Complex organizations, tax policy and financial stability

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Abstract

This paper investigates defaults of organizations which display ownership connections among affiliates. To this end, it examines leverage and ownership in a group under the traditional tax-bankruptcy trade-off. Subsidiary dividends help the solvency of a levered parent. Intercorporate dividend taxes (IDT) may therefore increase default costs by reducing intercorporate ownership. However, the parent company has zero optimal leverage, and IDT are neutral for group financial stability, when the parent bails out its subsidiary so as to increase value. Finally, IDT lowers default costs, making groups even more stable than both mergers and stand-alone firms, in conjunction with Thin Capitalization rules.

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1 Introduction

The crisis led to close scrutiny of highly leveraged firm combinations. Several of them defaulted on their debts over the years in both manufacturing and the financial industry— including AIG, Enron, Ferruzzi, Lehman and Parmalat. On top, most systemically relevant financial firms have hundreds of subsidiaries. These observations prompt us to investigate the link between intercorporate ownership, that is their most notable feature, and their own financial instability. On the one hand, the internal capital market of complex organizations should better protect them from bankruptcy relative to simpler corporate structures without ownership connections. The reason is that affiliates may receive funds from other affiliates when they are unable to honor their debts. At the same time, they are separate entities that are not liable for the other affiliates’ debt obligations. On the other hand, the tax code distorts both leverage and ownership choices. It grants a privilege to debt financing by not only allowing for interest deductions but also taxing profits distributed by subsidiaries to their parent companies. Such Intercorporate Dividend Taxation (IDT) results in a double taxation of dividends to ultimate shareholders, which provides incentives against the indirect ownership of shares. It is therefore difficult to predict whether default costs are larger in firm combinations or in stand-alone firms.

This paper studies the joint determination of optimal intercorporate links, leverage and default in complex organizations. Models of complex interactions of many units are usually reduced-form. We adopt instead a structural approach but lower the dimensionality of complex interactions. We model the choice of an entrepreneur who fully owns two firms, and selects debt in each firm as well as their intercorporate links with the objective of maximizing their overall value. As in Leland (2007), each firm is subject to the traditional tax-bankruptcy cost trade-off, which drives the choice of capital structure. Debt provides a tax shield since interests are tax-deductible; at the same time, higher leverage increases the likelihood of endogenous default, which is costly. We also allow the entrepreneur to decide whether the group is hierarchical, that is whether a firm should own shares in the other. When this happens, the parent firm is entitled to intercorporate dividends from its subsidiary proportionally to its ownership share. It is then possible to assess the financial stability of the resulting organization and its sensitivity to tax policy.

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1 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 Carnassi (2009). Lehman Brothers Holding Inc. had 433. A stylized representation of its group structure is available in the Chapter 11 Proceedings Examiner Report at Jenner.com. Penati and Zingales (1997) describe the structure of the Ferruzzi Group.
We first establish that the entrepreneur prefers to fully own one firm through the other one rather than directly owning stand-alone firms. The reason is that intercorporate dividends help the parent company in servicing its debt without impacting on the service of debt in the subsidiary. This reduces the parent’s default probability and allows it to raise more debt so as to better shield income from taxes.\footnote{Consistent with this view, a recent paper finds that larger dividend payouts by French subsidiaries are associated to larger debt financing by the parent company (De Jong et al., 2012).} This result obtains when ownership is the sole link between firms. However, both Boot et al. (1993) and Luciano and Nicodano (2014) show that an internal bail-out mechanism, by which the parent helps its affiliate out of insolvency when it has sufficient funds, is value increasing.\footnote{Bodie and Merton (1992) and Gopalan et al. (2007) witness the role of non-contractual support to weaker subsidiaries in US and Indian business groups, respectively.} Such bail-out possibility markedly affects group capital structure. The subsidiary raises all group debt even if its cash flow mean and volatility, its proportional default cost rate and tax rate are equal to the parent’s. Debt concentration in the subsidiary on the one hand protects the parent from default, on the other allows the parent to use all of its cash flows to bail-out the subsidiary when necessary. Such enhanced bail-out possibility reduces the subsidiary’s cost of debt, making it possible to raise additional debt and optimize the tax shield. In this “cum bail-out” case, intercorporate ownership does not affect group capital structure.

Against this background, our structural approach allows to investigate the impact of IDT on the financial stability of this complex organization. One expects IDT to both discourage indirect ownership and increase leverage, by adding an additional tax layer to equity financing. Our results align with the first conjecture. They tell us a different story concerning leverage, because IDT either reduces optimal leverage or, in the “cum bail-out” benchmark case, leaves it unchanged. However, even a lower leverage may be associated with higher expected default costs due to distortions in the optimal allocation of debt across firms.

Our theory of intercorporate ownership emphasizes its relationship to leverage. It thus complements previous arguments that focus on investment financing and expropriation of minority shareholders. In Almeida and Wolfenzon (2006b), the controlling family either owns its affiliates directly in a horizontal group or indirectly through a pyramidal structure (i.e. a hierarchical structure that has separation between ownership and control). The family prefers this second organization when its affiliate has lower net present value, so as to involve outside shareholders in its funding. In the base set-up of our model, net present
values are equal across firms. Yet there is an incentive to full intercorporate ownership, i.e. without outside shareholders, because of the enhanced possibility to avoid default. It is the very introduction of IDT that leads to a reduction of intercorporate ownership. If the IDT tax rate is not too high, the group will remain hierarchical but will allow for less than full intercorporate ownership. Otherwise, the group will become horizontal so as to avoid the double taxation of dividends.

Our paper also contributes to the debate on corporate tax policy. Morck (2005) argues that IDT, which is still present in the US tax code, was effective in discouraging pyramidal groups during the New Deal. This improves on corporate governance if expropriation of minority shareholders is worse in pyramids than in alternative corporate organizations. Bank and Cheffins (2010) and Bank (2013) however contend that the introduction of the intercorporate dividend tax did not foster the dismantling of corporate pyramids because the tax rate was too low. Our paper indicates that IDT helps dismantling hierarchical groups, assuming a positive dividend payout ratio. However, we offer a new perspective on IDT by shifting the focus from corporate governance to financial stability. In this new light, dismantling hierarchical groups through IDT need not be welfare increasing. If the intercorporate dividend tax rate is sufficiently high, the entrepreneur restructures her hierarchical groups and directly owns the firms. In the “cum bail-out” case, default costs and welfare are unchanged because the parent company was, and remains, unlevered. In the “no bail-out” case, the unbundling of the hierarchical group can even be welfare reducing, because optimal parent leverage was, and remains, positive.

