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AN ECONOMIC ASSESSMENT OF THE EVOLUTION OF THE CORPORATE TAX SYSTEM IN ITALY

by Ernesto Zangari*

Abstract

This paper provides an assessment of the evolution of the Italian corporate tax system over the last decade through the computations of new and updated effective tax rates. The analysis takes into account the specificities of Italy's Allowance for Corporate Equity (ACE) and looks at the evolution of market interest rates to evaluate the effects. It relies on a new method to measure the effect of the limits to the deductibility of the cost of debt. Over the period 2010-2020, the legislative changes led to effective taxation becoming highly volatile. This dynamic was mostly driven by the evolution of the ACE regime. Since 2016, the temporary tax incentives for purchasing machinery greatly reduced the cost of capital. However, since 2019 the provision that phased out the incentives at higher-levels of investment may have lowered their effectiveness for larger firms. The analysis also shows that ACE has better economic properties than the Mini-Ires regime that replaced it temporarily in 2019, in terms of incentive to invest and to increase equity funding.

JEL Classification: H25, H32, H71.
Keywords: taxation, effective tax rates, corporate taxation, EMTR, allowance for corporate equity.
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Contents

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1. Introduction*

Over the last decade, the Italian corporate tax system has been characterized by a certain volatility. While the corporate tax rate changed only once in 2017 (from 27.5% to 24%), there were many modifications of the tax base, not always in the same direction; some of them were even very short-lived, being in force just for a few months[1].

Among the most important developments there are surely those regarding the tax treatment of equity funding. In 2011, Italy became one of the few countries in the world to have an ACE (Allowance for Corporate Equity) regime granting a notional interest deduction to equity. Since then, the ACE regime has undergone several changes. The notional interest rate was first increased from 2014 and then decreased from 2017. At the beginning of 2019, a regime called "Mini-Ires", assigning an allowance only to retained earnings, substituted the ACE. However, the change had no effects: at the end of 2019, the ACE was reinstated from tax year 2019. Since 2016, other relevant modifications of the system are those that granted temporary allowances to new investments in machinery and technological innovation.

From 2011, the evolution of the ACE regime was by far the most important driving factor of the tax base and it clearly shows up in the available measures of effective taxation. Figure 1 presents the effective marginal tax rates (EMTR) in the period 2010-2019 - computed by the Centre for European Economic Research (ZEW) for the European Commission - for the main European countries and the UK, as well as the EU-27 average (ZEW-PWC, 2020). The figure shows that the ACE regime made the Italian corporate tax system more competitive and that the developments of the notional rate had an important impact on effective taxation. The figure also shows that Italy is clearly the country with the largest volatility of the tax component of the cost of capital.

The evolution of the corporate tax system may have well affected firms' choices. Since 2016, after the prolonged contraction of capital accumulation due to the financial crisis, the expansion of the capital stock may have benefited from the tax incentives to machinery and innovation[2]. As regards the tax treatment of the funding sources, since 2011 after the introduction of ACE, Italian firms actually rebalanced their financial structures: in 2018, the ratio of debt over total assets was 9 percentage points below the peak in 2011[3]. The empirical literature supports the possible role of corporate taxation in shaping firms' choices over the recent period. Indeed, cross-country evidence confirms the relevance of corporate taxes for investment (Bond and Xing, 2015; Steinmüller et al. 2019) and financial structures (de Mooij, 2011; De Socio and Nigro, 2012)[4]. Specific evidence is also

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[1] For a description of the evolution of the Italian corporate tax system until 2017, see Gastaldi et al. (2018). For an analysis of the changes after the 2019 Budget Law and the "Decreto Crescita" (DL 34/2019), see UPB (2019a). For an analysis of the recent developments of the international corporate tax system, see Ceriani and Ricotti (2019).

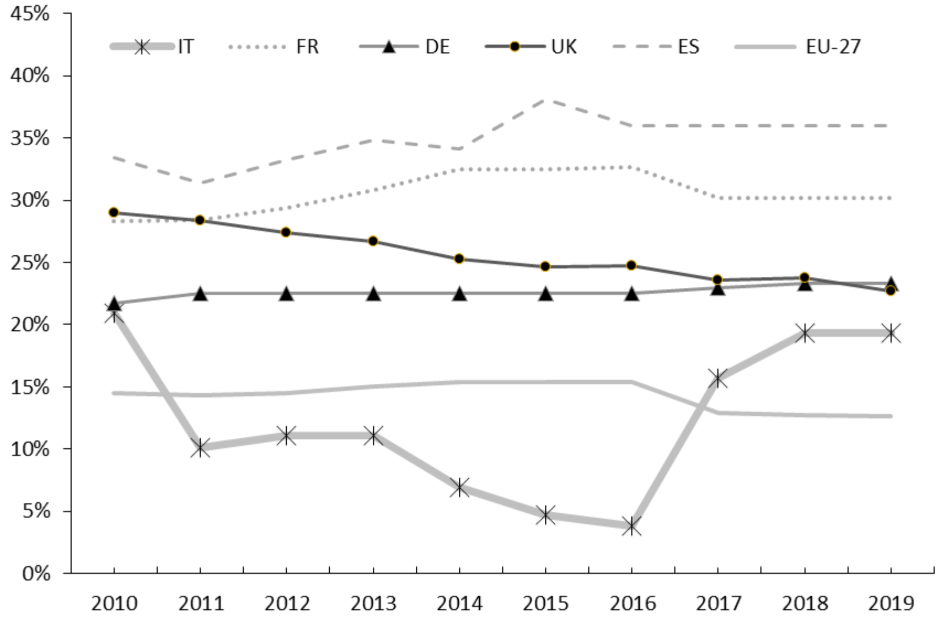
[2] See Banca d'Italia, Annual Report 2016 (p. 65) and Annual Report 2018 (p. 73).

