

# Ownership, Taxes and Default\*

Giovanna Nicodano,<sup>†</sup> Luca Regis<sup>‡</sup>

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## Abstract

This paper determines ownership and leverage of two units facing a tax-bankruptcy trade-off. Connected units have higher leverage and lower tax burden, because of internal support through both bailouts and corporate dividends. Ownership adjusts to additional tax provisions. A hierarchical group with a wholly-owned subsidiary results from Thin Capitalization rules. The presence of corporate dividend taxes generates horizontal groups, or a Special Purpose Vehicle, or a private equity fund. Combinations of tax provisions contain tax savings, debt and default in connected units. No bailout provisions, such as the Volcker rule, succeed in reducing leverage and default.

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<sup>†</sup>Collegio Carlo Alberto and ESOMAS, Università di Torino and Department of Finance, LSE. e-mail: giovanna.nicodano@unito.it.

<sup>‡</sup>IMT Institute for Advanced Studies Lucca and Collegio Carlo Alberto; e-mail: luca.regis@imtlucca.it.

# 1 Introduction

Shareholders in control of multiple activities often own the shares of one unit through the other, in a hierarchical group. When controlling shareholders directly hold shares in each unit, groups are horizontal instead of hierarchical. Outsiders may own minority stakes, but it is not unusual that the controlling entity fully owns the group. Ownership is not the only link between units connected by common control. Quite often we observe that one unit helps the other meet its debt obligations.<sup>1</sup>

This paper sets out to explain such types of ownership and support links, relating them to both taxes and capital structure. High leverage is in fact commonly observed across several types of connected activities, ranging from family groups to financial conglomerates. Prior literature explains higher leverage in a diversified merger, showing that diversification allows for both higher debt and higher tax shield. However, contagion costs may offset gains stemming from the tax shield when activities are highly risky and display correlated cash flows (Leland, 2007). This is why a unit that supports the other, in a group, obtains both tax shield and diversification benefits while avoiding contagion altogether (Luciano and Nicodano, 2014).

This paper investigates the ownership possibilities of two such units that share a common controlling entity. We call them “units”, instead of firms or banks, because there is no explicit production or investment or intermediation activity and hence no real synergy (as in Leland, 2007). Units own two stochastic cash flows, that stem from future receipts from either financial assets or sales. The controlling entity could be an entrepreneur, a family, a financial intermediary or a multinational. It may choose to own one unit (the “subsidiary”) indirectly through the other unit (the “parent”). In case of indirect ownership, dividends from the subsidiary help the parent in servicing its debt. In turn, the parent may bail out its subsidiary, after meeting its own debt obligations. Finally, each unit is subject to the tax-bankruptcy cost trade-off in that debt provides a tax shield because interests are tax-deductible; at the same time, higher debt increases the likelihood of costly default.

We first show conditions ensuring that support by the parent company to its subsidiary is value enhancing, while dividend support to the parent is irrelevant. Ownership irrelevance holds because the parent is optimally unlevered. The controlling entity finds it profitable to exploit the tax shield in the supported subsidiary only, thereby protecting

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<sup>1</sup>Formal and informal bailout commitments are common in parent-subsidiary structures (see Bodie and Merton, 1992 and Boot et al., 1993) as well as in securitization (Gorton and Souleles, 2006).

the parent from default. Subsidiary dividends affect neither the parent nor the subsidiary default costs, leaving the tax-bankruptcy trade-off unaffected and making ownership of the subsidiary indifferent to the controlling entity. This result indicates that a zero leverage and a levered unit optimize the tax shield. In turn, leverage is higher than in non-connected units if the ratio of proportional bankruptcy costs to the tax rate is bounded above. The zero leverage unit - such as a sponsor, a financial holding company or a fund - specializes in providing support to the highly levered unit. The latter unit may have no ownership connection to the sponsor, as in an orphan Special Purpose Vehicle (SPV). It may be a partly owned subsidiary (as in a pyramid) or a fully owned subsidiary (as in family firms, multinationals and private equity).

This ownership irrelevance result obtains only if there are no real synergies and no additional tax and regulatory provisions that restrict business groups and, more generally, connected units. Ownership irrelevance breaks down when there are taxes on dividends distributed to the parent, the so called Intercorporate Dividend Taxes (IDT) that are levied in the U.S.. The controlling entity avoids double taxation in two ways. One is direct ownership in each unit, which gives rise to a horizontal group. Such ownership structure allows to enjoy identical tax benefits, because leverage and bailout possibilities are unaffected. A sale to third parties of the cash-flow rights of the highly leveraged, supported unit is also value maximizing. This gives rise to a financial conduit.

Ownership irrelevance no longer holds when binding Thin Capitalization rules are in place, as well. These are caps on interest deductions for guaranteed units, that are common to major jurisdictions.<sup>2</sup> If enforced in each and every connected unit, Thin Capitalization rules make full intercorporate ownership optimal. Indeed, the parent company becomes levered so as to exploit the tax shield, in order to counterbalance the binding cap on subsidiary debt.<sup>3</sup>

A combination of IDT and caps on interest deductions may finally contain both tax savings and default costs. Our simulations, calibrated following Leland(2007) to BBB-rated firms, indicate that such combination reduces expected default costs in the group

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<sup>2</sup>The UK tax authority (Her Majesty Revenue and Customs (INTM541010)) explains their rationale as follows: “Thin capitalization commonly arises where a company is funded...by a third party...but with guarantees...provided to the lender by another group company or companies (typically the overseas holding company). The effect of funding a U.K. company or companies with excessive ...parentally guaranteed debt is...excessive interest deductions. It is the possibility of excessive deductions for interest which the U.K. legislation on thin capitalisation seeks to counteract.”

<sup>3</sup>Blouin et al. (2014) find that affiliates’ leverage responds to the introduction of Thin Capitalization rules in US multinationals while consolidated leverage does not. Their finding is consistent with debt shifting onto parent companies.

to \$1.02 for every 100\$ of expected cash flow, as opposed to \$8.13 without IDT and Thin Capitalization rules.<sup>4</sup> IDT and Thin Capitalization rules correspondingly increase the tax burden of the group to \$35.57, up from \$25.37.<sup>5</sup> Importantly, both tax savings and default costs in groups become smaller than in two stand-alone, unconnected companies. However, this combination of tax provisions is ineffective if Thin Capitalization rules apply to proper subsidiaries of hierarchical groups only, as it often happens in practice. In such a case, mutant ownership adjusts: subsidiaries become directly owned but preserve their high leverage, tax shield and default costs.