The above results do not consider that positive parent debt may also emerge due to caps on interest deductions in the subsidiary, even when internal bail-outs are possible. These tax rules, named “Thin Capitalization”, target high leverage in subsidiaries (for a survey of worldwide tax rules see Webber(2010)) trying to lower it to the stand-alone level. Our model highlights that the introduction of such a cap does not equate the financial stability of hierarchical groups to that of stand-alone firms, because it causes debt shifting towards the parent company.\footnote{Blouin et al. (2014) show that affiliates’ leverage responds quickly to the introduction of these caps. However, an invariant consolidated leverage indicates the presence of debt shifting.} We show that a calibrated combination of both tight caps on interest deductions and IDT is able to lower default costs not only relative to the stand-alone organization, but vis-à-vis a merger as well. Indeed, caps on interest deductions enhance the stabilizing effects of internal bail-outs on subsidiaries by...
limiting their debt. In turn, IDT avoids excess debt shifting onto the parent company.

In our model financial synergies alone motivate the formation of a hierarchical group. Other synergies, such as tax consolidation, make indirect ownership less sensitive to intercorporate dividend taxation. Also, we fix a positive payout ratio and collapse the intercorporate dividend and ownership choice together. With a flexible dividend payout, the introduction of IDT may prompt the subsidiary to simply cut back dividends without reducing intercorporate ownership.\(^6\) Our results thus constitute an upper bound for the impact of dividend taxes on indirect ownership and financial stability.

The paper is organized as follows. Section 2 is devoted to closely related literature. Section 3 presents the model and characterizes optimal ownership and leverage choices without IDT. Section 4 determines leverage and ownership choices in the presence of IDT, and proves its welfare neutrality in the “cum bail-out” benchmark case. Section 5 considers other tax policies, bearing on indirect ownership, in conjunction with IDT and numerically investigates financial stability outside the benchmark case. Section 6 concludes. All proofs are in the Appendix. The Appendix also contrasts IDT in the US and in the EU.

2 Related Literature

This essay builds on two previous no-arbitrage models of leveraged firm combinations, none of which focuses on the welfare costs deriving from their financial instability. Leland (2007) analyzes optimal leverage in a merger of two stand-alone companies, when only financial synergies justify the merger. Our setting coincides with Leland’s stand-alone case when both intercorporate ownership and the internal bail-out are absent. Luciano and Nicodano (2014) extend Leland’s analysis to parent-subsidiary structures, when the parent owns 100% of the subsidiary shares and its bail-out promise is fully credible. They show that debt is concentrated in the guaranteed company; and that subsidiary debt may be larger than twice the optimal debt of a stand-alone company. Their model is our benchmark for a highly leveraged hierarchical group. We extend it to any level of intercorporate ownership and to tax policy, in order to analyze financial stability of

\(^6\)Taxes appear to be non-neutral for intercorporate ownership. Dahlquist et al. (2013) show that Swedish controlling corporations, which are tax exempt, hold larger stock portfolios than non-controlling ones, that are taxed. The evidence on the tax sensitivity of dividend payouts is instead mixed (Barclay et al. (2009), Holmen et al. (2008)).
complex organizations.\footnote{Other models of firm combinations usually focus on investment financing (see for instance Matvos and Seru (2014) and Stein (1997)) or product market competition and workers’ incentives (Fulghieri and Sevilir (2011)) rather than risky leverage, which is the driver of welfare effects in our setting.}

In our model, the internal bail-out mechanism inside groups adversely interacts with gains deriving from the tax shields. This leads to higher leverage and higher bankruptcy costs in groups than in stand-alone firms, even if there is no moral hazard. This is the rationale for regulating groups. On the contrary, Almeida and Wolfenzon (2006a) indicate that dismantling groups may improve on resource allocation as they provide excessive financing to mediocre internal investments.

A vast literature studies tax planning in multinationals. One strand studies transfer pricing, that is internal trade of goods and assets that shift profits from more to less taxed affiliates. Another strand studies debt shifting across subsidiaries in different countries (see Huizinga et al. (2008)). A third one concerns the effect of repatriation taxes when multinational subsidiaries are located in low-tax countries (Altshuler and Grubert (2003)).\footnote{Desai et al. (2007) analyze dividend payout determinants in multinationals, discussing the relative importance of taxes and control motives.} Our analysis concerns a pervasive form of tax planning, namely the one associated with interest deductions. Contrary to most other forms, such tax planning activity is effective even when affiliates have equal cash flows and tax rates. It therefore applies to fully domestic groups and financial conglomerates, along with multinationals.

Clearly, an unlevered parent generates more value for the entrepreneur if incorporated in a tax heaven. However, it can exploit non-debt tax shelters (as in De Angelo and Masulis (1980) and Graham and Tucker (2006)) when incorporated domestically. Thus, debt and non-debt tax shields may become complements, rather than substitutes, in a complex organization.

Several previous papers analyze personal dividend taxes. They focus on their impact on dividend payout, investment and equity issues (see Chetty and Saez, 2010, and references therein), but ignore leverage and corporate organization. On the contrary, we fix payout, investment and equity issues and analyze how intercorporate dividend taxes affect intercorporate ownership and leverage. Our limited understanding of complex organizations and their prevalence among multinationals, family firms and financial intermediaries, provides support to our new approach.
3 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, \( D_i \):

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

At time \( T \), realized cash flows are distributed to financiers. Equity is a residual claim: shareholders receive the difference between operational cash flow, net of corporate income taxes, and debt face value 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 \( D_i \). The tax shield is a convex function of \( F_i \).

Absent any link between units, the expected tax burden in each unit separately – each

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\(^9\)The subsidiary, \( S \), can be thought of as the consolidation of all other affiliates.

\(^10\)No tax credits or carry-forwards are allowed.
taken as a stand-alone (SA) firm – is equal to (see Leland (2007)):

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

(3)

where the expectation is based on the risk-neutral probability\(^{11}\) 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 the cash flow is insufficient to reimburse lenders. Default occurs when the level of realized cash flows is lower than the default threshold, \( X^d_i = F_i + \tau_i (1 - \tau_i) D_i \):

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

(4)

Default costs represent a deadweight loss to the economy and they cannot be redistributed to any stakeholder of the firm. They increase in the default cost parameter, \( \alpha_i \), 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, \( X^d_i \), 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 the organization:

\[ W = \nu_{PS} + \sum_i T_i, \]  

(5)

\( W \) represents the total value created by the firm and distributed to 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.

\(^{11}\)This allows to incorporate a risk premium in the pricing of assets without having to specify a utility function.
3.1 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, $\omega$, of its subsidiary’s equity. The subsidiary distributes its profits after paying the tax authority and lenders, $(X^n_S - F_S)^+$, where $X^n_S$ 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 $T$. Results below are qualitatively unchanged as long as the payout ratio is positive and inflexible. 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:

$$ID = \phi \omega \mathbb{E} \left[ (1 - \tau_D)(X^n_S - F_S)^+ \right].$$

(6)

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

$$X^n_{P,\omega} = X^n_P + (1 - \tau_D)\omega(X^n_S - F_S)^+.\quad (7)$$

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, $\omega$, 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 personal dividend (and capital gains) tax rate are already included in $\tau_D$, which is an effective tax rate. Similarly, we focus on the entrepreneur’s choice of direct versus indirect ownership without involving minority shareholders.\footnote{We artificially build some asymmetries between the parent and its subsidiary for brevity. For instance, we could allow (also) the subsidiary to provide a bail-out to its parent and (also) the parent to own shares in its subsidiary. We refer the reader to Luciano and Nicodano (2014) for the analysis of both mutual guarantees and optimal group structure when units differ.}

As for the internal bail-out promise, we model it following Luciano and Nicodano (2014). One firm promises to transfer cash to the other, in order to prevent its default,
if it will have sufficient funds. In formulas, 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 bail-out promise affect default costs and the
tax burden of the group.