[3] See Banca d'Italia, Annual Report 2018 (p. 91 and Fig. 7.4) and Annual Report 2019 (p. 92 and Fig. 7.4).

[4] For empirical evidence on the effectiveness of corporate tax incentives on stimulating private investments in the US, see Edgerton (2010), Zwick and Mahon (2017) and Ohrn (2018, 2019); for the UK, Maffini et al (2019). As regards ACE regimes, Hebous and Ruf (2017) analyze empirically their effects on financing and investment choices by multinationals, and Hebous and Klemm (2018) provide a review of the empirical evidence on its effects on financial structures (where many studies rather consistently point to the effectiveness of ACE) and investment (where the

available on the effects of the Italian ACE on the rebalancing of funding sources[5]. For the period 2008-2013, Branzoli and Caiumi (2020) find that the ACE deduction introduced in 2011 decreased the leverage ratio of Italian firms on average by 9 percentage points[6]. Based on the empirical evidence on the negative effects of high indebtedness on investment, the likely reduction of debt holdings induced by ACE may have also driven to positive indirect effects on investment[7].

Figure 1. Effective marginal tax rate in the main European countries and the UK, 2010-2019



Source: ZEW-PWC (2020).

Notes: the effective marginal tax rate is an average across sources of finance (retained earnings: 55%, new equity: 10% and debt: 35%) and five equally-weighted assets (financial asset, inventory, industrial buildings, machinery and intangibles).

This paper provides an economic assessment of the most relevant developments of the Italian corporate tax system since 2010, building on the literature on the measurement of effective tax rates for non-financial firms. In summary, the results show a volatility of effective taxation over the period 2010-2020 much larger than what emerges from figure 1. The strong decline of the effective marginal tax rate until 2016 was basically reversed in the following years. The same pattern is found for the debt bias indicator. These dynamics were mostly driven by the evolution of the ACE regime. From 2016, the investment incentives were also positively affected by the temporary tax allowances to

studies are scant and the results more dubious). For empirical evidence of the possible negative effects of corporate tax uncertainty on investment, also related to too frequent and erratic changes of the tax rules, see Devereux (2016).

5 For some recent empirical evidence of the effects of Italian corporate taxation on investment, see Federici and Parisi (2015), and Bonucchi et al. (2015).

6 See also Panteghini et al. (2012).

7 Based on the empirical results in Giordano et al (2018), in the period 1995-2016 the high indebtedness of Italian non-financial firms hindered the investment dynamic in the short-run. The positive indirect effects of ACE on investment could be particularly valuable during strong downturns when the relationship between leverage and investment seems to be stronger (as in De Socio and Sette (2018) who analyse Italian firms' investment during the global financial crisis and the sovereign debt crisis). As regards the effects on the Italian ACE on investment, Zeli (2018) estimated a model for the period 2007-2013 and found only a small effect by comparing firms that benefited of the allowance from those that did not.

machinery. Since 2019, these allowances may have become less favorable for larger firms, given the limit to the amount of the investment that could benefit of them.

The paper is structured as follows. Section 2 provides a brief review of the relevant literature and it discusses the motivations of the paper and its contributions to the literature. Section 3 describes more in details the evolution of the Italian corporate tax system since 2011. Section 4 presents the basic features of the model used to compute the cost of capital and the effective tax rates. Section 5 discusses how the main characteristics of the Italian system are incorporated into the formal set-up, with sub-sections on debt funding, ACE systems, tax incentives to investment and the Mini-Ires regime. Section 6 presents the results for cost of capital, EMTR and tax treatment of debt vs. equity. Section 7 concludes.

2. A brief review of the literature and the contributions of the paper

Assessing the tax burden on firms allows comparisons over time and across countries and it is a necessary step to estimate the magnitude of the effects of taxation on investment and financial choices. In the literature, the measurement of the tax burden relies on two sets of indicators, depending on the aim of the analysis[8].

Backward-looking indicators are built on tax return and/or balance sheet micro data, or on aggregate macro data. These indicators have the important advantage of taking into account the impact of all tax provisions, but they also have some drawbacks. Firstly, backward-looking indicators measure at best an average tax rate, whereas in some cases the tax burden “at the margin” is more relevant. Secondly, these indicators generally reflect the history of firm’s profits and losses and are affected by the investment policy - since higher investments tend to decrease the tax burden via larger depreciation - as well as by the possible tax planning. Moreover, when computed at an aggregate level, they may vary with the economic cycle, even in the presence of stable tax rules. For the above reasons, backward-looking indicators are not well suited for empirical analysis, since they are endogenous with respect to firm choices.

Forward-looking indicators consider a hypothetical investment focusing only on the main elements of the tax code, namely statutory tax rates and main tax allowances. By construction, they are exogenous with respect to business choices and allow measuring also the effective taxation at the margin that is relevant for the level of investment and the financial structure. Moreover, these indicators enable a model-based breakdown of the tax wedge into its different components that allows appreciating their relative importance[9].

Building on early theoretical contributions[10], King and Fullerton (1984) developed the framework for computing forward-looking effective corporate tax rates[11]. Devereux and Griffith (1999, 2003) extended this formal set-up introducing the distinction between the effective marginal tax rate

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8 See the discussion in Devereux (2003) and Sørensen (2004).

9 Effective tax rates can also be computed using microsimulation models of the corporate tax. These very detailed measures are particularly useful for comparisons across types of firms for distributional purposes. Moreover, they allow estimating the revenue impact of tax measures. They have actually features of both backward- and forward-looking indicators. As the former, they rely on tax return and balance sheet data, but – as argued above – they are not exogenous with respect to firms’ choices. As the latter, they allow investigating counterfactual scenarios. Compared with model-based measures, they require much more data and maintenance. For Italy, microsimulation models of the corporate tax are used by UPB (Gastaldi, 2019; UPB, 2019a; UPB, 2019b) and ISTAT (Caiumi and Di Biagio, 2016; ISTAT, 2018).