This paper contributes to the theory of corporate ownership. Previous models focus on dispersed shareholders. In Almeida and Wolfenzon (2006), the entrepreneur prefers a pyramidal structure to a horizontal group when the affiliate has lower net present value, so as to involve outsiders in its funding. In Demsetz and Lehn (1985), ownership irrelevance holds because firm value is insensitive to agency costs associated with ownership dispersion. Our paper shifts the focus from agency vis-à-vis dispersed shareholders onto taxes and leverage as determinants of ownership, that have so far been overlooked.

So doing, this paper also provides the first theoretical analysis of taxes targeted to complex organizations.<sup>6</sup> 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 indicates that, when full intercorporate ownership is optimal prior to the introduction of IDT, a sufficiently high IDT rate transforms a wholly-owned subsidiary into a partially owned one. Thus, IDT may give rise to a pyramid, unless the tax rate decreases in the ownership share of the parent company. This observation provides a rationale for the presence of this last feature in the US tax code. Our model confirms that IDT dismantles pyramidal groups, when ownership irrelevance prevails prior to the introduction of IDT. Such ownership transformation does not however affect leverage and default.<sup>7</sup>

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<sup>4</sup>This estimate posits enforcement of tax rules in each unit. It overlooks the reduction in risk taking and externalities stemming from lower leverage and default. It does not account for any liquidity or operational improvement associated with the tax arbitrage vehicle.

<sup>5</sup>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 (Desai et al., 2007; Huizinga et al., 2008), while our model assumes equal tax rates so as to focus on an additional tax arbitrage.

<sup>6</sup>Several papers analyze the effect of personal dividend taxes on dividend payout, investment and equity issues (see Chetty and Saez, 2010, and references therein), ignoring intercorporate links and leverage. We fix payout, investment and equity issues and analyze how IDT affect intercorporate links and leverage.

<sup>7</sup>Our analysis also advances our understanding of capital structure in connected units. It highlights conditions ensuring that both units have positive leverage as opposed to the polarized capital structure

Our ownership theory ignores both control issues (Zingales, 1985) and real synergies (Fulghieri and Sevilir, 2011), in order to highlight pecuniary gains stemming from tax arbitrage. Despite such limited focus, observations concerning ownership adjustments that preserve the tax shield appear broadly consistent with its implications.

Like the parent company in our ownership irrelevance proposition, the private equity fund is unlevered and contributes to debt restructurings in its highly leveraged portfolio firms. A sizeable part of value creation by LBO deals is due to taxes (Acharya et al., 2009; Kaplan, 1989; Renneboog et al., 2007), as in our simulations.

Taxes may explain some contrasting features of business groups in the EU and in the US. The EU tax authorities do not tax intercorporate dividends but cap interest deductions. EU parent units display higher leverage than their subsidiaries, and often own 100% of their affiliates (Bloch and Kremp, 1999; Bianco and Nicodano, 2006; Faccio and Lang, 2012). Moreover, the association between larger intercorporate dividend payments with parent debt financing is visible in France (De Jong et al., 2012). In the US, instead, intercorporate dividends are taxed unless parent ownership exceeds a high threshold. Accordingly, evidence on family ownership (Amit and Villalonga, 2009; Masulis et al., 2011) shows that direct control via a horizontal structure is most common in the US, while pyramidal ownership is predominant in Europe.

Another mutation of ownership, that allows to optimally exploit the tax-bankruptcy trade off, is a financial conduit. The guaranteed subsidiary in our model avoids Inter-corporate Dividend Taxes - and possibly Thin Capitalization rules - but enjoys interest deductions when outsiders own its cash-flow rights. In a financial conduit, the sponsoring unit 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 SPV, 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 the observation that securitization increases with the corporate tax rate, i.e. with incentives to exploit the tax shield (Han et al., 2015).

Our simulations suggest that subjecting SPVs to both IDT and Thin Capitalization rules is able to limit both tax arbitrage and default costs. We also analyze the effect of “no bailout” provisions, implied for instance by the Volcker rule, that ban bailouts of SPVs by bank conglomerates. In such “no bailout” case, it is optimal for the parent to lever up, because the tax shield and default costs in the subsidiary revert to the stand-alone

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derived by Luciano and Nicodano (2014).

case. Subsidiary dividends help such levered parent repay its debt. Thus its leverage is higher than that of a comparable stand-alone unit 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. However, we show that even a lower overall leverage may deliver higher expected default costs due to distortions in the optimal allocation of debt across units - that is too much leverage in the subsidiary relative to the no-IDT allocation.

The rest of the paper is organized as follows. Section 2 presents the model and characterizes optimal intercorporate ownership, bailout probability and leverage choices without additional frictions. Section 3 examines corrective tax tools. It proves the neutrality of IDT and studies Thin Capitalization rules. A discussion of IDT in conjunction with either tax consolidation or a ban on bailouts follows. Section 4 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 a survey of worldwide Thin Capitalization rules.

## 2 The model

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

At time 0, a controlling entity owns two units,  $i = P, S$ .<sup>8</sup> 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 controlling entity 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,  $D_i$ :

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

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.

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<sup>8</sup>The subsidiary,  $S$ , can be thought of as the consolidation of all other affiliates.

The unit 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.<sup>9</sup> The presence of a tax advantage for debt generates a trade-off for the unit: 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 unit is more likely to default. Maximizing the value of debt and equity is equivalent to minimizing the cash flows which the controlling entity expects to lose in the form of taxes ( $T_i$ ) or of default costs ( $C_i$ ):

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

The expected tax burden of each unit 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) unit – is equal to (see Leland, 2007):

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

where the expectation is computed under the risk-neutral probability<sup>10</sup> and  $\phi$  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).

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,  $X_i^d = F_i + \frac{\tau_i}{1-\tau_i} D_i$ :

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

Default costs represent a deadweight loss to the economy. They increase in the default cost parameter,  $\alpha_i$ , as well as in (positive) realized cash flows when the unit goes bankrupt.

<sup>9</sup>No tax credits or carry-forwards are allowed.

<sup>10</sup>This allows to incorporate a risk premium in the pricing of assets without having to specify a utility function.

A rise in the nominal value of debt,  $F_i$ , increases the default threshold,  $X_i^d$ , thereby increasing expected default costs.

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 above costs should be considered a lower bound to default costs.