### 3.2 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, \( \omega \), 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
firm. These obtain with 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. The reduction in expected default costs due to the bail-out mechanism \( (\Gamma) \)
is equal to:

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

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 \( 1 \{\cdot\} \) defines the 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 properties of the function \( h \), which is defined in the Appendix,
imply that rescue by the parent is likelier the smaller is 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, \( \omega \). 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:

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

\(^{13}\)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
help the subsidiary service its debt, but may impair the parent’s service of debt.
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 firms. We denote this change as \( \Delta T \):

\[
\Delta T(F_S, \omega) = T_S(F_S, \omega) + T_P(F_P, \omega) - T_{SA}(F_P) + T_{S}(F_S) = \phi \omega \tau_D E[(X^a_S - F_S)^+] \geq 0.
\]

This is positive, and increasing in subsidiary’s dividend, when the tax rate on intercorporate dividends is positive. In turn, dividend increases in profits after the service of debt, \((X^a_S - F_S)^+\), and in intercorporate ownership, \( \omega \).

### 3.3 Optimal Intercorporate Ownership and Leverage

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

\[
\min_{F_S,F_P,\omega,\pi} T_S(F_S, \omega) + T_P(F_P) + C_S(F_P, F_S, \pi) + C_P(F_S, F_P, \omega),
\]

through the choice of its capital structure \((F_P \text{ and } F_S)\) and of its intercorporate links \((\omega, \pi)\). The value-maximizing organization may result in two stand-alone firms, with no links. It may instead be a complex hierarchical group, with both intercorporate ownership and a bail-out mechanism; or an organization with either internal bail-outs (as in horizontal groups) or intercorporate ownership.

Before proceeding, we introduce the following lemma that summarizes the properties of \( \Delta C \) and \( \Delta T \) with respect to debt levels:

**Lemma 1** The default costs saved thanks to the dividend transfer, \( \Delta C \), are decreasing in subsidiary debt, \( F_S \). The additional tax burden due to intercorporate dividend taxation \((\tau_D > 0)\), \( \Delta T \), is decreasing in subsidiary debt and insensitive to parent debt, \( F_P \).

The first property of default costs and tax burden derives from the fact that the lower the subsidiary debt, the higher subsidiary equity and dividends, leading to both higher parent debt servicing and higher collected dividend taxes.
The proposition below deals with the joint determination of leverage and ownership structure, given the bail-out promise:

**Theorem 2** Assume $\tau_D = 0$. If the sum of the tax burden and default costs in each unit is convex in both face values of debt, then:

(i) if $\pi \geq \bar{\pi} > 0$ the parent is unlevered ($F^*_P = 0$) and the optimal intercorporate ownership share is indefinite; (ii) if $0 \leq \pi < \bar{\pi}$ the parent face value of debt is positive and the subsidiary is fully owned ($\omega^* = 1$).

Theorem 2(i) states that the parent is optimally unlevered, and the subsidiary raises all group debt, if the bail-out promise is sufficiently credible ($\pi \geq \bar{\pi}$). Such degree of credibility equates the loss in the unlevered parent tax shield to the reduction in subsidiary expected default costs, evaluated absent the bail-out guarantee. The Appendix recovers the cut-off level $\bar{\pi}$, above which the parent is optimally unlevered. For given $F_S$, $\bar{\pi}$ is decreasing in the proportional default costs rate (of the subsidiary, when it differs from the parent’s). This is because the incentive to exploit the default cost saving effect of the guarantee (thus leaving the parent unlevered) is higher the higher is $\alpha_S$. The guarantee lowers so much the default likelihood of the subsidiary, at the initial face value of debt, that the subsidiary fully exploits the tax shield of the firm combination, isolating the parent from default costs. With such capital structure, the value of the firm combination is insensitive to intercorporate ownership and dividend receipts, as they do not affect the tax-bankruptcy trade-off.

Absent such sufficiently credible bail-out mechanism, part (ii) of Theorem 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 ($\omega = 0$) is then always sub-optimal for the entrepreneur, even when they do not exploit bail-out transfers ($\pi = 0$). This result provides a rationale for the observation that several groups are unlisted and fully owned. It also explains why dividends of French subsidiaries are correlated to their parents’ debt (De Jong et al., 2012).

The following theorem characterizes the optimal credibility of the bail-out guarantee.

**Theorem 3** The value of the group is increasing in the credibility of the guarantee, given $\omega$. Hence, $\pi^* = 1$.

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14For 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.
A fully credible guarantee maximizes the value of the corporate organization. It allows to raise all debt only in the subsidiary, thereby making default costs in the parent equal to zero. At the same time, such higher subsidiary debt leads to its likelier default, resulting in a larger risk premium required by lenders and a larger tax shield. But the bail-out guarantee prevents default costs from rising faster than tax savings. Thus groups, whether horizontal or hierarchical, have higher value than stand-alone firms, thanks to internal bail-outs. This theorem implies that the optimal complex organization has an unlevered parent, a highly levered subsidiary with a high tax shield which is rescued by its parent when it has sufficient funds and any intercorporate ownership absent IDT.

Below we will use these benchmark results so as to determine the effect of tax policy in general, and IDT in particular, on the financial stability of firm combinations.

4 Dividend Taxes, Ownership and Default

This section first establishes the effects of IDT on optimal intercorporate ownership. We then prove the neutrality of IDT for financial stability and value of the optimal organization, when the entrepreneur is unconstrained in her choice of ownership, debt and commitment to the bail-out promise.

4.1 Intercorporate Dividend Taxation and Ownership

So far, we obtained our results in the absence of dividend taxation. The following theorem characterizes optimal ownership in presence of IDT:

Theorem 4 Assume \( \tau_D > 0 \) and let \( 0 < \tau_D \leq \bar{\tau}_D < 1 \). Then: i) if \( \tau_D > \bar{\tau}_D > 0 \), optimal intercorporate ownership is less than full (\( \omega^* < 1 \)); ii) if \( F^*_p = 0 \) or \( \tau_D > \bar{\tau}_D \), then optimal intercorporate ownership is zero (\( \omega^* = 0 \)).

Theorem 4 states that IDT discourages full intercorporate ownership. If the tax rate \( \tau_D \) is high enough, optimal ownership may even drop to zero. In this case a horizontal group becomes optimal (\( \omega^* = 0 \)), with the entrepreneur directly controlling the two firms. The introduction of IDT, even with a very low tax rate, drives optimal intercorporate

\[ \text{In other words, the subsidiary’s tax shield increases at an increasing rate in debt, while the bail-out transfer from the unlevered parent contains the increase of the subsidiary’s default threshold. This shrinks the set of states in which the subsidiary defaults and pays taxes, which occur for cash-flow realizations between the tax shield and the default threshold.} \]
ownership to zero when the parent is unlevered, since dividends do not help reducing default costs in the parent while they increase the tax burden.