10 See Jorgenson (1963), Jorgenson and Hall (1967) and King (1974).

11 Alworth (1988), Keen (1991) and OECD (1991) extended the framework to international investments.

(EMTR) and the effective average tax rate (EATR). The first indicator measures the effects of taxation on the minimum pre-tax rate of return required by the investors to undertake an investment and therefore on the incentive to expand the capital stock; instead, the EATR measures the tax incentive to choose between different investment projects earning more than the cost of capital (typically, the EATR is used to analyse the incentive to invest in different countries)[12]. Nowadays, the Devereux-Griffith's approach (henceforth, DG) is the most commonly used in a variety of contexts. The European Commission and the OECD regularly release measures of effective taxation using this framework[13]. In Italy, ISTAT provides figures using the DG model in the analyses of the developments of corporate taxation[14].

This paper builds upon the theoretical and empirical literature on the measurement of forward-looking effective corporate tax rates and it delivers more tailored and updated measures of the tax wedge and effective taxation for the Italian corporate tax system. The main goal is to provide a more precise assessment of the tax incentives for two important firm's choices, namely the expansion of the domestic capital stock and the financial structure. The empirical analysis starts from 2010 that is the year preceding the structural change represented by the introduction of the ACE regime.

The analysis considers the overall evolution of the corporate tax system with specific in-depth focuses on the tax provisions on debt, equity and investment incentives. The scope is therefore broader than in ISTAT (2018). Compared with available measures of effective taxation for Italy until 2019 (ZEW-PWC, 2020 - see figure 1 above), the new computations are more precise since they take into account the specificities of the Italian limits to the deductibility of interests and of the Italian ACE, as well as the investment incentives since 2016[15].

From a methodological point of view, the analysis relies on a multi-period model set up in continuous time. Compared with the DG approach used in ZEW-PWC (2020), ISTAT (2018) and at the OECD level (Hannapi, 2018) – that considers a one-period change of the capital stock, in discrete time – a multi-period framework more naturally conforms to some of the analyzed provisions, such as the new tax credit introduced in 2020 for investments in machinery where the tax effects extend over a certain number of periods[16]. The standard multi-period model is then adapted to take into account the characteristics of the Italian tax system.

In terms of modelling, the main contributions of the paper are the following.

First, compared with the current applications of the DG model, the approach used in this work allows a better assessment of the effects of the ACE regime along two dimensions. It explicitly analyzes the differences between the textbook ACE and the Italian ACE, pointing out the possible relevance for

[12] Egger et al. (2009) extend the Devereux-Griffith's framework to compute forward-looking firm-specific effective tax rates by incorporating information on investment structure and financing opportunities at the firm level (see also Egger and Loretz, 2010). Federici and Parisi (2015) rely on this set-up to estimate the effects of the Italian corporate tax on investment. See Steinmüller et al. (2019) for a more recent empirical application that exploits both firm- and industry-specific data in a panel of countries.

[13] See ZEW-PWC (2020) and Hannapi (2018).

[14] See ISTAT (2018) and Caiumi et al (2015).

[15] For ACE, ZEW-PWC (2020) considers two scenarios. Under the base scenario, the reference rate is the nominal discount factor, common to all countries. Under the alternative scenario, the reference rate is set equal to the ACE notional rate. The super-depreciation regime, as well as the patent box, the tax credit for R&D and the hyper-depreciation, are taken into account in the computations of the cost of capital in PWC-ZEW (2018) and Olbert et al. (2019) for the analysis of the digital business models at the international level for the period 2017-2018.

[16] A multi-period framework is also preferable to model other changes of the Italian tax system that were introduced and not implemented, such as the modification of the ACE base in 2017, where the tax effects would have depended on the changes of equity funding over a certain number of periods.

real-world ACE systems of the distinction between accounting and tax-based definitions of equity. Moreover, in order to assess the neutrality properties of ACE, the model explicitly considers the relationship between the notional rate and the market interest rates, following the indications of the Mirlees Review (Griffith et al., 2010), relying as reference rate on an actual time-varying long-term interest rate on the corporate debt of Italian firms. Instead, in the available measures of effective tax rates for Italy (by ISTAT, OECD and ZEW), either the notional ACE rate is implicitly compared with a fixed nominal interest rate, or it is set equal to this latter rate, assuming by construction no bias in favor of debt.

Second, the paper proposes a new method to analyze the effects on the cost of capital of the earning stripping rules that limits the deductibility of interest costs that are present in many countries. The existing empirical literature simply assumes that the interest limitation rules are either binding or not binding (ZEW, 2016; ISTAT, 2018) and, when binding, it assumes a fixed correction of the value of interests deduction (ZEW, 2016; Hannapi 2018). Instead, I derive an expression for the correction factor that depends on the overall level of interest deductibility at the company level, as well as on the discount factor. This expression can be calibrated using tax returns data. The method allows measuring more precisely the effects of the interest limitation rules on the cost of capital and the tax treatment of the debt versus equity, as well as to differentiate between firms.

Third, the work provides a formal analysis of some regimes granting tax benefits to equity funding different from the ACE, such as the "Mini-Ires" introduced in 2019. In particular, taking as a reference the first best textbook ACE, the results highlight the role played in these alternative regimes by asset depreciation rate and discount factor.

3. The evolution of the corporate tax system since 2011

Since 2011, the Italian corporate tax system has gone through several changes[17]. As noted in the introduction, while the tax rate was modified only once in 2017, from 27.5% to 24%, there were many variations of the tax base.