## 2.1 Intercorporate bailouts and Ownership

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

The parent owns a fraction,  $\omega$ , 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  $\omega$  of the subsidiary profits at time  $T$ . 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

$$ID = \phi\omega\mathbb{E}[(1 - \tau_D)(X_S^n - F_S)^+]. \quad (5)$$

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

$$X_P^{n,\omega} = X_P^n + (1 - \tau_D)\omega(X_S^n - F_S)^+. \quad (6)$$

Equation (6) 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 unit combination, whose size increases in the parent ownership,  $\omega$ , and falls in the dividend tax rate,  $\tau_D$ , 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  $\tau$ , which is indeed an effective tax rate.

We also assume 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 controlling entity's choice of direct versus indirect ownership without explicitly involving minority shareholders.

As for the internal bailout probability, we model it following Luciano and Nicodano (2014). The parent chooses the probability of the ex post cash transfer to the other unit. 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  $\pi$ .

We can now show how dividends and the bailout 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 bailout in favour of the subsidiary and intercorporate ownership,  $\omega$ , 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 unit. These coincide with group values when there is zero intercorporate ownership ( $\omega = 0$ ) and no bailout promise ( $\pi = 0$ ). Default costs in the subsidiary,  $C_S$ , are lower due to the bailout transfer from the parent. Such reduction in expected default costs ( $\Gamma$ ) is equal to

$$\Gamma = C_{SA}(F_S) - C_S = \pi \alpha_S \phi \mathbb{E} \left[ X_S 1_{\{0 < X_S < X_S^d, X_P \geq h(X_S)\}} \right] \geq 0. \quad (7)$$

Subsidiary expected default costs are lower the higher the probability of the bailout promise and the greater the ability of the parent to rescue its subsidiary. The indicator function  $1_{\{\cdot\}}$  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, implies 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 (6) – is larger the larger is intercorporate ownership,  $\omega$ . 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,  $\Delta C$ , are equal to

$$\Delta C = C_{SA}(F_P) - C_P = \alpha_P \phi \mathbb{E} \left[ X_P \left( 1_{\{0 < X_P^n < F_P\}} - 1_{\{0 < X_P^{n,\omega} < F_P\}} \right)^+ \right] \geq 0. \quad (8)$$

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 relative to the case of two stand-alone units. We denote this change as  $\Delta T$ , defined as

$$\Delta T = T_S + T_P - T_{SA}(F_P) + T_{SA}(F_S) = \phi \omega \tau_D \mathbb{E}[(X_S^n - F_S)^+] \geq 0. \quad (9)$$

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  $\omega$ .

### 2.3 Optimal Intercorporate Links and Leverage

This section determines the capital structure ( $F_P$  and  $F_S$ ) and intercorporate links ( $\pi, \omega$ ) that minimizes total default costs and tax burdens of the two units (as in equation (2)), solving

$$\min_{F_S, F_P, \omega, \pi} T_S + T_P + C_S + C_P. \quad (10)$$

Dividend taxes and other frictions are absent. Throughout the paper, we maintain the standard technical assumption of convexity of the objective function with respect to the face values of debt. We report the Kuhn-Tucker conditions associated to the minimum program at the beginning of Appendix B. The value-maximizing organization may result in two stand-alone units, with no links ( $\pi^* = 0, \omega^* = 0$ ). It may instead be a complex hierarchical group, with both intercorporate ownership and a bailout mechanism ( $\pi^* > 0, \omega^* > 0$ ) or an organization with internal bailouts but no intercorporate ownership ( $\pi^* > 0, \omega^* = 0$ ) as in horizontal groups or in subsidiaries fully financed by outsiders. Finally, it can be a structure with partially-owned subsidiaries but no bailout promises ( $\pi^* = 0, \omega^* > 0$ )<sup>11</sup>. Before proceeding, we introduce the following lemma that summarizes the properties of  $\Delta C$  and  $\Delta T$  with respect to debt levels.

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<sup>11</sup>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-à-vis its subsidiary's lenders also when it is the sole owner of its subsidiary.

**Lemma 1** *Default costs of the parent are decreasing in intercorporate ownership,  $\omega$ . The additional tax burden due to intercorporate dividend taxation (when  $\tau_D > 0$ ),  $\Delta T$ , is decreasing in subsidiary debt, insensitive to parent debt,  $F_P$ , and non-decreasing in intercorporate ownership  $\omega$ .*

The higher is subsidiary debt, the lower are subsidiary dividends - given its exogenous cash flows. This implies lower taxes on intercorporate dividends. As for ownership, the higher the share  $\omega$  the lower the default costs in the parent thanks 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 bailout promise.

**Lemma 2** *Let  $\tau_D = 0$ . 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, the parent is levered and it fully owns its subsidiary.*

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

If the bailout is unlikely, 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 units ( $\omega = 0; \pi = 0$ ) is therefore sub-optimal for the controlling entity. It is also suboptimal for the controlling entity to own directly shares in the subsidiary, and/or to allow outside shareholders to buy subsidiary shares ( $\omega < 1$ ).

This lemma indicates that the bailout transfer has more marked effects than the dividend transfer on capital structure. We trace back this characteristics to the bailout providing a higher tax shield, because it is conditional on positive subsidiary cash flow. This reduces the lenders' recovery upon default and the value of debt, thereby increasing the tax shield by more than a dividend transfer. Subsidiary dividends typically increase the lenders' recovery should the parent default.<sup>12</sup>

This conditional bailout differs from both internal loans and unconditional guarantees. Both help the subsidiary service its debt, but impair the parent's service of its own debt.

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<sup>12</sup>In the model it is possible to make subsidiary payout contingent on the parent being profitable. In the real world, parent company lenders would file a revocatory action if the parent defaults.

Moreover, internal loans and contractual guarantees are typically not contingent on the subsidiary's cash flow being positive.<sup>13</sup>

It is now possible to characterize the optimal intercorporate ownership, the probability of the bailout and the associated capital structure.

**Theorem 1** *Assume  $\tau_D = 0$ . Then the bailout occurs with certainty ( $\pi^* = 1$ ) and intercorporate ownership ( $\omega^*$ ) 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  $Q$ .*

Theorem 1 shows that the extreme capital structure in Luciano and Nicodano (2014) carries over to any intercorporate ownership, and that a unit probability of bailout is value maximizing. This occurs because the bailout prevents default costs from rising faster than tax savings the more, the higher its probability.<sup>14</sup> This result provides a rationale for zero leverage companies (Strebulaev and Yang, 2013).