4.2 Neutrality of Intercorporate Dividend Taxes

The following theorem addresses the effects of IDT on the optimal firm combination in the benchmark “cum bail-out case”:

**Theorem 5** The introduction of a tax on intercorporate dividend leads to the dismantling of the hierarchical group. However, it affects neither value nor financial stability.

This theorem 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. The entrepreneur opts for a horizontal group, i.e. to hold shares directly, when the IDT tax rate becomes positive. This is in line with Morck (2005) argument on the suitability of this tax instrument in order to obtain a simpler form of corporate organization. In the current setting, that does not consider minority shareholders’ expropriation, Theorem 5 proves the welfare neutrality of IDT and of the dismantling of hierarchical business groups. Such neutrality derives from the fact that the parent is unlevered and therefore does not default irrespective of dividend receipts.\(^\text{16}\)

Recall that the personal dividend tax was collapsed into the effective corporate income tax to avoid cumbersome notation. It is worthwhile emphasizing that Theorem 5 holds 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. The personal tax rate on distributions must also be positive. Otherwise it is possible for the entrepreneur to payout subsidiary profits and directly rescue the parent. Finally, IDT neutrality hinges on the reliability of the bail-out promise \((\pi \geq \bar{\pi})\), which is due to ex-ante incentives (see Theorem 3). The entrepreneur’s ex-post incentives to honor the bail-out promise may however be weaker.\(^\text{17}\)

\(^{16}\)IDT may not affect ownership if the dividend payout ratio can be set to zero, provided the parent may receive cash flows through subsidiary share repurchases or the parent purchase of subsidiary’s assets or intercompany loans. Regulation often restricts the transfer of funds to the parent through non-dividend distributions in order to safeguard subsidiary’s stakeholders. For an overview of EU member states approach see European Commission (2011), p.60. Central banks also freeze transfers of funds from domestic bank subsidiaries to the foreign holding company.

\(^{17}\)Luciano and Nicodano (2014) characterize conditions ensuring that the parent honors the guarantee ex-post in a repeated version of the game. The bail-out occurs ex-post when the amount of the rescue transfer from the parent’s shareholders is lower than the discounted value of the subsidiary accruing to them.
Below we numerically address cases of groups with a levered parent,\(^{18}\) as this allows IDT to affect default costs and welfare.

## 5 Financial stability with other tax frictions

The previous section deals with an unlevered parent only. We now explore the effects of IDT on financial stability outside the benchmark neutrality case.

The first section analyzes the opposite benchmark case in which the bail-out mechanism is absent. This case highlights the largest welfare diminishing effect of IDT. The following two sections consider relevant additional common tax provisions, namely caps on interest deductions in the subsidiary and tax consolidation. This latter case introduces a synergy deriving from intercorporate ownership. It therefore allows to separately address payout policy and ownership structure choices.

### 5.1 Welfare diminishing IDT: absence of bail-outs

In this section we numerically analyze the impact of IDT on financial stability when there is no bail-out mechanism between the parent and its affiliate. The parameters are collected in Table 1. They 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. The two firms are assumed to have equal exogenous cash flow mean and volatility, default cost rate and tax rate.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash flow actual mean ((\mu))</td>
<td>100</td>
</tr>
<tr>
<td>Annual cash flow volatility ((\sigma))</td>
<td>22%</td>
</tr>
<tr>
<td>Default costs ((\alpha))</td>
<td>23%</td>
</tr>
<tr>
<td>Effective tax rate ((\tau))</td>
<td>20%</td>
</tr>
<tr>
<td>Intercorporate dividend tax rate ((\tau_D))</td>
<td>7%</td>
</tr>
<tr>
<td>Discount rate ((\phi))</td>
<td>0.7835</td>
</tr>
</tbody>
</table>

Table 1: Base-case parameters

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

\(^{18}\)The parent may lever up when investment risk is endogenous and non-contractible. This avoids paying high interest rates that lenders would otherwise charge to highly levered subsidiaries for bearing investment risk (see Bianco and Nicodano (2006)).
Previous theorems show that the parent optimally raises debt when it does not consider bailing out its subsidiary in case of distress. Absent IDT, it fully owns its subsidiary (see part (ii) of Theorem 2). Table 2 presents the no bail-out and no IDT case 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, because of higher diversification benefits since subsidiary dividends tend to be larger when the parent is less profitable. Default costs drop from 2.13 when $\rho = 0.8$ to 0.39 when $\rho = -0.8$. Dividend also cause more debt shifting from the subsidiary onto the parent as correlation falls. For instance, debt in subsidiary (parent) equals 47 (87) when $\rho = 0.8$, while they respectively become 25 (132) when $\rho = -0.8$. A high enough dividend tax rate dismantles the group and stand-alone firms emerge as the optimal configuration (as indicated in part (ii) of Theorem 4 and reported in the first column). With IDT, value falls because of the higher tax burden for all correlation levels. IDT leads to lower optimal debt, 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.

<table>
<thead>
<tr>
<th>Cash-flow Correlation ($\rho$)</th>
<th>Value ($\nu$)</th>
<th>Parent Debt ($F_P$)</th>
<th>Subsidiary Debt ($F_S$)</th>
<th>Default costs ($C$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-0.8</td>
<td>162.94</td>
<td>57</td>
<td>57</td>
<td>1.78</td>
</tr>
<tr>
<td>-0.5</td>
<td>165.19</td>
<td>132</td>
<td>25</td>
<td>0.39</td>
</tr>
<tr>
<td>-0.2</td>
<td>164.47</td>
<td>108</td>
<td>35</td>
<td>0.84</td>
</tr>
<tr>
<td>0</td>
<td>164.01</td>
<td>100</td>
<td>37</td>
<td>1.16</td>
</tr>
<tr>
<td>0.2</td>
<td>163.84</td>
<td>96</td>
<td>40</td>
<td>1.41</td>
</tr>
<tr>
<td>0.5</td>
<td>163.71</td>
<td>90</td>
<td>42</td>
<td>1.45</td>
</tr>
<tr>
<td>0.8</td>
<td>163.59</td>
<td>86</td>
<td>45</td>
<td>1.72</td>
</tr>
</tbody>
</table>

Table 2: Welfare effects of IDT, $\pi = 0$

5.2 Thin Capitalization rules

In many countries regulation limits the fiscal deductibility of subsidiary interests through “Thin Capitalization” rules. These measures, which directly cap interest deductions 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.\footnote{A similar effect obtains with capital requirements for financial conglomerates.}

We now characterize the optimal capital structure following the introduction of Thin Capitalization rules, as well as the effect of taxing dividends twice.
Theorem 6 Assume the leverage constraint in the subsidiary is binding, \( F_S^* = K \). Then a) the parent is optimally levered, for all \( \pi \geq 0 \) as long as \( K \leq K^*(\alpha_S, \pi) \); b) the introduction of IDT lowers parent debt when \( \tau_D > \bar{\tau}_D \).