In 2011, Italy introduced a structural modification of the corporate tax system adopting the so called "Aiuto alla Crescita Economica" (henceforth, ACE). This regime shares the acronym and the main features with one of the traditional blueprints for corporate tax reform, namely the Allowance for Corporate Equity[18]. Under the Italian ACE, companies can indeed deduct a notional return to equity from the corporate income tax base. The allowance supplements the standard deduction of interest costs and it promotes the neutrality of the corporate tax system with respect to investment and financial choices, addressing the debt bias due to the deductibility of interest costs only[19]. In order to limit the revenue impact in the short-run, the ACE was implemented in an incremental manner, granting the deduction only to the new equity accumulated from 2011.

Until 2016, the ACE was strengthened, thanks to a gradual increase of the notional ACE rate from 3% in the period 2011-2013 to 4.75% in 2016. As from 2017, the regime entered a phase of instability:

[17] See Annex 1 for a detailed chronology of the main corporate tax measures since 2011.

[18] In Europe, ACE-like systems are present in Belgium, Cyprus, Malta, Portugal and Poland. Apart from the DIT (Dual Income Tax) in Italy in the period 1997-2003 (that was actually a partial ACE-type system taxing favorably the notional return to equity), in the past ACE regimes were also adopted in Austria (2000-2004), Croatia (1994-2000) and Latvia (2009-2014). Outside Europe, these schemes are currently present in Brazil (since 1996), Liechtenstein (since 2011) and Turkey (since 2015). For a detailed comparison between the Italian system and the Belgian system, see Zangari (2014). For a description of the ACE systems in Europe, see Kock and Gérard (2017).

[19] See the Mirlees Review (Griffith et al. 2010), de Mooij and Devereux (2011) and IMF (2016).

a new restriction on the base for the computation of the deduction was introduced in order to rule it out for purely financial investments; the notional rate was substantially reduced (from 4.75% to 1.6% in 2017 and 1.5% in 2018) and formally decoupled from the market interest rates and the risk premium, by getting rid of these elements from the law provisions; in April 2017, a regulation contained in a law decree changed the definition of the ACE base, limiting the tax relevant increase of equity to the last five years, but the conversion law in June repealed that provision. Interestingly, the proposed change was similar to the Allowance for Growth and Investment (AGI) of the re-launched Common Consolidated Corporate Tax Base (CCCTB) tabled by the European Commission in October 2016[20]. In December 2018, the 2019 Budget Law abrogated the ACE and introduced a new regime called "Mini-Ires", featuring a lower taxation on the part of the tax base corresponding to the previous year's undistributed profits. After just a few months, in April 2019, the Mini-Ires regime was changed because it was considered too complex[21]. Finally, the 2020 Budget Law repealed the new regime and retroactively reintroduced the ACE from 2019 reducing the notional rate to 1.3%.

During the period 2011-2020, other provisions were implemented with potentially important effects on the cost of capital. The 2016 Stability Law introduced a new temporary depreciation regime, called "super-ammortamento" (henceforth "super-depreciation"), which provided for an increase of the tax value for the depreciation of specific assets (basically, machinery). This provision can be interpreted as a temporary comeback to a pre-2008 situation when other tax provisions to increase the present value of tax depreciation were in force ("Anticipated" depreciation and "Accelerated" depreciation)[22]. This temporary tax incentive was extended yearly to new investments, until 2018. The 2019 Budget Law instead did not extend it. But, just after a few months, in April 2019, the super-depreciation was reintroduced for 2019, even if only for investments up to a certain amount and undertaken from April till the end of the year[23]. The 2020 Budget Law furtherly prolonged the incentive to 2020 and it changed its structure into a tax credit.

Since 2019, the corporate tax regime for real estate taxation was also modified by increasing progressively over time - from 20% (set in 2014) to 100% in 2023 - the deductibility of the real estate tax against the corporate income tax base.

The analysis in this paper focuses on the main changes of the corporate tax system, in particular the evolution, the sunset and the resurgence of the ACE regime, the super-depreciation since 2016 and the new tax credit introduced in 2020, as well the new provisions for real estate taxation. The final version of the Mini-Ires regime will also be analyzed since it was legally in force for the whole 2019, arguably shaping the tax incentives for investment and financial choices. Annexes 2 and 3 provide additional results on the systems that were not implemented, namely the AGI-type regime mentioned above and the first version of the Mini-Ires.

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[20] In the Commission's proposal the equity increase relevant for the deduction is limited to the last ten years (see European Commission, 2016). A provision similar to that proposed in Italy was introduced in Belgium as from 2018.

[21] See, among others, Nastri et al. (2019).

[22] For an analysis of the 2008 tax reform, see Zangari (2009).

[23] Since 2017, incentives similar to the ones for machinery were granted to companies investing in the technological and digital transformation, in accordance with the Industry 4.0 model. Other important tax incentives to technological innovation introduced in the analyzed period were the patent box regime (2015), providing a tax relief for intellectual property income, and new R&D tax regimes (2015 and 2020). In this paper, given the focus on the economic aspects of the general design of the corporate tax system, the tax incentives of the Industry 4.0 model and to technological innovation are not considered.

4. The model

The economic analysis of the corporate tax system is undertaken with a multi-period model of investment set up in terms of instantaneous rates that abstracts from risk, financing constraints and adjustment costs[24]. The model only focuses on corporate taxation without considering the personal layer of taxation. As in the DG approach, I assume that the marginal source of finance is retained earnings in all the periods other than the initial period. Since the model is standard, its general structure is described very briefly[25].