Theorem 1 is an ownership-irrelevance proposition. Due to the bailout, the controlling entity 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 or a ban on bailouts.

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

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<sup>13</sup>In a static model, the ex-post enforcement of bailouts must rely on courts. In practice, enforcement mechanisms vary from reputation (as in Boot et al., 1993) to the purchase of the junior tranche by the sponsoring parent (as in De Marzo and Duffie, 1999).

<sup>14</sup>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 in default. At the same time the bailout transfer from the unlevered parent contains the increase in the subsidiary's default.

of ownership and control. We leave this extension to further research, so as to keep the focus on taxes.

### 3 Tax Policy, Mutant Ownership and Financial Stability

This section analyzes the effects of additional policies on the tax burden, leverage and distress of connected units. Such provisions may effectively address the incentives to lever up provided by interest deductibility. The analysis starts from intercorporate dividend taxes, as they 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 guaranteed companies, thereby putting an upper bound on the incentive to lever up. This section proves that these measures do not yield the level of expected tax receipts and expected default costs provided by stand-alone units, unless they are combined. We also discuss the effects of group synergies deriving from tax consolidation. Last but not least, we explore the consequences of a ban on internal bailouts when combined with dividend taxes.

#### 3.1 Neutrality of Intercorporate Dividend Taxes

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

**Theorem 2** *Let the tax rate on corporate dividend be positive ( $0 < \tau_D < 1$ ). Then optimal intercorporate ownership is zero ( $\omega^* = 0$ ) while the capital structure and probability of bailouts 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  $\tau_D$  is non-null, optimal intercorporate ownership drops to zero so as to avoid the double taxation of dividends. Both the sure state-contingent bailout and the associated capital structure remain optimal. Indeed, the bailout still ensures the optimal exploitation of the tax bankruptcy trade-off.

A real-world counterpart of the 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).<sup>15</sup> This ensures the SPV exploits the tax-bankruptcy trade-off effectively, saving on intercorporate dividend taxes.

Another organization implied by this theorem is a horizontal group. The controlling entity 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 bailout guarantee from its former parent.

The following corollary summarizes the effects of IDT:

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

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 both welfare and tax neutral.

A few remarks are useful. First, the dismantling result holds as long as the payout ratio is positive and inflexible. Dividend payouts for corporate shareholders appear not to adjust to corporate tax clienteles (Barclay et al., 2009; Dahlquist et al., 2014). Neutrality 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 to provide funds to the parent is a subsidiary share repurchase programme, that generates a capital gain instead of a dividend. 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.<sup>16</sup>

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<sup>15</sup>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.

<sup>16</sup>Capital gains are subject to taxes in several jurisdictions. More generally, 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.

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.

### 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 limit the interest deductions in guaranteed units through the so-called “Thin Capitalization” rules. These measures directly cap interest deductions in subsidiaries or indirectly restrict them by constraining debt/equity ratios below a certain level. Either way, they 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** *Let the leverage constraint in the guaranteed unit be binding ( $F_S^{**} = K < F_S^*$ ) and let  $0 < \underline{\tau}_D \leq \bar{\tau}_D < 1$ . If  $K \leq \bar{K}(\alpha_S)$ , then the parent is optimally levered. Furthermore: intercorporate ownership is (a) full ( $\omega^* = 1$ ) if  $\tau_D = 0$ ; (b) less than full ( $\omega^* < 1$ ) if  $\tau_D > \underline{\tau}_D$ , zero for  $\tau_D > \bar{\tau}_D$ .*

The first part of the theorem 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 in the subsidiary. 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 second part of the theorem states that the introduction of IDT increases the cost of paying out dividends. For sufficiently high tax rate, the parent will no longer own all

the shares in its subsidiary. This, in turn, may generate a pyramid if shares are sold to outsiders.

As for the effects on distress, a cut in intercorporate dividends reduces the parent debt for several parametric combinations. This always happens when  $\tau_D > \bar{\tau}_D$ , so that the parent no longer holds subsidiary shares. A carefully calibrated mix of Thin Capitalization rules and IDT reduces default costs delivered by connected units below 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,  $\tau_D$ , when subsidiary debt is constrained to the stand-alone level.

**Theorem 4** *When the leverage constraint in the subsidiary is binding to the optimal stand-alone unit 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 units. 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.

This result obtains only if the tax authority enforces Thin Capitalization rules in every formally or informally supported unit. If it limits enforcement to proper subsidiaries in hierarchical groups, the neutrality theorem characterizing intercorporate dividend taxes carries over to Thin Capitalization rules. The controlling entity will directly own the tax arbitrage vehicle or will sell it to third parties so as to preserve tax gains.

Thus, Theorem 4 suggests that a mix of the two tax policies makes connected units not only privately optimal but 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 collects the parameters in our numerical analysis.<sup>17</sup>

The two units are assumed to have equally distributed Gaussian cash flows, and equal default cost rate and tax rate. As in the previous part of the paper, we focus on the case in which units are equal because it represents a “worst-case scenario” for the group. Indeed, as highlighted in Luciano and Nicodano (2014), asymmetries between

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<sup>17</sup>Parameters are calibrated following Leland (2007) on a BBB-rated firm. We fix the IDT tax rate,  $\tau_D$ , to the lowest applicable rate in the US.

<b>Table 1: Base-case parameters</b>	
<b>Parameter</b>	<b>Value</b>
Cash-flow actual mean ( $\mu$ )	100
Annual cash-flow volatility ( $\sigma$ )	22%
Default costs ( $\alpha$ )	23%
Effective tax rate ( $\tau$ )	20%
Intercorporate dividend tax rate ( $\tau_D$ )	7%
Discount rate ( $\phi$ )	0.7835

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

units' characteristics lead to higher value gains with respect to mergers and stand-alone units, because the conditionality of the guarantee limits contagion costs.

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 units, while the last two columns refer to a group.

The table shows that the default costs are lower in the merger than in the two stand-alone companies. Such gains are due to diversification benefits, that reduce its default costs relative to stand-alone units, 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 translates into higher tax shield.<sup>18</sup> 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 level. Group default costs are lower than in stand-alone units, despite a much higher face value of debt (138). However, they are higher than in the merger 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 controlling entity,

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<sup>18</sup>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
<b>Value (<math>\nu</math>)</b>	163.14	162.94	166.59 (49.46; 117.13)	163.88 (120.81; 43.07)	163.36 (80.65; 82.72)
<b>Ownership share (<math>\omega</math>)</b>	-	-	indefinite	100%	0%
<b>Default costs (<math>C</math>)</b>	1.23	1.78	8.13 (0; 8.13)	1.56 (1.12; 0.44)	1.02 (0.78; 0.24)
<b>Tax burden (<math>T</math>)</b>	35.43	35.40	25.40 (20.01; 5.39)	34.69 (16.85; 17.84)	35.57 (17.81; 17.76)
<b>Face Value of Debt (<math>F</math>)</b>	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 bailouts, when there are either no corrective taxes (PS, no tax); or Thin Capitalization rules only (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.