Given a binding constraint to subsidiary leverage, debt shifts towards the parent so as to exploit the tax shield. The reduction in subsidiary debt increases its dividends, which helps the parent repay its obligations in case of distress and boost optimal parent leverage.

The introduction of IDT increases the cost of paying out dividends. Hence, optimal intercorporate ownership and dividends fall. In turn, this reduces the parent debt for several parametric combinations. In particular this always happens when \( \tau_D \) is high enough to drag optimal intercorporate ownership to 0, down from 100\% without IDT.

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 \( \tau_D \) when subsidiary debt is constrained to the stand-alone level.

Theorem 7 When the leverage constraint in the subsidiary is binding to the stand-alone level, \( F_S^* = F_S^{SA} \), 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.

IDT discourages the hierarchical structure of groups in favor of a horizontal one. 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 implies that a mix of the two tax policies can align the privately optimal choice, the group, with the welfare optimal organization.

Previous sections contrast alternative complex organizations with stand-alone firms, only. The entrepreneur may consider the possibility of creating a unique entity, the merger \((M)\), even when there are no operational synergies. Indeed, a merger always provides cash flow diversification benefits and is not subject to double taxation of dividends, although it suffers from contagion costs. We therefore compare the optimal characteristics of the merger (as in Leland (2007)) to groups in Table 3 and Figure 1 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 columns refer to a group.
Table 3: Merger and PS

<table>
<thead>
<tr>
<th></th>
<th>M</th>
<th>SA</th>
<th>PS, TC no IDT</th>
<th>PS, TC+IDT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value ($\nu$)</td>
<td>163.14</td>
<td>162.94</td>
<td>163.88 (120.81; 43.07)</td>
<td>163.36 (80.65; 82.72)</td>
</tr>
<tr>
<td>Ownership share ($\omega$)</td>
<td>-</td>
<td>-</td>
<td>100%</td>
<td>0%</td>
</tr>
<tr>
<td>Default costs ($C$)</td>
<td>1.23</td>
<td>1.78</td>
<td>1.56 (1.12; 0.44)</td>
<td>1.02 (0.78; 0.24)</td>
</tr>
<tr>
<td>Tax burden ($T$)</td>
<td>35.43</td>
<td>35.40</td>
<td>34.69 (16.85; 17.84)</td>
<td>35.57 (17.81; 17.76)</td>
</tr>
<tr>
<td>Welfare ($W$)</td>
<td>198.78</td>
<td>198.34</td>
<td>198.57</td>
<td>199.09</td>
</tr>
<tr>
<td>Face Value of Debt ($F$)</td>
<td>117</td>
<td>114</td>
<td>138 (81; 57)</td>
<td>112 (55; 57)</td>
</tr>
</tbody>
</table>

Table 3: The table compares the optimal properties of a merger (M column) to the ones of two stand-alone units (SA) and to the PS structure when thin capitalization rules are present (PS, TC no IDT column) and when they are coupled with IDT (PS, TC+IDT column). Subsidiary debt in the last two columns is constrained to be lower than the stand-alone one, $F_S^* \leq 57$. Optimal values of the parent and the subsidiary unit are reported in the brackets. Equity of the subsidiary is net of the dividend.

When Thin Capitalization rules constrain subsidiary debt to the stand-alone one level (third column), default costs fall to 1.56 thus remaining higher than in the merger (1.23). However, when IDT is introduced along with Thin Capitalization rules (forth column), debt capacity in the group is limited to 112 and default costs fall to 1.02. Also the tax burden increases to 35.57, up from 34.69. Neither a cap on subsidiary leverage, nor the combination of thin capitalization rules and IDT are able to dismantle the group. This 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 (the horizontal group) is also welfare optimal (delivering welfare equal to 199.09 versus 198.78 in the merger case). This is noteworthy because when units are equal, with low cash-flow volatility and correlation, contagion in mergers is less likely.\(^{20}\)

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 clearly provides a rationale for Thin Capitalization rules, showing the extent of both subsidiary leverage (220) and its default costs (8.13). It also suggests that financial stability can be achieved through the enforcement of tax-based regulation.

\(^{20}\)Leland (2007) shows that 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. Luciano and Nicodano (2014) show that the PS structure is more valuable than the merger in those circumstances, as well as in the case of perfect cash flow correlation. Absent tax motives, mergers are less valuable when coinsurance gains are lower than contagion costs (Banal-Estanol et al., 2013).
5.3 Hierarchical Group Synergies: Tax Consolidation

So far group affiliates are more valuable with respect to stand-alone firms because of internal bail-out transfers and coordinated capital structure choices. Both features allow to optimize their use of the tax shield, taking into consideration differential default costs. However, these are all financial synergies. The presence of other synergies may justify intercorporate ownership and the birth of groups. One such synergy is tax consolidation, by which a profitable parent can use subsidiary losses to reduce its taxable income, and vice versa. Tax consolidation is outright forbidden in certain jurisdictions, such as the UK and some US states. It 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.

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.

Importantly, the presence of tax consolidation modifies our benchmark result in Theorem 2, when $\tau_D = 0$, when there is a minimum prescribed threshold for consolidation, $\bar{\omega}$. It implies that the optimal intercorporate ownership can be equal to such threshold,
instead of being indefinite, even when the bail-out mechanism is in place. 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. We can prove that:

**Proposition 8** Assume there are tax synergies associated with the group organization if intercorporate ownership exceeds a threshold $\bar{\omega}$. Then, there exist a tax rate $\bar{\tau}_D(\rho, \sigma, \tau)$ and a tax rate $\tau_D(\rho, \sigma, \tau)$ such that (i) for $\tau_D > \bar{\tau}_D$, optimal intercorporate ownership is either zero or $\bar{\omega}$; (ii) for $0 \leq \tau_D \leq \bar{\tau}_D$, optimal intercorporate ownership is greater than or equal to $\bar{\omega}$.

This proposition highlights that dismantling the hierarchical structure of groups is no longer an obvious consequence of the introduction of intercorporate dividend taxation in the cum-bailout case. Indirect ownership is preserved even when the dividend tax rate is positive if tax consolidation synergies are substantial. Otherwise, the inference of the benchmark model goes through, with the tax rate $\bar{\tau}_D$ substituting the zero level. In other words, an increase of the IDT rate above $\bar{\tau}_D$ will produce a cut to both intercorporate ownership and dividends that reduces funds available to the parent. This leaves capital structure and default costs unchanged if the parent is unlevered. Otherwise, reducing dividends will lower the parent’s ability to service its debt along with its tax shield and group value, possibly leading to the welfare reductions highlighted in previous sections.

