial\Delta C(F_P^*,F_S^*)}{\partial F_P} = \mu_1, & (i)\\[4pt]
F_P^* \geq 0, & (ii)\\[4pt]
\mu_1 F_P^* = 0, & (iii)\\[4pt]
\frac{dT_{SA}(F_S^*)}{dF_S} + \frac{dC_{SA}(F_S^*)}{dF_S} - \frac{\partial\Gamma(F_P^*,F_S^*)}{\partial F_S} - \frac{\partial\Delta C(F_P^*,F_S^*)}{\partial F_S} + \frac{\partial\Delta T(F_S^*)}{\partial F_S} = \mu_2, & (iv)\\[4pt]
F_S^* \geq 0, & (v)\\[4pt]
\mu_2 F_S^* = 0, & (vi)\\[4pt]
\mu_1 \geq 0, \mu_2 \geq 0 & (vii)\\[4pt]
-\frac{\partial\Delta C(F_P^*,F_S^*,\omega^*)}{\partial\omega} + \frac{\partial\Delta T(F_P^*,F_S^*,\omega^*)}{\partial\omega} = \mu_3 + \mu_4 & (viii)\\[4pt]
\omega^* - 1 \leq 0 & (ix)\\[4pt]
\omega^* \geq 0 & (x)\\[4pt]
\mu_3(\omega^* - 1) = 0 & (xi)\\[4pt]
\mu_4(\omega^*) = 0 & (xii)\\[4pt]
\mu_3 \leq 0, \mu_4 \geq 0 & (xiii)\\[4pt]
-\frac{\partial\Gamma(F_P^*,F_S^*)}{\partial\pi} = \mu_5 + \mu_6 & (xiv)\\[4pt]
\pi^* - 1 \leq 0 & (xv)\\[4pt]
\pi^* \geq 0 & (xvi)\\[4pt]
\mu_5(\pi^* - 1) = 0 & (xvii)\\[4pt]
\mu_6(\pi^*) = 0 & (xviii)\\[4pt]
\mu_5 \leq 0, \mu_6 \geq 0 & (xix)
\end{cases}
\tag{12}
$$

Proof of Lemma 1

The integral expressions of ΔC and ΔT read

$$
\begin{aligned}
\Delta C(F_P,F_S,\omega) &= \alpha_P\phi \int_{X_S^d}^{+\infty}\int_{\left(X_P^d-\omega(1-\tau_D)\left[(1-\tau_S)y+\tau X_S^Z-F_S\right]\right)^+}^{X_P^d} xg(x,y)dxdy\\[6pt]
&= \alpha_P\phi \int_{X_S^d}^{\frac{X_P^d}{\omega(1-\tau_D)(1-\tau_S)}+X_S^d}\int_{\left(X_P^d-\omega(1-\tau_D)\left[(1-\tau_S)y+\tau X_S^Z-F_S\right]\right)}^{X_P^d} xg(x,y)dxdy,
\end{aligned}
$$

$$
\Delta T(F_S,\omega) = \phi\omega\tau_D \int_{X_S^d}^{+\infty} [(1-\tau_S)x + \tau_S X_S^Z - F_S)]f(x)dx.
$$

We now compute the first derivatives of ΔC and ΔT with respect to F_S and F_P and we prove our statement:

$$
\begin{aligned}
\frac{\partial \Delta C}{\partial F_P} &= \alpha_P \phi \frac{\partial X_P^d}{\partial F_P} \int_{X_S^d}^{\frac{X_P^d}{\omega(1-\tau_D)(1-\tau_S)}+X_S^d} X_P^d g(X_P^d, y) dy + \\
&\quad - \alpha_P \phi \frac{\partial X_P^d}{\partial F_P} \int_{X_S^d}^{\frac{X_P^d}{\omega(1-\tau_D)(1-\tau_S)}+X_S^d} \left(X_P^d - \omega(1-\tau_D)\left[(1-\tau_S)y + \tau_S X_S^Z - F_S\right]\right) \times \\
&\quad \times\; g\left(\left(X_P^d - \omega(1-\tau_D)\left[(1-\tau_S)y + \tau_S X_S^Z - F_S\right]\right), y\right) dy,
\end{aligned} \tag{13}
$$