Consider a firm that invests 1 Euro in an asset at time 0 by retaining earnings. Assume that this asset depreciates exponentially at the rate δ and that nominal profits increase at the rate of inflation, π. At time u, the firm will receive a total return (including the depreciation of the period) equal to $(p+\delta)e^{-(\rho+\delta-\pi)u}$, where ρ represents the shareholder's discount rate.

As regards taxation, assume a tax-exhaustion scenario, i.e. in every period the firm generates enough income to fully and immediately benefit from any tax deduction. The present value of corporate taxes collected over the lifetime of the investment (NPVT) can be expressed as the present value of taxes paid on the gross returns (p + δ) minus the present value of the future reductions in taxes due to the depreciation rules, A:

$$NPVT = \int_0^{\infty} \tau(p+\delta)e^{-(\rho+\delta-\pi)u}du - A = \frac{\tau(p+\delta)}{\rho+\delta-\pi} - A \qquad [1]$$

where τ measures the statutory tax rate on profits. For the Italian system, the statutory tax rate is the sum of the CIT rate and the IRAP rate ($\tau = \tau_{cit} + \tau_{irap}$).

Considering tax depreciation at the historical cost at the exponential rate θ, the present value of the future reductions in taxes due to the depreciation rules is the following:

$$A = \int_0^{\infty} \tau \cdot \theta \cdot e^{-(\theta+\rho)u}du = \frac{\tau\theta}{\theta+\rho} \qquad [2]$$

In order to calculate the cost of capital, it is necessary to characterize the marginal investment. Define the present value of the gross-of-tax returns generated by the investment, PVG, as follows:

$$PVG = \int_0^{\infty} (p+\delta)e^{-(\rho+\delta-\pi)u}du = \frac{p+\delta}{\rho+\delta-\pi} \qquad [3]$$

The marginal investment is defined as that investment for which the economic rent is zero:

$$PVG - NPVT - 1 = 0 \qquad [4]$$

Replacing [1] and [3] in [4] gives the user cost of capital[26], $\hat{p}$:

$$\hat{p} = \frac{(1-A)(\rho+\delta-\pi)}{(1-\tau)} - \delta \qquad [5]$$

The term (1-A) measures the net-of-tax cost of a unit investment and the term (1-A)/(1-τ) is the tax component of the user cost of capital. From the cost of capital, it is possible to compute the Effective Marginal Tax Rate (EMTR) as follows:

$$EMTR = \frac{\hat{p}-r}{\hat{p}} \qquad [6]$$

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24 These are the same simplifying assumptions of the DG approach. See Keuschnigg and Ribi (2013) for an analysis of the role of financing constraint for the effects of taxation on investment. See Edgerton (2010) for a discussion of alternative models of investment featuring a cash flow role for the effects of taxation, including models with adjustment costs, financing frictions and uncertainty.

25 The formulation in continuous time can be found, among others, in King and Fullerton (1984) and Sørensen (2004).

26 Notice that equation [5] is equal to equation [3.13] in Devereux and Griffith (1999).

where r is the real interest rate ($r = \rho - \pi$)[27]. On the basis of equation [5], the taxation system will be neutral with respect to investment choices if the present value of tax savings deriving from the rules defining the tax base, A, is equal to the statutory tax rate, τ. Indeed, in this case the cost of capital is exactly equal to the real interest rate; from equation [6] this corresponds to an effective marginal tax rate equal to zero (EMTR = 0). When A is greater than τ, the system stimulates investments (EMTR<0); finally, when A is less than τ, at the margin the system disincentives investments (EMTR>0).

In what follows, A will be defined more broadly to also incorporate the effects of the tax rules on the cost of finance[28]. This allows representing the different possible taxation systems. Let us start with debt funding in the general model.

Debt funding. The evaluation of the cash flows for a debt-funded investment has to consider the additional tax savings due to the deductibility of interests. Given a 1 Euro of debt retired at the declining balance rate of δ, the overall tax savings due to the rules defining the tax base, A^{debt} , become:

$$A^{debt} = \int_0^\infty \tau \cdot \theta \cdot e^{-(\theta+\rho)u} du + \int_0^\infty i \cdot \tau \cdot e^{-(\delta+\rho)u} du = \frac{\tau\theta}{\theta+\rho} + \frac{\tau \cdot i}{\delta+\rho} \qquad [7]$$

where i is the market nominal interest rate[29].

Notice that the first term of equation [7] is equal to the only term of [2]. With respect to [2], in [7] - apart from the interest rate - there is the economic depreciation rate δ. This implies that in the assessment of tax savings deriving from the rules defining the tax base one has to take into account the difference between economic and fiscal amortization. Based on this investment model, in a traditional corporate tax system (featuring for funding sources only the deductibility of interest costs), only when the investment is debt-funded and the two depreciation rates coincide ($\theta = \delta$)[30], $A^{debt} = \tau$, p^ = ρ and EMTR = 0, i.e. the taxation system is neutral on investment choices.

5. The main features of the Italian corporate tax system in the model

This section shows how the main specific features of the Italian system and the developments described in section 3 have been incorporated into the formal set up. In particular, the focus is on debt funding, ACE systems, the tax incentives to machinery and the Mini-Ires regime.

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27 In equations [5] and [6] it is possible to recognize some of the tax regressors used in the empirical analyses of the effects of corporate tax and tax incentives. For instance, Bond and Xing (2015) use the tax component of the user cost of capital in their cross-country panel model and estimate long run elasticities of capital–output ratios with respect to this tax variable of around −0.4 in the case of total capital and around −0.7 for equipment. In their sample, this implies that on average a 10% reduction of the tax component of the user cost of capital would bring about in the long-run an increase of the capital-asset ratio by 4% and 7% for total capital and equipment, respectively. Steinmüller et al. (2019) estimate a cross-country panel and use the EMTR, finding that on average a 10% increase of this variable triggers a 3.3% decrease in fixed asset investment. In their analysis of the effect of tax incentives in the UK, Maffini et al. (2019) use the net-of-tax cost of a unit investment and estimate that a 1% decrease of this variable increases the investment rate by 8.3-9.9 percent.