This example indicates that the entrepreneur may want to reduce the subsidiary payout (if flexible) as the tax rate on intercorporate dividend increases, while keeping the hierarchical group organization intact so as to exploit the tax consolidation option. The US rules concerning IDT are interesting in this last respect. Consolidation is possible only when ownership exceeds $\bar{\omega} = 80\%^{21}$, which is also the threshold that triggers a zero tax rate on intercorporate dividends. Thus such tax design does not discourage dividend support to a levered parent, while allowing the group to exploit consolidation for tax purposes.

### 6 Summary and Concluding Comments

This is the first paper investigating the interplay of tax policy and the default of complex organizations. It points out that the parent optimally owns all the subsidiary’s shares, A minority interest may however be sufficient for financial conduits.

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21 A minority interest may however be sufficient for financial conduits.
because full intercorporate ownership enhances the possibility to avoid default. Introducing Intercorporate Dividend Taxation impairs such stabilizing effect and may deliver higher expected default costs even if overall debt falls. Thus the double taxation of dividends may be welfare diminishing when corporate governance concerns are second order relative to financial stability ones.

The result above does not consider the possibility to adjust capital structure so as to best exploit group internal bail-outs. The latter paradoxically lead to greater financial instability as they magnify the capital structure distortion against equity associated with the tax privilege on interests. This generates the high leverage observed in some affiliates of complex organizations, that reduce their tax burden and increase default costs - even abstracting from systemic externalities.

As for tax policy, Intercorporate Dividend Taxes are able to dismantle hierarchical groups, at least when the dividend payout ratio is not flexible. Hierarchical groups transform into horizontal groups, that preserve the high leverage and default costs of hierarchical structures since they also rely on internal bail-outs to enhance their tax shield. It follows that discouraging hierarchical groups through Intercorporate Dividend Taxes need not be desirable from the point of view of financial stability. This result may explain why the European Union avoids such double taxation of dividends.

However, we find that a combination of both IDT and Thin Capitalization rules effectively prevents debt shifting and contains group leverage - contributing to financial stability. When global enforcement of tax rules is possible, default costs in complex organizations may fall below the ones of stand-alone firms and mergers, as bail-outs and dividends inside groups are no longer targeted to increase the affiliates’ tax-shield. This observation may provide a rationale, albeit parametric, for the current design of US tax policy. It also suggests that authorities in charge of financial stability may fruitfully co-ordinate with tax-authorities in their joint efforts to contain the insolvency of firm combinations.
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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:

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

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

Proof of Lemma 1

Let us first write the integral expressions of $\Delta$ and $\Delta T$:

$$\Delta C(F_P, F_S, \omega) = \alpha_P \phi \int_{X_S^d}^{+\infty} \int_{X_S^d}^{X_P^d} xg(x, y)dx dy,$$

$$\Delta T(F_S, \omega) = \phi \omega \tau_D \int_{X_S^d}^{+\infty} \left[(1 - \tau_S)x + \tau_S X_S^Z - F_S\right]f(x)dx.$$
\[ \frac{\partial \Delta C}{\partial F_P} = \alpha P \phi \frac{\partial X^d_P}{\partial F_P} \int_{\frac{\tau S^2}{S^2 + \tau D} + \frac{\tau S^2}{S^2 + \tau D}} \frac{x^d_P g(x^d_P, y)}{dy} + \]

\[= \alpha P \phi \frac{\partial X^d_P}{\partial F_P} \int_{\frac{\tau S^2}{S^2 + \tau D} + \frac{\tau S^2}{S^2 + \tau D}} \left( X^d_P - \omega(1 - \tau D) \left[ (1 - \tau S) y + \tau S X^d_S - F_S \right] \right) \times \]

\[ \times g \left( (X^d_P - \omega(1 - \tau D) \left[ (1 - \tau S) y + \tau S X^d_S - F_S \right], y \right) dy, \]

(12)

\[ \frac{\partial \Delta C}{\partial F_S} = \alpha P \phi \omega (1 - \tau D) \left[ \tau S \frac{\partial X^Z_S}{\partial F_S} - 1 \right] \times \]

\[ \times \int_{\frac{\tau S^2}{S^2 + \tau D} + \frac{\tau S^2}{S^2 + \tau D}} \left( X^d_P - \omega(1 - \tau D) \left[ (1 - \tau S) y + \tau S X^d_S - F_S \right] \right) \times \]

\[ \times g \left( y, (X^d_P - \omega(1 - \tau D) \left[ (1 - \tau S) y + \tau S X^d_S - F_S \right] \right) dy \leq 0, \]

\[ \frac{\partial \Delta T}{\partial F_P} = 0, \]

\[ \frac{\partial \Delta T}{\partial F_S} = \phi \omega \tau D \left[ \tau S \frac{dX^Z_S}{dF_S} - 1 \right] (1 - G(X^d_S)) \leq 0. \]

### Proof of Theorem 2

Let us examine the Kuhn-Tucker conditions for a minimum of the sum of tax burden and default costs.

\[
\begin{align*}
\frac{dT_1(F^*_P)}{dF_P} + \frac{dC_1(F^*_P)}{dF_P} - \frac{dT_2(F^*_P, F^*_S)}{dF_P} - \frac{d\Delta C(F^*_P, F^*_S)}{dF_P} &= \mu_1, \\
F^*_P &\geq 0, \\
\mu_1 F^*_P &= 0, \\
\frac{dT_3(F^*_S)}{dF_S} + \frac{dC_2(F^*_S)}{dF_S} - \frac{dT_2(F^*_P, F^*_S)}{dF_S} - \frac{d\Delta C(F^*_P, F^*_S)}{dF_S} + \frac{\partial \Delta T(F^*_S)}{\partial F_S} &= \mu_2, \\
F^*_S &\geq 0, \\
\mu_2 F^*_S &= 0, \\
\mu_1 &\geq 0, \mu_2 \geq 0.
\end{align*}
\]

(13)

We investigate the existence of a solution in which \( F^*_P = 0 \) and \( F^*_S > 0 \), i.e. \( \mu_1 \geq 0 \) and \( \mu_2 = 0 \). We focus on condition (iv) first. We have to prove that the term \( \frac{\partial \Delta C(F^*_P, F^*_S)}{\partial F_P} + \frac{\partial \Delta T(F^*_S)}{\partial F_S} \) has a negative limit as S debt tends to zero, and a positive one when \( F^*_S \) 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 $\frac{\partial \Delta C(F_P, F_S)}{\partial F_S}|_{F_P^*=0} = 0$. 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 $\lim_{F_S \rightarrow 0} \frac{\partial X_Z^S}{\partial F_S} = 1 - \phi(1 - G(0)) > 0$. When $F_S$ goes to infinity, $\frac{\partial \Delta T}{\partial F_S}$ goes to zero as $G(X_Z^S)$ 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 $\mu_1$ to fulfill the condition. The l.h.s. of (i) is positive when

$$\pi \geq \tau_P (1 - G(0))(1 - \phi(1 - G(0))) \int_{0}^{X_Z^S(F_P^*)} xg(x, \frac{F_P^*}{1 - \tau_P} - \frac{x}{1 - \tau_P}) dx + \int_{X_Z^S(F_P^*)}^{X_Z^P} xg(x, X_Z^S(F_S^*) - x) dx.$$  (14)

We denote the level at which equation (14) is satisfied as an equality as $\bar{\pi}$. $\pi \geq \bar{\pi}$ is a necessary – and sufficient, given our convexity assumption – condition, given $F_S^*$, for the existence of a solution in which $F_P^* = 0$. Notice that condition (14) is satisfied for all levels of $\pi$ only when $\tau_P = 0$, a trivial case that we rule out. \[22\] The denominator can be interpreted as the expected level of default costs in the subsidiary, adjusted by the tax rate of the parent and the (joint and univariate) distribution of cash flows. The higher these “adjusted expected default costs” in the subsidiary, the lower $\bar{\pi}$.