$$
\begin{aligned}
\frac{\partial \Delta C}{\partial F_S} &= \alpha_P \phi \omega(1-\tau_D)\left[\tau_S \frac{\partial X_S^Z}{\partial F_S} - 1\right] \times \\
&\quad \times \int_{X_S^d}^{\frac{X_P^d}{\omega(1-\tau_D)(1-\tau_S)}+X_S^d} \left(X_P^d - \omega(1-\tau_D)\left[(1-\tau_S)y + \tau_S X_S^Z - F_S\right]\right) \times \\
&\quad \times\; g\left(y, \left(X_P^d - \omega(1-\tau_D)\left[(1-\tau_S)y + \tau_S X_S^Z - F_S\right]\right)\right) dy \leq 0,
\end{aligned}
$$

$$
\frac{\partial \Delta T}{\partial F_P} = 0,
$$

$$
\frac{\partial \Delta T}{\partial F_S} = \phi \omega \tau_D \left[\tau_S \frac{dX_S^Z}{dF_S} - 1\right](1 - G(X_S^d)) \leq 0.
$$

$$
\begin{aligned}
\frac{\partial \Delta C(F_P, F_S)}{\partial \omega} &= \alpha_P \phi \int_{X_S^d}^{\frac{X_P^d}{\omega(1-\tau_D)(1-\tau_S)}+X_S^d} (1-\tau_D)[(1-\tau_S)y + \tau_S X_S^Z - F_S] \times \\
&\quad \times\; (X_P^d - \omega(1-\tau_D)[(1-\tau_S)y + \tau_S X_S^Z - F_S])] \times \\
&\quad \times\; g\left(X_P^d - \omega(1-\tau_D)\left[(1-\tau_S)y + \tau_S X_S^Z - F_S\right], y\right) dy \geq 0.
\end{aligned} \tag{14}
$$

ΔC is non-decreasing in ω, as default costs saved in the parent through dividends are higher the higher the dividend transfer from the subsidiary. The change in the tax burden due to IDT is always non-decreasing in ω as well, as – ceteris paribus – higher dividend taxes are paid the higher the ownership share:

$$
\frac{\partial \Delta T}{\partial \omega} = \phi \tau_D \int_{X_S^d}^{+\infty} (x(1-\tau_S) + \tau_S X_S^Z - F_S) f(x) dx \geq 0. \tag{15}
$$

This derivative takes zero value when $\tau_D = 0$.

Proof of Lemma 2

Consider the Kuhn Tucker conditions (i) to (xiii) in (12). We investigate the existence of a solution in which $F_P^* = 0$ and $F_S^* > 0$. This implies $\mu_1 \geq 0$ and $\mu_2 = 0$. We focus on condition (iv) first. We have to prove that the term $-\frac{\partial \Delta C(0, F_S^*)}{\partial F_S} + \frac{\partial \Delta T(F_S^*)}{\partial F_S}$ has a negative limit as subsidiary debt, F_S tends to zero, and a positive one when goes to infinity, since the rest of the l.h.s. does, under the technical assumptions that $xf(x)$ converges as $x \longrightarrow +\infty$ (see Luciano and Nicodano, 2014).

The derivative $\frac{\partial \Delta C(F_P, F_S)}{\partial F_S}|_{F_P^*=0} = 0$. Moreover, $\frac{\partial \Delta T}{\partial F_S}$ is always lower than or equal to zero, and has a negative limit as F_S goes to zero since $\lim_{F_S \to 0} \frac{\partial X_S^Z}{\partial F_S} = 1 - \phi(1 - G(0)) > 0$. When F_S goes to infinity, $\frac{\partial \Delta T}{\partial F_S}$ goes to zero as $G(X_S^d)$ tends to one. Hence, we proved that, when $F_P^* = 0$ there exists an $F_S^* > 0$, which solves the equation that equates the l.h.s. of condition (iv) to zero.