28 A may also incorporate the cash flows effects of other taxes. Annex 4 discusses the real estate tax on companies, as well as some modelling aspects of the investment in inventories and financial assets.

29 This is in line with the Devereux-Griffith approach, where it is assumed that all cash flows from t+1 on (including the tax savings due to depreciation and the deductibility of the interests) give rise to variations of the distributed dividends. Under this assumption, it is correct to discount these cash flows using the shareholder's discount factor ρ (Devereux and Griffith, 1999).

30 The discount rate can be set equal to the interest rate since the model is deterministic and it only considers the taxation at the corporate level.

5.1 Debt funding: IRAP and EBITDA rule

In the Italian system, a first aspect of the tax treatment of interest expenses to consider is the un-deductibility of this cost from the IRAP tax base. This clearly has consequences on the neutrality properties of the corporate tax system since the gross return to investment is taxed under both the CIT and IRAP.

A second important aspect in the analysis of the tax effects of cost of debt is that its deductibility from the corporate income tax base is subject to an earning stripping regime introduced in 2008. Under this regime, interest costs are deductible up to 30% of the gross operating income (earnings before interest, taxes, depreciation and amortization, EBITDA)[31], determined using tax-adjusted values of the Profits and Loss Account. Interest expenses not immediately deducted can be carried forward without time limits. Instead, the excess EBITDA can be carried forward for 5 years[32]. In terms of the model, an earning stripping rule implies that the deductibility of interests may not be full in every period. Therefore, the value of interest deductions will be lower than in the scenario of full and immediate deductibility.

There are several modeling options to deal with earning stripping rules[33]. One may consider two basic extreme scenarios: one where the EBIDTA limit is always binding, which implies that the value of the interest deduction is nil; another where the limit is never binding, which implies instead a full value of interest deductibility[34]. Another possible option is to parametrize the loss of economic value of the deductions through a parameter, $\beta \in [0,1]$, which measures the part of the max present value of the interest deductions – see the second component of equation [7] – to be considered for the evaluation of a debt-funded investment in a regime with an earning stripping rule[35].

While the EBITDA limit appears a relevant phenomenon based on tax returns data[36], the calibration of the β parameter would require detailed company-level tax data for several years. One shortcut to calibrate this parameter is to assume a constant overall interest deductibility over time at the company

31 The EBIDTA limit only applies to interest expenses exceeding the interest income accrued in the same year.

32 Both the reference to the tax EBITDA (instead of the accounting-based one) and the 5-year limit for carrying over the excess EBITDA (previously there was no limit) were introduced as from 2019 with the transposition of the ATAD Directive (Anti Tax Avoidance Directive) into national law. Overall, these changes tend to make the framework for the deductibility of interest costs more restrictive. Other specific rules apply to companies participating to the tax consolidation regime, increasing the possibility to deduct at the group level interest expenses un-deducted at the level of the single entities.

33 For a discussion of the different limits to interest deducibility and the related modelling aspects, see ZEW (2016). See also Hanappi (2018: 16-17).

34 Another option is to model explicitly the EBITDA rule, making assumptions on the optimal debt-asset ratio, as in Caiumi et al. (2015). The authors provide an analysis of the Italian earning stripping rule (including carryovers) within the one-period Devereux-Griffith framework, also considering the interactions with the depreciation allowances and the ACE regime. However, it seems that implicitly they do not attribute any value to the amount of the un-deducted interests carried-forward in the future and this may lead to overestimating the effects of the earning stripping rule on the cost of capital. Indeed, in the equation of the post-tax economic rent (section 3 of the paper, p. 11), the only term measuring the effects of interest deductibility is equal to the product of the statutory tax rate and the min between the interest rate and the percentage α (30%) of the gross operating profit (that in the model is equal to $(p+\delta)$).

35 In Zangari (2009) a similar approach was used for a sensitivity analysis of the effects of the earning stripping rule on the cost of capital following the 2008 tax reform, but the parameter β was not linked to other model's parameters.

36 See https://www1.finanze.gov.it/finanze3/pagina_dichiarazioni/dichiarazioni.php.

level, ω ϵ [0,1][37]. Under this assumption, given the carry-over of un-deducted interest costs, the present value of the deductions for debt finance – PV-DEBT^{IT} – can be written as follows[38]:

$$PV - DEBT^{IT} = \underbrace{\left[\omega + \frac{\omega(1-\omega)}{\rho+\omega}\right]}_{\beta} \cdot \tau_{cit}\,\frac{i}{\delta+\rho} \qquad [8]$$

The intuition behind the β parameter in [8] is simple: a part ω of interests is deducted in the period when it accrues; the remaining part (1 - ω) is deducted over time at the rate ω (decaying therefore at the same rate). The postponement of the deductions reduces the present value of interest deductibility; the higher the discount factor ρ, the larger this reduction is. Thus, the economic loss due to the postponement of the deductibility of interests could be differentiated across firms and be larger for firms that attribute more value to immediate cash flows, such as for instance in presence of binding financial constraints[39].

Table 1 shows the value of β under different assumptions on the average deductibility parameter ω and the discount factor. Since the EBITDA rule only postpones the deductibility of interest, its effects are limited and affected strongly by the discount factor. Notice that the correction of the value of interest deductions is much less severe than that assumed in ZEW (2016)[40]. For instance, with a discount factor equal to 7% and an average yearly deductibility equal to 50%, the earning stripping rule would reduce the present value of interest deductions by about 6%.