When $\pi$ 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 ($\Delta C = 0$). Also, $\Delta T = 0$ when $\tau_D = 0$. Intercorporate ownership $\omega$ has no effect on the default costs and tax burden of the subsidiary and $S$ value is unchanged: $\omega^*$ is indefinite and part (i) of our proposition is proved.

When $\pi < \bar{\pi}$, leverage is optimally raised also by the parent. Let us fix $\pi = \hat{\pi} < \bar{\pi}$ and focus on the effects of the dividend transfer on the value of PS. Let us comment on the behavior of $\Delta C - \Delta T$, which represents the net value gain from the dividend transfer, when $\omega$ changes. Consider first the derivative $\frac{\partial \Delta C}{\partial \omega}$. For fixed $F_P$ and $F_S$ it is equal to:

\[22\hat{\pi}\] depends implicitly on $\pi$ itself, as the market value of debt which enters in the thresholds $X_Z^S$ and $X_Z^d$ depends on the credibility of the bail-out. Under the additional assumption that $g(\cdot, \cdot)$ is increasing in the second argument between 0 and $\max \left(X_Z^S - X_Z^2, \frac{F_P^* - X_Z^2}{1 - \tau_P}\right)$, we can give an explicit (i.e. independent of $\pi$) sufficient condition at a given $F_S^*$ level. This condition is $\pi \geq \hat{\pi}$, where $\hat{\pi} \geq \bar{\pi}$ is obtained evaluating the term appearing in square brackets at the denominator of (14) at $F_S^*$ and at $\pi = 0$. 

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\[
\frac{\partial \Delta C(F_P, F_S)}{\partial \omega} = \alpha P \phi \int_{X_s^d}^{x_P^d} \left( (1 - \tau_D)[(1 - \tau_S)y + \tau_S X_s^Z - F_S] \times (X_P^d - \omega(1 - \tau_D))[1 - \tau_Sy + \tau_S X_s^Z - F_S] \right) \times \left( X_P^d - \omega(1 - \tau_D)[(1 - \tau_S)y + \tau_S X_s^Z - F_S] \right) dy \geq 0.
\]

\[
\Delta C \text{ is non-decreasing in } \omega, \text{ as default costs saved in the parent through dividends are higher the higher the dividend transfer from the subsidiary. The change in the tax burden due to IDT is always non-decreasing in } \omega \text{ as well, as – ceteris paribus – higher dividend taxes are paid the higher the ownership share:}
\]

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

This derivative takes zero value when \( \tau_D = 0 \). Let us examine now how the Kuhn-Tucker conditions in (13) are modified when we choose \( \omega \) along with \( F_S \) and \( F_P \). Necessary conditions include the ones in (13), together with:

\[
- \frac{\partial \Delta C(F_P^*, F_S^*, \omega^*)}{\partial \omega} + \frac{\partial \Delta T(F_P^*, F_S^*, \omega^*)}{\partial \omega} = \mu_3 + \mu_4 \quad (viii)
\]

\[
\omega^* - 1 \leq 0 \quad (ix)
\]

\[
\omega^* \geq 0 \quad (x)
\]

\[
\mu_3(\omega^* - 1) = 0 \quad (xi)
\]

\[
\mu_4(\omega^*) = 0 \quad (xii)
\]

\[
\mu_3 \leq 0, \mu_4 \geq 0 \quad (xiii) \quad (17)
\]

Let us consider all possible cases, discussing these conditions. 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 (16).

Let us consider now the case of an interior solution, \( 0 < \omega^* < 1 \), which 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 \( \mu_3 \) and all other conditions can be satisfied at
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 (17). Condition (viii) in (17) when $\omega^* = 0$ is:

\[-\alpha_P \phi (1 - \tau_D) \int_{X_{dS}^*}^{+\infty} [(1 - \tau_S)y + \tau_S X_{dS}^* - F_{dS}^*] X_{dP}^* g(X_{dP}^*, y) dy + \]
\[+ \phi \tau_D \int_{X_{dS}^*}^{+\infty} (x(1 - \tau_S) + \tau_S X_{dS}^* - F_{dS}^*) f(x) dx = \mu_4,\]

where we considered that the upper limit of integration, $\frac{X_{dS}^*}{\omega(1 - \tau_D)(1 - \tau_S)} + X_{dS}^*$, tends to $+\infty$ when $\omega$ goes to 0 and we denoted with $X_{dS}^*$ and $X_{dP}^*$ 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 $F_{dS}^*$ and $F_{dP}^*$, is that $\tau_D$ is higher than a certain level $\bar{\tau}_D$. This quantity depends on $\alpha_P, \rho, \sigma, \tau_S, \tau_H, \phi, \mu$. 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:
\[- \alpha_p \phi \int_{X^d_S}^{x^d_S} (1 - \tau_D)((1 - \tau_S)y + \tau_S X^z_S - F^*_S) \times \]
\[\times (X^d_P - (1 - \tau_D)((1 - \tau_S)y + \tau_S X^z_S - F^*_S)) \times \]
\[\times g(X^d_P - (1 - \tau_D) [(1 - \tau_S)y + \tau_S X^z_S - F^*_S], y) dy + \phi \int_{X^d_S}^{\infty} (x(1 - \tau_S) + \tau_S X^z_S - F^*_S) f(x) dx = \mu_3, \]

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 \( \tau_D, \bar{\tau}_D \), 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 \( X^d_S \), then \( \bar{\tau}_D \leq \bar{\tau}_D \). Finally, when \( F^*_P = 0, \frac{d\Delta C}{d\omega} = 0 \) and conditions (viii)-(xiii) in (17) are satisfied only for \( \omega^* = 0 \). This concludes our proof of part ii) of the theorem.