As for condition (i), notice that the derivative $\frac{\partial \Delta C}{\partial F_P}$ also vanishes at $F_P^* = 0$. Hence, we look for conditions for the l.h.s. to be positive and set it equal to μ_1 to fulfill the condition. We know from Luciano and Nicodano (2014) that this condition is satisfied for a certain F_S^* when $\pi = 1$ and that, when $\pi = 0$, the l.h.s. is negative at $F_P^* = 0$, because a stand alone firm is never unlevered. Moreover, the l.h.s is increasing in π. Thus, by continuity and convexity of the objective function, there exists a value $\bar{\pi}$ above which the l.h.s. is positive. $\pi \geq \bar{\pi}$ is then a necessary – and sufficient, given our convexity assumption – condition, given F_S^*, for the existence of a solution in which $F_P^* = 0$.

When π is above $\bar{\pi}$ and $\tau_D = 0$, the dividend from the subsidiary to the parent does not affect the parent value, as it does not affect its default costs (ΔC=0). Also, ΔT=0 when $\tau_D = 0$. Intercorporate ownership ω has no effect on the default costs: notice that when $F_P^* = 0$, condition (viii) is always satisfied, for any ω. The tax burden of the subsidiary and its value are independent of ω: ω^* is indefinite and part (i) of our proposition is proved.

When $\pi < \bar{\pi}$, leverage is optimally raised also by the parent as there exists no solution in which $F_P^* = 0$. We consider now ω^* when $F_P^* > 0$. When $\omega^* = 0$, $\mu_4 \geq 0, \mu_3 = 0$. Condition (viii) is violated, since the l.h.s. is negative at $\omega = 0$ from (15). The existence of an interior solution, $0 < \omega^* < 1$, requires both $\mu_3 = 0$ and $\mu_4 = 0$. Condition (viii) is satisfied only for $\omega^* \to \infty$, which violates condition (ix). Hence, no interior solution satisfies the Kuhn-Tucker conditions.

Finally, let us analyze the corner solution $\omega^* = 1$, which requires $\mu_3 \leq 0, \mu_4 = 0$. Condition (viii) is satisfied for appropriate μ_3 and all other conditions can be satisfied at

$F_S^*, F_P^*, \omega^* = 1$. It follows that $\omega^* = 1$ when $\tau_D = 0$ and part (ii) is proved.

Proof of Theorem 1

We first show that the optimal commitment to bail-outs is full. First of all, we remark that $-\frac{\partial \Gamma}{\partial \pi}$ is always negative as one can easily derive from equation (8). It follows that the only value of π^* that satisfies the Kuhn-Tucker conditions is $\pi^* = 1$. If $\pi^* \neq 1$, indeed, the right hand side of condition (iv) is either zero or positive, leading to violation of the conditions. It follows then immediately from Lemma 2, part (i) that $F_P^* = 0$ and that ω^* is indefinite. As for $F_S^* + F_P^* > 2F_{SA}^*$ if $\alpha/\tau > Q$, we know that $F_S^* > 2F_{SA}^*$ if $\pi = 1, \omega = 1$ and $\alpha/\tau > Q$ (see Luciano and Nicodano (2014)). Here we have $\pi^* = 1$, $F_P^* = 0$ and F_S depends on ω only trough the parent debt. Then the statement is true.

Proof of Theorem 2

Theorem 1 proves that optimal PS structures, absent IDT, are characterized by $\pi^* = 1$ and that, in that case, $F_P^* = 0$. Let us now introduce IDT. Analogous discussion of the Kuhn Tucker conditions w.r.t. Lemma 2 part (ii) allows us to state that as soon as $\pi > \bar{\pi}$ there exists a solution in which $F_P^* = 0, F_S^* > 0$ even when $\tau_D > 0$. Moreover, we know from the proof of Theorem 1 that $\pi^* = 1$, the result being independent of τ_D. When $\tau_D > 0$, $\omega^* = 0$ is the only value of ω which does not lead to contradiction of condition (viii). In fact, $\frac{\partial \Delta C(0, F_S^*, \omega^*)}{\partial \omega} = 0$, while $\frac{\partial \Delta T}{\partial \omega}$ is strictly positive as soon as $\tau_D > 0$, leading to contradiction unless $\omega^* = 0$ and hence $\mu_3 = 0$. The entrepreneur who can freely select ownership or payout optimally sets $\omega^* = 0$ as soon as $\tau_D > 0$, with no influence on optimal value in the optimal arrangement. Indeed, when $\omega = 0$ both ΔC and ΔT are 0 for every (F_P, F_S) couple. The presence or absence of IDT is then irrelevant at the optimum for value, capital structure choices, default costs and welfare.