Table 1. Correction factor of the present value of interest deductions (β)

Average deductibility (ω)	**Discount factor (**ρ**)**		
	4%	7%	10%
0.25	0.90	0.83	0.79
0.50	0.96	0.94	0.92
0.75	0.99	0.98	0.97

The calibration of the ω parameter for the computation of the cost of capital and effective tax rates will be based on the analysis of the data on tax returns.

Given the above discussion, combining equations [2] and [8], the overall present value of depreciation and interest expenses for a debt-funded investment in the Italian corporate system, A^{debt_IT}, can be written as follows:

$$A^{debt\_IT} = \frac{\tau}{\theta+\rho}\left[\theta + i\beta\,\frac{\theta+\rho}{\delta+\rho}\right] - \beta\tau_{irap}\,\frac{i}{\delta+\rho} \qquad [9]$$

37 A constant overall interest deductibility over time clearly masks the likely cyclical variation of the deductibility parameter. This variation implies that the EBITDA rule incorporates a likely pro-cyclical effect on the cost of capital.

38 Equation [8] is derived by taking the sum of the present values of all the interest deductions over the lifetime of the hypothetical investment, assuming in each period a partial fixed deduction (ω) of all the interests that it would be possible to deduct in that period, equal to the sum of the period's accrued interests and all the interests carried forward from the past.

39 See the discussions in Edgerton (2010), Keuschnigg and Ribi (2013) and Zwick and Mahon (2017).

40 In ZEW (2016) effective tax rates are computed with the Devereux-Griffith's single period approach under different assumptions: either interest limitation rules are not binding or they are binding. In the latter case, the value of the deductibility of interests is reduced by 50% (in countries where unlimited carry-forward rules are available, such as Italy and Germany) or 75% (in countries where carry-forward is limited in time, such as Poland and Portugal). ISTAT (2018) also provides measures for Italy assuming either a binding or a not-binding interest rule.

with the $\tau = \tau_{cit} + \tau_{irap}$. As it is well known[41], equation [9] shows that in the Italian system even for a debt-funded investment – under the assumptions of equal tax depreciation and economic depreciation ($\theta = \delta$), and full immediate deductibility of interest costs ($\beta = 1$) – the tax wedge is positive ($A^{debt\_IT} < \tau$) because of the IRAP. Indeed, in this case $A^{debt\_IT} = \tau - \tau_{irap} \frac{i}{\delta+\rho}$.

5.2 ACE regimes

The ACE regime is characterized by the possibility to deduct from the corporate income tax base a notional return to equity. In a textbook ACE regime[42], for a fully financed equity investment the overall present value of the tax savings allowed by the rules defining the tax base can be expressed as follows:

$$A^{ace} = \int_0^\infty \tau \cdot \theta \cdot e^{-(\theta+\rho)u} du + \int_0^\infty i_{ace} \cdot \tau \cdot e^{-(\theta+\rho)u} du = \frac{\tau\theta}{\theta+\rho} + \frac{\tau \cdot i_{ace}}{\theta+\rho} \qquad [10]$$

where i_{ace} is the notional rate of return.

Notice that the tax savings deriving from the deductibility of the notional cost of equity are computed assuming that equity is retired at the tax depreciation rate θ. Indeed, in a textbook ACE regime the base for computing the deduction (the ACE base) is the equity calculated using the tax definitions of assets and liabilities. This point is relevant because, under the ACE regime introduced in 2011 in Italy, the ACE base was implicitly defined as accounting equity rather than as tax equity. Therefore, under the Italian ACE, in terms of the model the decay rate to be used for the computation of the tax savings due to the ACE regime is the economic/accounting depreciation rate δ and the variable A – defined as A^{ace_IT} – can be expressed as follows:

$$A^{ace\_IT} = \frac{\tau\theta}{\theta+\rho} + \frac{\tau_{cit} \cdot i_{ace}}{\delta+\rho} \qquad [11]$$

where $\tau = \tau_{cit} + \tau_{irap}$. Notice also that in the Italian system the deduction of the notional return to equity is only against the corporate income tax base and not also against the IRAP tax base. Clearly, this affects the neutrality properties of the Italian ACE regime because the investment return is taxed under both the CIT and the IRAP[43].

From equation [10], for the textbook ACE if the notional rate is equal to the shareholder's discount rate ($i_{ace} = \rho$) then $A^{ace} = \tau$ and EMTR = 0. Crucially, as it is well known, the difference between tax depreciation and economic depreciation does not affect neutrality for the textbook ACE, differently from the case of debt-funding.

For the Italian ACE, it is possible to re-write equation [11] in order to highlight the different sources of non-neutrality:

$$A^{ace\_IT} = \frac{\tau}{\theta+\rho}\left[\theta + \rho\left(\frac{i_{ace}}{\rho}\right)\frac{\theta+\rho}{\delta+\rho}\right] - \tau_{irap}\frac{1}{\delta+\rho}\left(\frac{i_{ace}}{\rho}\right)\rho \qquad [12]$$

41 See, for instance, Bordignon et al. (2001).

42 See IFS (1991).

43 Under the Italian ACE, the equity relevant for the computation of the allowance was the equity increase from 2010 (so called "incremental" ACE). Although this feature is important in the short-run for the revenue impact of the system, this paper does not consider it since, as a first approximation, in a basic forward-looking framework is not relevant (Annex 2 for the long-run tax revenue effects). Moreover, in the Italian system the notional deduction in excess of taxable income could be carried forward without time limits or - as from 2014 - it could be "transformed" into a tax credit to offset IRAP in five equal yearly instalments. Specific rules applied within the tax consolidation mechanism allow transferring to the parent the excess ACE of the subsidiaries. The model does not consider these specific details of the regime.