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 (default costs being 1.02 vs. 1.23 in the Merger case).

Figure 1 represents the same unit combinations as the table, but adds the case of an unregulated group with internal bailouts 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 are 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 when the organization is a systemically relevant financial intermediary, that acts as guarantor for securitized obligations.<sup>19</sup> Such losses may in fact trigger the default of a large number of financing “outsiders”, including insurance companies and banks, thereby inducing the central bank to bail out the originator.<sup>20</sup> We keep on abstracting from prudential regulation of financial conglomerates (see Freixas et al., 2007) for two reasons. On the one hand, bank capital structure responds to the tax-bankruptcy trade-off while it is insensitive to bank-specific regulations (Gropp and Heider, 2009). On the other hand, capital requirements for SPVs were absent prior to the crisis. Moreover, their current discretionary, risk-based application (Board of Governors, 2013)

<sup>19</sup>Sponsoring banks were providing guarantees to conduits, see Board of Governors (2002) and Acharya et al. (2013).

<sup>20</sup>Banks with larger holdings of even highly-rated tranches had worse performance during the crisis (see Erel et al., 2014).

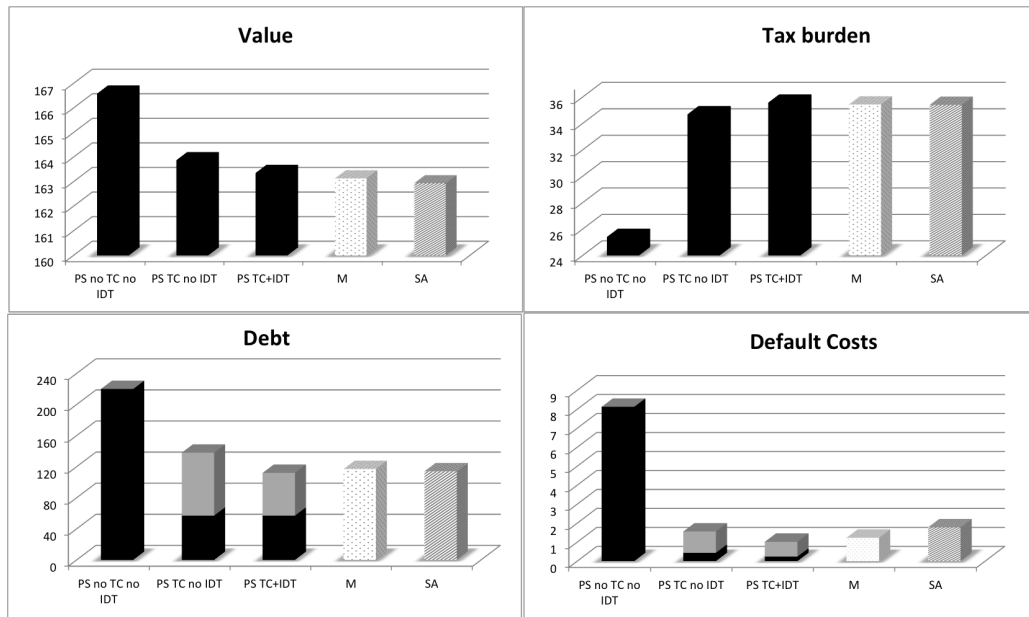


Figure 1: This figure reports value, tax burden, debt and default costs with reference to a group with internal bailout and 1. neither Thin Capitalization rules nor IDT (PS no TC no IDT); 2. with Thin Capitalization rules only (PS TC no IDT); 3. with both Thin Capitalization rules and IDT (PS TC+IDT) 4. a merger (M); 5. two stand-alone firms (SA). The light part of the bars displaying PS figures refers to the parent company.

need not restore tax receipts and contain the default costs, as the latter are independent from both risk taking and liquidity considerations.<sup>21</sup>

Table 3 reports the endogenous default probabilities and losses upon default of Parent-Subsidiary vehicles, along with those of both optimal stand-alone units and Mergers. Without corrective taxes, the profitable subsidiary enjoys bailouts from its parent in known states of the world. Despite bailouts, the subsidiary incurs into default with much larger probability (47.38%) than a stand-alone unit (11.09%). Moreover, its lenders incur into larger losses upon default (67.72% instead of 50.74%) because the subsidiary defaults only when it is unprofitable.

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

<sup>21</sup>De Mooji et al. (2013) also simulate the effects of new tax measures that contain aggregate bank leverage and financial instability.

Table 3: Tax policy and financial stability					
	M	SA	PS, no tax policy	PS, TC no IDT	PS, TC+IDT
<b>Default Probability (DP)</b>	6.40%	11.09%	0% (0%; 47.38%)	4.25% (9.51%; 6.29%)	1.94% (10.22%; 3.85%)
<b>Loss Given Default (LGD)</b>	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.

stand-alone counterpart, despite its higher leverage, thanks to the receipt of subsidiary dividends.

Adding IDT to Thin Capitalization 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 bailouts allow to remarkably reduce the likelihood of default with respect to equally leveraged stand-alone companies.<sup>22</sup> However, conditional on a default, the percentage losses incurred in by lenders of a well capitalized subsidiary are higher than in a stand-alone unit 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 support 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. Another group-related synergy is tax consolidation, by which a profitable parent can use subsidiary losses to reduce its taxable income, and viceversa.<sup>23</sup> The consolidation option is valuable because it implies that the tax burden of the group

<sup>22</sup>For instance, a stand-alone company raising the debt of the SPV when no Thin Capitalization rules and IDT are present (220), would default 98.81% of the times instead of 47.38%.

<sup>23</sup>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.

never exceeds the one of stand-alone units, and is typically smaller.