Proof of Theorem 3

Before proving Theorem 3, we prove this useful lemma:

Lemma 3 *Assume $F_P^* > 0$ and $\tau_D > 0$ and let $0 < \underline{\tau}_D \leq \bar{\tau}_D < 1$. Then: i) if $\tau_D > \underline{\tau}_D > 0$, optimal intercorporate ownership is less than full ($\omega^* < 1$); ii) if $\tau_D > \bar{\tau}_D$, then optimal intercorporate ownership is zero ($\omega^* = 0$).*

Proof. Let us consider first the case in which $\tau_D > 0$. In particular, we look for a condition on τ_D such that $\omega^* = 0$. This implies $\mu_4 \geq 0$, $\mu_3 = 0$ in (12). Condition (*viii*) in (12) when $\omega^* = 0$ reads:

$$-\alpha_P \phi (1 - \tau_D) \int_{X_S^{d*}}^{+\infty} \left[(1 - \tau_S) y + \tau_S X_S^{Z*} - F_S^* \right] X_P^{d*} g(X_P^{d*}, y) dy +$$

$$+ \phi \tau_D \int_{X_S^{d*}}^{+\infty} (x(1 - \tau_S) + \tau_S X_S^{Z*} - F_S^*) f(x) dx = \mu_4,$$

where we considered that the upper limit of integration, $\frac{X_P^d}{\omega(1-\tau_D)(1-\tau_S)} + X_S^d$, tends to $+\infty$ when ω goes to 0 and we denoted with X_i^{Z*} and X_i^{d*} for $i = P, S$ the thresholds evaluated at the optimum. The l.h.s. of the above equation is non-positive for $\tau_D = 0$ and it is increasing in τ_D, since its first derivative with respect to τ_D is strictly positive. It follows that a necessary condition for the existence of a solution where $\omega^* = 0$, for given F_S^* and F_P^*, is that τ_D is higher than a certain level $\bar{\tau}_D$. This quantity depends on $\alpha_P, \sigma, \rho, \tau_S, \tau_H, \phi, \mu$. If $\tau_D < \bar{\tau}_D$, then $\omega^* > 0$. This proves part i).

Opposite considerations apply when looking for solutions where $\omega^* = 1$. Condition (viii), evaluated at $\omega^* = 1$ is:

$$
\begin{aligned}
- \quad & \alpha_P \phi \int_{X_S^{d*}}^{\frac{X_P^{d*}}{(1-\tau_D)(1-\tau_S)} + X_S^{d*}} (1 - \tau_D)[(1 - \tau_S) y + \tau_S X_S^{Z*} - F_S^*] \times \\
\times \quad & (X_P^{d*} - (1 - \tau_D)[(1 - \tau_S) y + \tau_S X_S^{Z*} - F_S^*)]) \times \\
\times \quad & g\left(X_P^{d*} - (1 - \tau_D)\left[(1 - \tau_S) y + \tau_S X_S^{Z*} - F_S^*\right], y\right) dy + \\
+ \quad & \phi \tau_D \int_{X_S^d}^{\frac{X_P^{d*}}{(1-\tau_D)(1-\tau_S)} + X_S^{d*}} (x(1 - \tau_S) + \tau_S X_S^{Z*} - F_S^*) f(x) dx = \mu_3,
\end{aligned}
$$

and $\mu_3 \leq 0$. When $\tau_D = 0$ the first term of the sum on the l.h.s. of the equation is negative and the second disappears, whereas when $\tau_D = 1$ the first term disappear, while the second is positive. Hence, by continuity, there exists a level of τ_D, $\underline{\tau}_D$, above which no $\omega^* = 1$ solution is present. Notice that under the additional assumption that $g(\cdot, \cdot)$ is non-decreasing in the first argument below X_P^d, then $\underline{\tau}_D \leq \bar{\tau}_D$. This concludes our proof of part ii) of the lemma. ■