**Proof of Theorem 5**

Let us introduce first a simple lemma:

**Lemma 9** *The objective function of a minimum of the sum of the tax burden and default costs is non-decreasing in \( \tau_D \).*

This lemma is verified by computing the derivative of the objective function with respect to \( \tau_D \), which is:

\[- \frac{\partial \Delta C}{\partial \tau_D} + \frac{\partial \Delta T}{\partial \tau_D} = \]
\[= \alpha_p \phi \int_{X^d_S}^{x^d_S} (1 - \tau_S)y + \tau_S X^z_S - F^*_S \times \]
\[\times (X^d_P - \omega(1 - \tau_D) [(1 - \tau_S)y + \tau_S X^z_S - F^*_S]) \times \]
\[\times g(X^d_P - \omega(1 - \tau_D) [(1 - \tau_S)y + \tau_S X^z_S - F^*_S], y) dy + \phi \omega \int_{X^d_S}^{+\infty} [1 - \tau_S]x + \tau_S X^z_S - F^*_S] f(x) dx \geq 0. \]

This quantity is greater than zero as soon as \( \omega > 0 \) and it is null when \( \omega = 0 \). In Theorem 3 we proved that optimal PS structures are characterized by \( \pi = 1 \) and we know from Luciano and Nicodano (2014) that, in that case, \( F^*_P = 0 \). Being the parent
unlevered, \( \omega \) is indefinite (see part i) of Theorem 2. Combining these results, it follows that the entrepreneur who can freely select ownership or payout sets \( \omega^* = 0 \) as soon as \( \tau_D > 0 \), with no influence on optimal value in the optimal arrangement. Indeed, both \( \Delta C \) and \( \Delta T \) are 0 for every \( (F_P, F_S) \) couple. The presence or absence of IDT is then irrelevant at the optimum for value. Optimal debt is unchanged and default costs and welfare are unchanged as well.

**Proof of Theorem 6**

We prove part a) 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 (13) and modify them appropriately:

\[
(iv)' : \frac{\partial T_2(F_S^*)}{\partial F_S} + \frac{\partial C_2(F_S^*)}{\partial F_S} - \frac{\partial T_1(F_P, F_S^*)}{\partial F_S} - \frac{\partial \Delta C(F_P, F_S^*)}{\partial F_S} + \frac{\partial \Delta T(F_S^*)}{\partial F_S} = \mu_2 - \mu_3, \\
(vii)' : \mu_1 \geq 0, \mu_2 \geq 0, \mu_3 \geq 0 \\
(viii) : \mu_3(F_S^* - K) = 0
\]

Let us consider the case in which the newly introduced constraint 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), since discussion of other conditions is similar to the one in the proof of Theorem 2. Condition (i), when \( F_P = 0 \) and \( F_S^* = K \), becomes:

\[
- \tau_P (1 - G(0)) \frac{\partial X_P^Z}{\partial F_P} \bigg|_{F_P = 0} + \pi \alpha S \phi \frac{\partial X_P^d}{\partial F_P} \bigg|_{F_P = 0} \left[ \int_0^{X_S^Z(K)} x g(x, \frac{K}{1-\tau} - \frac{x}{1-\tau}) dx + \int_{X_S^Z(K)}^{X_S^Z(0)} x g(x, X_S^Z(K) - x) dx \right] = \mu_1
\]

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:

\[
\pi \alpha S \phi \frac{\partial X_P^d}{\partial F_P} \bigg|_{F_P = 0} \left( \frac{\partial X_S^d}{\partial F_S} X_S^d f(X_S^d, 0) \right) > 0.
\]
It follows that the condition can be satisfied only for sufficiently high $K$: for each value of $\pi$, no solutions with an unlevered parent exist unless $K$ is high enough. We define as $K^*(\pi, \alpha_S)$ the cap above which the parent is optimally unlevered. It solves the following equation:

$$
\pi \alpha_S \phi \frac{\partial X_F^P}{\partial F_P}|_{F_P=0} \left[ \int_{X_{S}^*(K^*)}^{X_{S}^*(K^*)} x g(x, \frac{K^*}{1-\tau} - \frac{x}{1-\tau}) dx + \int_{X_{S}^*(K^*)}^{X_{S}^*(K^*)} x g(x, X_{S}^d(K^*) - x) dx \right] = \mu_1 + \tau_P (1 - G(0)) \frac{\partial X_{P}^Z}{\partial F_P}|_{F_P=0}.
$$

Considerations similar to the unconstrained case apply to condition (iv)', which is met at $F_S^* = K$ by an appropriate choice of $\mu_3$. Notice also that the higher $\pi$ and $\alpha_S$, the lower the required cap level $K$ that allows for the presence of an optimally unlevered parent company.

As for part b), it follows from Theorem 4 that if $\tau_D$ is high enough, optimal ownership structure, which implies $\omega^* = 1$ when $\tau_D = 0$, modifies. Even when $\omega^*$ 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 know from Lemma 9 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 (6).

When $\tau_D > \bar{\tau}_D$, we know from Theorem 4 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 $\omega^*$ and $F_S^*$ are fixed, $\frac{\partial \Delta C}{\partial F_P} \leq 0$ (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 7

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 $\nu_{PS}(F_{SA}, F_{P}^*) \geq 2\nu_{SA}(F_{SA})$. 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:

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

(19)

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

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

(20)

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 (19) is verified.

Proof of Proposition 8

Value gains due to tax synergies can be represented through a function

$$S = t(\tau, \rho, \mu_1, \mu_2, \sigma_1, \sigma_2)1_{\{\omega^* > \bar{\omega}\}}.$$

t(\ldots) does not depend on $\omega$ itself. The modified objective function we seek to minimize has a point of discontinuity at $\omega = \bar{\omega}$. Indeed, the only change related to the presence of
the tax synergy occurs when \( \omega \) exceeds \( \bar{\omega} \).

When \( \omega^* \geq \bar{\omega} \) without the tax synergy, nothing changes in terms of optimal ownership. This consideration, combined with part iii) of Theorem 4 proves part ii) of the Proposition. Tax synergies may influence capital structure choice, impacting on overall value, default costs and welfare.

Let us consider the case in which, without the tax synergy, \( \omega^* < \bar{\omega} \). This includes the case of \( \omega^* = 0 \) characterized in Theorem 4. When the tax synergy is introduced, it is necessary to check whether \( \nu_{PS}(\bar{\omega}) > \nu_{PS}(\omega = \omega^*) \). If that is the case, the optimal level of \( \omega \), which we call \( \omega^*_{TS} \) is \( \omega^*_{TS} = \bar{\omega} \), otherwise \( \omega^*_{TS} = \omega^* \). This finding, combined with the previous condition on \( \tau_D \) for \( \omega^* = 0 \), establishes part i) and concludes our proof.

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

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The derivative (in distributional sense) of \( S \) with respect to \( \omega \) is the product of \( f \) times the Dirac delta function \( \delta(\omega^* - \bar{\omega}) \).

---
subsidiaries or to fully acquire them: by the end of the Thirties US firms were almost entirely stand-alone companies. According to La Porta et al. (1999), still nowadays U.S. non-financial firms are organized mainly as stand-alone units, even if indirect ownership remains widespread among family firms (Amit and Villalonga (2009)), while in several developing and European countries business groups are prevalent. Morck (2005) and Morck and Yeung (2005) point out that, among all the measures adopted by the Congress, IDT was the crucial one in dismantling business groups. Today, the tax rate on intercorporate dividends is equal at least to 7% if intercorporate ownership is lower than 80%. For the sake of simplicity, in the paper we do not model the dependence of the tax rate on ownership.