Tax consolidation (and other real synergies) do not affect our previous results, to the extent that the controlling entity creates separate tax arbitrage vehicles while the rest of the group exploits consolidation. Otherwise, the impact of consolidation on previous results is as follows. With a minimum prescribed ownership 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,  $\omega$ . Increasing it up to the prescribed threshold,  $\bar{\omega}$ , lowers the tax burden through consolidation but increases taxes paid on intercorporate dividends. Zero intercorporate 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 ( $\bar{\omega} = 80\%$ )<sup>24</sup> also triggers a zero tax rate on intercorporate dividends. 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. Below this threshold, horizontal groups should be more common (La Porta et al., 1999, Morck, 2005, Morck and Yeung (2005), and Amit and Villalonga, 2009).<sup>25</sup>

### 3.5 Prohibiting bailouts: welfare diminishing IDT

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

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<sup>24</sup>A minority interest may however be sufficient for financial conduits.

<sup>25</sup>Consolidation benefits, Thin Capitalization Rules and no IDT may in turn 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).

affiliates.<sup>26</sup>

Lemma 2 indicates that the parent optimally raises debt when it does not consider bailing out its subsidiary in case of distress.<sup>27</sup> 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 bailouts, stand-alone units emerge as the value maximizing organization for the controlling entity. The introduction of IDT leads to a lower optimal debt in stand-alone organizations, yet default costs are higher than in the connected units 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 than in stand-alone units.

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 Capitalization rules (for  $\rho = 0.2$ ). Combining IDT with a ban, however, may increase financial instability if it leads the controlling entity to prefer stand-alone units, thus eliminating the dividend support mechanism.

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<sup>26</sup>See the discussion in Segura (2014).

<sup>27</sup>In the case of securitization, Jones (2000) observes that credit risk spreads required by investors without a guarantee from the sponsor would not allow to raise debt.

Table 3: Welfare effects of IDT, $\pi = 0$								
	IDT	No IDT						
		Cash-flow Correlation ( $\rho$ )						
		-0.8	-0.5	-0.2	0	0.2	0.5	0.8
<b>Value (<math>\nu</math>)</b>	162.94	165.19	164.47	164.01	163.84	163.71	163.55	163.59
<b>Parent Debt (<math>F_P</math>)</b>	57	132	108	100	96	90	86	87
<b>Subsidiary Debt (<math>F_S</math>)</b>	57	25	35	37	40	42	45	47
<b>Default costs (<math>C</math>)</b>	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 bailout 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.

## 4 Summary and Concluding Comments

This is the first model investigating the link between tax arbitrage, ownership structure and default. Our ownership irrelevance proposition implies that tax arbitrage vehicles are mutant. They may be proper subsidiaries, since corporate limited liability protects other group companies from default. They may also be sold to third parties, if such type of ownership avoids other tax or non-tax provisions.

Tax authorities impose group-specific tax provisions to restore tax receipts, that are curtailed by the interaction of the debt tax privilege with internal support mechanisms. Our model shows that ownership adaptations are able to neutralize intercorporate dividend taxes, as the controlling entity may directly own the levered subsidiary or may alternatively sell its cash-flow rights to third parties. Thin Capitalization rules are equally ineffective unless they are enforced in every supported unit, including the conduits owned by third parties. If enforcement is limited to proper subsidiaries in hierarchical groups, the neutrality theorem characterizing intercorporate dividend taxes carries over to Thin Capitalization rules.

Strictly enforced Thin Capitalization rules are anyway unable to restore debt and default costs to the level of stand-alone units. They result in debt shifting from the debt-capped unit towards its parent company, that receives dividend support from its subsidiary. A combination of both Intercorporate Dividend Taxes and Thin Capitalization rules effectively prevents debt shifting and contains total group leverage. Expected default costs in connected units may fall below the ones of stand-alone units, as bailouts 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.

We also study the effects of a ban on subsidiary bailouts by sponsors, which appears in both the Volcker Rule and the UK Financial Services Act. Our analysis indicates that,

absent bailout 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.

The previous analysis does not address tax policy issues, such as the welfare rationale behind interest deductions. It also assumes that tax authorities enforce corrective rules so as to restore tax receipts and contain default costs. The model does not however account for the multinational structure of several financial and non financial groups, that may impair enforcement. On the one hand, the domestic tax authority may not be able to enforce corrective taxes in other jurisdictions. On the other hand, it may choose not to enforce them domestically so as to provide a subsidy to domestic firms that compete internationally. Another possible obstacle to enforcement is complexity, especially in the financial industry. Citigroup had over 2400 subsidiaries and 15 other systemic financial conglomerates had more than 260, see Herring and Carmassi (2009). Lehman Brothers Holding Inc. had 433 subsidiaries. The 2009 Joint Administrators' progress report reveals the net equity position of its main guaranteed European subsidiary was below 2% of the gross book value of market positions, a striking example of a thinly capitalized unit. Our model is also mute as to aspects already highlighted in prior literature, namely liquidity gains brought about by securitization or operational gains in LBO portfolio firms. The tax authority may optimally refrain from enforcing Thin Capitalization rules when expected benefits exceed expected default costs. Future investigations may shed light on these tax policy questions, along with the welfare rationale for a debt tax shield.

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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 (10). For notational simplicity, here and in the following proofs we report dependence of the functions on parent and subsidiary debt

only, specifying computations at  $\omega^*$  and  $\pi^*$  when necessary.

$$\left\{ \begin{array}{ll}
\frac{dT_{SA}(F_P^*)}{dF_P} + \frac{dC_{SA}(F_P^*)}{dF_P} - \frac{\partial\Gamma(F_P^*, F_S^*)}{\partial F_P} - \frac{\partial\Delta C(F_P^*, F_S^*)}{\partial F_P} - \frac{\partial\Delta T(F_P^*, F_S^*)}{\partial F_P} = \mu_1, & (i) \\
F_P^* \geq 0, & (ii) \\
\mu_1 F_P^* = 0, & (iii) \\
\frac{dT_{SA}(F_S^*)}{dF_S} + \frac{dC_{SA}(F_S^*)}{dF_S} - \frac{\partial\Gamma(F_P^*, F_S^*)}{\partial F_S} - \frac{\partial\Delta C(F_P^*, F_S^*)}{\partial F_S} + \frac{\partial\Delta T(F_P^*, F_S^*)}{\partial F_S} = \mu_2, & (iv) \\
F_S^* \geq 0, & (v) \\
\mu_2 F_S^* = 0, & (vi) \\
\mu_1 \geq 0, \mu_2 \geq 0 & (vii) \\
-\frac{\partial\Delta C(F_P^*, F_S^*)}{\partial\omega} + \frac{\partial\Delta T(F_P^*, F_S^*)}{\partial\omega} = \mu_3 + \mu_4 & (viii) \\
\omega^* - 1 \leq 0 & (ix) \\
\omega^* \geq 0 & (x) \\
\mu_3(\omega^* - 1) = 0 & (xi) \\
\mu_4(\omega^*) = 0 & (xii) \\
\mu_3 \leq 0, \mu_4 \geq 0 & (xiii) \\
-\frac{\partial\Gamma(F_P^*, F_S^*)}{\partial\pi} = \mu_5 + \mu_6 & (xiv) \\
\pi^* - 1 \leq 0 & (xv) \\
\pi^* \geq 0 & (xvi) \\
\mu_5(\pi^* - 1) = 0 & (xvii) \\
\mu_6(\pi^*) = 0 & (xviii) \\
\mu_5 \leq 0, \mu_6 \geq 0 & (xix)
\end{array} \right. \quad (11)$$