We now prove part a) of the theorem first. The presence of a cap on subsidiary debt introduces a further constraint in the optimization program: $F_S^* \leq K$, where K is the imposed cap. We thus consider the set of Kuhn-Tucker conditions in (12) and modify

them appropriately:

$$(iv)': \quad \frac{\partial T_2(F_S^*)}{\partial F_S} + \frac{\partial C_2(F_S^*)}{\partial F_S} - \frac{\partial \Gamma(F_P^*, F_S^*)}{\partial F_S} - \frac{\partial \Delta C(F_P^*, F_S^*)}{\partial F_S} + \frac{\partial \Delta T(F_S^*)}{\partial F_S} = \mu_2 - \mu_3,$$

$$(vii)': \quad \mu_1 \geq 0, \mu_2 \geq 0, \mu_3 \geq 0$$

$$(xx)': \quad \mu_3(F_S^* - K) = 0$$

Let us consider the case in which the newly introduced constraint (xx)' is binding, so that $F_S^* = K$. We look for the conditions under which the parent can be unlevered. Hence, $\mu_1 \geq 0, \mu_2 = 0, \mu_3 \geq 0$. We focus on condition (i), and we refer the reader to the proof of Lemma 2 for the discussion of other conditions, which is immediate. Condition (i), when $F_P^* = 0$ and $F_S^* = K$, becomes:

$$
\begin{aligned}
- \quad & \tau_P(1 - G(0))\frac{\partial X_P^Z}{\partial F_P}\Big|_{F_P^* = 0} + \\
+ \quad & \alpha_S \phi \frac{\partial X_P^d}{\partial F_P}\Big|_{F_P^* = 0} \left[\int_0^{X_S^Z(K)} xg(x, \frac{K}{1-\tau} - \frac{x}{1-\tau})dx + \right. \\
+ \quad & \left. \int_{X_S^Z(K)}^{X_S^d(K)} xg(x, X_S^d(K) - x)dx \right] = \mu_1
\end{aligned}
$$ (16)

While the first term is negative, the second one is null when $K = 0$ and is increasing in K, since its derivative with respect to K is:

$$\alpha_S \phi \frac{\partial X_P^d}{\partial F_P}\Big|_{F_P = 0} \left(\frac{\partial X_S^d}{\partial F_S} X_S^d f(X_S^d, 0) \right) > 0.$$

It follows that condition (i) can be satisfied only for sufficiently high K: no solutions with an unlevered parent exist unless K is high enough. We define as $\bar{K}(\alpha_S)$ the cap above which the parent is optimally unlevered. It solves the following equation:

$$
\alpha_S \phi \frac{\partial X_P^d}{\partial F_P}|_{F_P^* = 0} \left[\int_0^{X_S^Z(\bar{K})} x g(x, \frac{\bar{K}}{1-\tau} - \frac{x}{1-\tau}) dx + \right.
$$

$$
\left. + \int_{X_S^Z(\bar{K})}^{X_S^d(\bar{K})} x g(x, X_S^d(\bar{K}) - x) dx \right] =
$$

$$
= \mu_1 + \tau_P (1 - G(0)) \frac{\partial X_P^Z}{\partial F_P}|_{F_P^* = 0}.
$$

Considerations similar to the unconstrained case apply to condition (iv)', which is met at $F_S^* = K$ by an appropriate choice of μ_3. Notice also that the higher α_S, the lower the required cap level K that allows for the presence of an optimally unlevered parent company. From the proof of Lemma 2 part (ii) we know that, when $\tau_D = 0$, as soon as $F_P^* > 0$, the only optimal value of ω which does not violate the Kuhn-Tucker conditions (viii) and (ix) is $\omega^* = 1$. This concludes our proof of part a) of the theorem.

As for part b), it follows from Lemma 3 that if τ_D is high enough, optimal ownership structure, which, following previous considerations, implies $\omega^* = 1$ when $\tau_D = 0$ as soon as $F_P^* > 0$, modifies. Even when ω^* is unchanged, the dividend transfer is lowered for fixed capital structure. The firm may adjust its capital structure choices accordingly, by changing F_S^* and F_P^*. For fixed capital structure, we remark that the objective function is increasing in τ_D. However, overall effects on optimal value depend on τ_D, as well as on other variables, and are hardly predictable. When $F_S^* = K$ we simply notice that ID is decreasing in τ_D, everything else fixed, as evident from equation (6).

When $\tau_D > \bar{\tau}_D$, we know from Lemma 3 that optimal ownership $\omega^* = 0$. In such case, $\Delta C = 0$ and $\frac{\partial \Delta C}{\partial F_P} = 0$. In order to fulfill condition (i) if $-\frac{\partial \Delta C}{\partial F_P}$ decreases, the remaining three terms of the sum of the l.h.s. must increase. Since ω^* and F_S^* are fixed, $\frac{\partial \Gamma}{\partial F_P} \leq 0$ (see Luciano and Nicodano, 2014) and the sum of tax burden and default costs of the stand-alone is convex by assumption, F_P must decrease. This concludes our proof of part b).

Proof of Theorem 4

We know from Luciano and Nicodano (2014) that conditional guarantees are value increasing. As a consequence, as soon as $\pi > 0$, the value of the parent-subsidiary structure

is $\nu_{PS}(F_P^*, F_{SA}) \geq 2\nu_{SA}(F_{SA})$. We want to show that, when $\tau_D \geq \bar{\tau}_D$:

$$2C_{SA}(F_{SA}^*) \geq C_P + C_S,$$

which amounts to showing that:

$$C_{SA}(F_{SA}^*) \geq C_{SA}(F_P^*) - \Gamma(F_P^*, F_{SA}^*) - \Delta C(F_P^*, F_{SA}^*, \omega^*). \tag{17}$$

We know from previous considerations that the f.o.c. for a solution to the PS problem when $F_P^* > 0$ include:

$$\frac{\partial T_{SA}(F_P^*)}{\partial F_P} + \frac{\partial C_{SA}(F_P^*)}{\partial F_P} - \frac{\partial \Gamma(F_P^*, F_{SA}^*, \pi^* = 1)}{\partial F_P} - \frac{\partial \Delta C(F_P^*, F_{SA}^*)}{\partial F_P} = 0. \tag{18}$$

The equivalent equation in the stand-alone case is simply

$$\frac{\partial T_{SA}(F_{SA}^*)}{\partial F_{SA}} + \frac{\partial C_{SA}(F_{SA}^*)}{\partial F_{SA}} = 0.$$

We also know that $\frac{\partial \Gamma(F_P^*, F_{SA}^*)}{\partial F_P} \leq 0$, since the guarantee is more valuable the lower F_P is, and non-zero as soon as $\pi > 0$. Also, when $\tau_D > \bar{\tau}_D$, $\Delta C = 0$ for all F_P and F_S since $\omega^* = 0$. Since by our assumption $T_{SA} + C_{SA}$ is convex in the face value of debt, it follows that $F_P^* < F_{SA}^*$ and, as a consequence, that (17) is verified.

Appendix C - Intercorporate Dividend Taxation in US and EU

The European Union, as well as most other developed countries, limits the double taxation of dividends. The Parent-Subsidiary Directive (1990) requires EU member states not to tax intercorporate dividends to and from qualified subsidiaries, whose parent's equity stake exceeds a threshold, as small as 10% since January 2009. The Member State of the parent company must either exempt profits distributed by the subsidiary from any taxation or impute the tax already paid in the Member State of the subsidiary against the tax payable by the parent company. A 2003 amendment prescribes to impute any tax on profits paid also by successive subsidiaries of these direct subsidiary companies.

IDT is typical of the US tax system. In order to understand the reason for its introduction, scholars go back to the years following the Great Depression when Congress promoted rules to discourage business groups. In the 1920s business groups were common in the U.S., but they were held responsible of the 1929 crisis. Morck (2005) gives an overview of the downsides attributed to pyramids, ranging from market power to tax avoidance through transfer pricing. During the Thirties, Congress eliminated consolidated group income tax filing, enhanced transparency duties, offered tax advantages to capital gains from sales of subsidiaries and introduced intercorporate dividend taxation.The action of the Congress induced companies either to sell their shares in controlled subsidiaries or to fully acquire them: by the end of the Thirties US firms were almost entirely stand-alone companies. Today, the tax rate on intercorporate dividends is equal at least to 7% if intercorporate ownership is lower than 80%.