## Proof of Lemma 1

The integral expressions of  $\Delta C$  and  $\Delta T$  read

$$\begin{aligned}
\Delta C &= \alpha_P \phi \int_{X_S^d}^{+\infty} \int_{(X_P^d - \omega(1-\tau_D)[(1-\tau_S)y + \tau X_S^Z - F_S])^+}^{X_P^d} xg(x, y) dx dy \\
&= \alpha_P \phi \int_{X_S^d}^{\frac{X_P^d}{\omega(1-\tau_D)(1-\tau_S)} + X_S^d} \int_{(X_P^d - \omega(1-\tau_D)[(1-\tau_S)y + \tau X_S^Z - F_S])}^{X_P^d} xg(x, y) dx dy + \\
&+ \alpha_P \phi \int_{\frac{X_P^d}{\omega(1-\tau_D)(1-\tau_S)} + X_S^d}^{+\infty} \int_0^{X_P^d} xg(x, y) dx dy,
\end{aligned}$$

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

We now compute the first derivatives of  $\Delta C$  and  $\Delta T$  with respect to  $F_S$  and  $F_P$  and we prove our statement:

$$\begin{aligned}
\frac{\partial \Delta C}{\partial F_P} &= \alpha_P \phi \frac{\partial X_P^d}{\partial F_P} \int_{X_S^d}^{+\infty} X_P^d g(X_P^d, y) dy + \\
&- \alpha_P \phi \left[ \frac{\partial X_P^d}{\partial F_P} - \omega(1 - \tau_D) \tau_S \frac{\partial X_S^Z}{\partial F_P} \right] \int_{X_S^d}^{\frac{X_P^d}{\omega(1 - \tau_D)(1 - \tau_S)} + X_S^d} (X_P^d - \omega(1 - \tau_D) [(1 - \tau_S)y + \tau_S X_S^Z - F_S]) \times \\
&\times g((X_P^d - \omega(1 - \tau_D) [(1 - \tau_S)y + \tau_S X_S^Z - F_S]), y) dy, \tag{12}
\end{aligned}$$

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

$$\frac{\partial \Delta T}{\partial F_P} = \phi \omega \tau_D \frac{\partial X_S^Z}{\partial F_P} \int_{X_S^d}^{+\infty} \tau_S f(x) dx \geq 0,$$

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

The above expressions result from the fact that  $\frac{\partial X_P^d}{\partial F_P} \leq 0$ ,  $\frac{\partial X_S^Z}{\partial F_P} \geq 0$ .

$$\begin{aligned}
\frac{\partial \Delta C}{\partial \omega} &= \alpha_P \phi \int_{X_S^d}^{\frac{X_P^d}{\omega(1 - \tau_D)(1 - \tau_S)} + X_S^d} (1 - \tau_D) [(1 - \tau_S)y + \tau_S X_S^Z - F_S] \times \\
&\times (X_P^d - \omega(1 - \tau_D) [(1 - \tau_S)y + \tau_S X_S^Z - F_S]) \times \\
&\times g(X_P^d - \omega(1 - \tau_D) [(1 - \tau_S)y + \tau_S X_S^Z - F_S], y) dy \geq 0. \tag{13}
\end{aligned}$$

$\Delta C$  is non-decreasing in  $\omega$ , 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  $\omega$  as well, as – ceteris paribus – higher dividend taxes are paid the higher the ownership share:

$$\frac{\partial \Delta T}{\partial \omega} = \phi \tau_D \int_{X_S^d}^{+\infty} (x(1 - \tau_S) + \tau_S X_S^Z - F_S) f(x) dx \geq 0. \tag{14}$$

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

## Proof of Lemma 2

Consider the Kuhn Tucker conditions (i) to (xiii) in (11). 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  $-\frac{\partial \Delta C(F_P^*=0, F_S^*)}{\partial F_S} + \frac{\partial \Delta T(F_P^*=0, F_S^*)}{\partial F_S}$  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  $x \rightarrow +\infty$  (see Luciano and Nicodano, 2014).

The derivative  $\frac{\partial \Delta C(0, F_S)}{\partial F_S} = 0$  for every  $F_S$ . 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  $\lim_{F_S \rightarrow 0} \frac{\partial X_S^Z}{\partial F_S} = 1 - \phi(1 - G(0)) > 0$ . 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 also the derivative  $\frac{\partial \Delta C}{\partial F_P}$  vanishes at  $F_P^* = 0$ . Hence, we look for conditions for the l.h.s. to be positive and set it equal to  $\mu_1$  to fulfill the condition. We know from Luciano and Nicodano (2014) that this condition is satisfied for a certain  $F_S^* > 0$  when  $\pi = 1$  and that, when  $\pi = 0$ , the l.h.s. is negative at  $F_P^* = 0$ , because a stand-alone unit is never unlevered. Moreover, the l.h.s is increasing in  $\pi$ . 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  $\pi$  is above  $\bar{\pi}$  and  $\tau_D = 0$ , the dividend from the subsidiary to the parent does not affect the value of the parent, as it does not affect its default costs ( $\Delta C = 0$  because  $X_P^d = 0$ ). Also,  $\Delta T = 0$  when  $\tau_D = 0$ . Intercorporate ownership  $\omega$  has no effect on the default costs: notice that when  $F_P^* = 0$ , condition (viii) is always satisfied, for any  $\omega$ . The tax burden of the subsidiary and its value are independent of  $\omega$ :  $\omega^*$  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  $\omega^*$  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 (14). The existence of an interior solution,  $0 < \omega^* < 1$ , requires both  $\mu_3 = 0$  and  $\mu_4 = 0$ . Condition (viii) is satisfied only for  $\omega^* \rightarrow \infty$ , 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  $\mu_3$  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 probability of bailouts is equal to 1. First of all, we remark that  $-\frac{\partial \Gamma}{\partial \pi}$  is always negative as one can easily derive from equation (7). It follows that the only value of  $\pi^*$  that satisfies the Kuhn-Tucker conditions is  $\pi^* = 1$ . If  $\pi^* \neq 1$ , indeed, the right hand side of condition (xiv) 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  $\omega^*$  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  $\omega$  only through 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. When  $\tau_D > 0, \omega^* = 0$  is the only value of  $\omega$  which does not lead to contradiction of condition (viii). In fact,  $\frac{\partial \Delta C(0, F_S)}{\partial \omega} = 0$  for every  $F_S$ , 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 controlling entity who can freely select ownership 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  $\Delta C$  and  $\Delta T$  are 0 for every  $(F_P, F_S)$  couple. 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  $\tau_D > 0$ , because  $\omega^* = 0$ . Moreover, we know from the proof of Theorem 1 that  $\pi^* = 1$ , the result being independent of  $\tau_D$ . As a consequence, the presence or absence of IDT is 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  $\tau_D$  such that  $\omega^* = 0$ . This implies  $\mu_4 \geq 0$ ,  $\mu_3 = 0$  in (11). Condition (viii) in (11) when  $\omega^* \rightarrow 0$  reads:

$$\begin{aligned} & - \alpha_P \phi (1 - \tau_D) \int_{X_S^{d^*}}^{+\infty} [(1 - \tau_S)y + \tau_S X_S^{Z^*} - F_S^*] X_P^{d^*} g(X_P^{d^*}, y) dy + \\ & + \phi \tau_D \int_{X_S^{d^*}}^{+\infty} (x(1 - \tau_S) + \tau_S X_S^{Z^*} - F_S^*) f(x) dx = \mu_4, \end{aligned}$$

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  $\omega$  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  $\tau_D$ , since its first derivative with respect to  $\tau_D$  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  $\tau_D$  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

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

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 disappears, while the second is positive. Hence, by continuity, there exists a level of  $\tau_D$ ,  $\underline{\tau}_D$ , 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 the first part 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 and  $(F_P^{**}, F_S^{**}, \omega^{**}, \pi^{**})$  denote the solution to such constrained program. We thus consider the set of Kuhn-Tucker conditions in (11) and modify them appropriately:

$$\begin{aligned}
(iv)' &: \frac{\partial T_{SA}(F_S^*)}{\partial F_S} + \frac{\partial C_{SA}(F_S^*)}{\partial F_S} - \frac{\partial \Gamma(F_P^*, F_S^*)}{\partial F_S} - \frac{\partial \Delta C(F_P^*, F_S^*)}{\partial F_S} + \frac{\partial \Delta T(F_P^*, F_S^*)}{\partial F_S} = \mu_2 - \mu_3, \\
(vii)' &: \mu_1 \geq 0, \mu_2 \geq 0, \mu_3 \geq 0 \\
(xx)' &: \mu_3(F_S^* - K) = 0.
\end{aligned}$$

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:

$$\begin{aligned}
& - \tau_P(1 - G(0)) \frac{\partial X_P^Z(0, K)}{\partial F_P} - \frac{\partial X_S^Z(0, K)}{\partial F_P} \int_{X_S^d(0, K)}^{+\infty} \tau_S f(x) dx + \\
& + \alpha_S \phi \frac{\partial X_P^d(0, K)}{\partial F_P} \left[ \int_0^{X_S^Z(0, K)} xg(x, \frac{K}{1-\tau} - \frac{x}{1-\tau}) dx + \right. \\
& \left. + \int_{X_S^Z(0, K)}^{X_S^d(0, K)} xg(x, X_S^d(0, K) - x) dx \right] = \mu_1 \tag{15}
\end{aligned}$$

The first term is negative, the second as well and it is increasing in  $K$  (as  $X_S^Z$  is increasing and convex with respect to  $F_P$ ), while the third one is null when  $K = 0$  and is increasing in  $K$ , since its derivative with respect to  $K$  is:

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

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:

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

Considerations similar to the unconstrained case apply to condition (iv)', which is met at  $F_S^{**} = K$  by an appropriate choice of  $\mu_3$ . Notice also that the higher  $\alpha_S$ , 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  $\omega$  which does not violate the Kuhn-Tucker conditions (viii) and (ix) is  $\omega^* = 1$ . Hence,  $\omega^{**} = 1$ . This concludes our proof of part a) of the theorem.

As for part b), it follows from Lemma 3 that if  $\tau_D$  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  $\omega^{**}$  is unchanged, the dividend transfer is lowered for fixed capital structure. The unit 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  $\tau_D$ . However, overall effects on optimal value depend on  $\tau_D$ , as well as on other variables, and are hardly predictable. When  $F_S^{**} = K$  we simply notice that  $ID$  is decreasing in  $\tau_D$ , everything else fixed, as evident from equation (5).

When  $\tau_D > \bar{\tau}_D$ , we know from Lemma 3 that optimal ownership  $\omega^* = 0$ . In such case,  $\omega^{**} = 0$  as well and  $\Delta C = 0$  and  $\frac{\partial \Delta C}{\partial F_P} \rightarrow 0$ . 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  $\omega^{**}$  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 unit 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:

$$C_{SA}(F_{SA}^*) \geq C_{SA}(F_P^{**}) - \Gamma(F_P^{**}, F_{SA}^*) - \Delta C(F_P^{**}, F_{SA}^*, \omega^{**}). \quad (16)$$

We know from previous considerations that the f.o.c. for a solution to the PS problem when  $F_P^{**} > 0$  and  $\pi = \pi^* = 1$  include:

$$\frac{\partial T_{SA}(F_P^{**})}{\partial F_P} + \frac{\partial C_{SA}(F_P^{**})}{\partial F_P} - \frac{\partial \Gamma(F_P^{**}, F_{SA}^*)}{\partial F_P} - \frac{\partial \Delta C(F_P^{**}, F_{SA}^*)}{\partial F_P} - \frac{\partial \Delta T(F_P^{**}, F_{SA}^*)}{\partial F_P} = 0. \quad (17)$$

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  $\tau_D > \bar{\tau}_D$ ,  $\Delta C = 0$  and  $\Delta T = 0$  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 (16) 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%.