From equation [12], even if $i_{ace} = \rho$, the Italian corporate tax system is not neutral since the ACE deduction is only against the CIT tax base; it is also not neutral when tax depreciation and economic depreciation are not equal. The other reason for non-neutrality – common with the textbook ACE – is the possible difference between the ACE notional rate and the shareholder's discount rate. This feature of ACE neutrality properties implies that the effects of the regime may be differentiated across firms and be relatively less favorable for firms facing higher financing costs[44]. In computing the effective tax rates, the difference between the ACE notional rate and the discount rate will be parametrized using a rate on long-term bank loans as the reference for the ACE notional rate. Notice that the structure of equation [12] is similar to that of equation [9] for debt funding, in particular with respect to the last term due to IRAP. Indeed, since both interest and the ACE notional return are not deductible against the IRAP tax base, IRAP increases the cost of capital but does not affect the bias in favor of debt (if $i_{ace} = \rho$ and $\beta = 1$).

5.3 The tax incentives to machinery

One of the distinctive recent features of the Italian corporate tax system is the provision of temporary incentives to investments, extended on a yearly basis. The "super-depreciation" regime (*super-ammortamento*) was in force for the period 2016-2018 and extended to 2019 only since April. The 2020 Budget Law prolonged to 2020 the tax benefits turning them into tax credits.

As described above, under the super-depreciation regime it is possible to deduct from the CIT base an amount higher than the purchase cost of specific assets (basically, machinery); crucially for the economic evaluation, this extra deduction is spread over the lifetime of the investment. In 2019, only investments in machinery up to EUR 2.5 million could benefit of the provision, targeting firms that did less investment and were, supposedly, smaller. In economic terms, it is important to highlight that this regime is different from accelerated depreciation that quickens the schedule for when firms can deduct from taxable income the cost of investment purchases altering the timing of deductions. Indeed, this latter system - which brings about lower taxes today but higher taxes tomorrow - activates deferred taxation accounting. The consequence is that – differently than in the case of accelerated depreciation – the positive cash flows due to super-depreciation can be distributed when they arise since they coincide with accounting income. This implies that, even if the present values of the cash flows of accelerated depreciation and super-depreciation were equal, the economic value of the cash flows from super-depreciation would be higher, given the larger financial flexibility associated with it.

The tax credit introduced by the 2020 Budget Law for investments in 2020 was similar to a cash grant at the rate of 6%, spread over five years. Therefore, its present value is lower than 6% and it depends on the discount factor. Only investments in machinery up to EUR 2 million could benefit of this tax benefit, again targeting smaller firms. Crucially, the tax credit could be used to not only lower the corporate tax bill, but also set off against other tax payments, such as the social security contributions. This implies that the probability to benefit of this tax allowance as it accrues is higher than in the case of super-depreciation, where a positive tax base was instead necessary. In its turn, this implies that in principle in some cases the cash flows related to the tax credit could be *ceteris paribus* valued more than those related to the super-depreciation. This could be particularly true for firms that value future

[44] In order to address the heterogeneity of the discount factor across companies, a possible solution could be setting a higher ACE rate for some specific group of companies. For instance, in the Belgian ACE system the notional rate is higher for medium-small companies.

cash flows using higher discount rates - for instance due to financial frictions or simply to a higher idiosyncratic failure risk[45] - and during downturns, when the same financial frictions tend to get worse, given the reduced cash-flow and pledgeable income, while at the same time the probability of a positive tax base decreases.

In terms of modeling, define ε as the proportion of the cost of the asset entitled to benefit from a generic tax incentive[46]. As regards the super-depreciation regime, define γ as the additional value of the investment that can be deducted. Then, the scheme entails additional tax savings in present value, SA, which can be expressed as follows:

$$SA = \varepsilon \int_0^\infty \tau_{cit}\gamma\theta e^{-(\theta+\rho)u} du = \varepsilon \frac{\tau_{cit}\gamma\theta}{\theta+\rho} \quad [13]$$

With regard to the tax credit, define τ_c as the rate of the tax credit. Since the tax credit is distributed over a given number of years, T, its the present value, TC, can be written as follows:

$$TC = \varepsilon \frac{\tau_C}{T} \int_0^T e^{-\rho u} du = \varepsilon \frac{\tau_C}{\rho T}(1 - e^{-\rho T}) \quad [14]$$

Clearly, the comparison between the super-depreciation and the tax credit depends on several factors and can be only assessed once the model is calibrated. However, a crucial element is the length of the depreciation period for machinery (as measured by the tax depreciation parameter θ): the longer this period (the smaller θ), the more likely the tax credit provides a larger tax benefit.

In the computation of the overall present value of tax savings due to the rules defining the tax base and affecting the final tax bill, *SA* has to be considered in the period 2016-2019 and *TC* for 2020.

5.4 The tax benefits to retained earnings: the Mini-Ires regimes

The 2019 Budget Law introduced a dual taxation of corporate income - called "Mini-Ires" - providing for a lower tax rate (15% vs 24%) on retained earnings up to the sum as from 2019 of the yearly tax depreciations related to new investments in machinery and the additional labour cost. After just a few months, in April 2019, the regime was modified, reshaping the tax benefit for reinvested profits and getting rid of the constraints to the use of retained earnings[47]. Under the new regime, the part of the tax base corresponding to the previous year's retained earnings would have been benefited of a rate cut equal to 1.5% in 2019, 2.5% in 2020, 3.0% in 2021, 3.5% in 2022 and 4% from 2023[48]. In what follows, the focus is on the final version of the Mini-Ires[49].

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45 See Zwick and Mahon (2017) for a discussion of the possible economic factors of such higher discount factors.

46 This follows the formulation in King and Fullerton (1984: pp. 19-20).

47 The M-I regimes share a common feature with the investment reserves and the tax allocation reserves used in many OECD countries - especially in the Nordic countries and especially until the early 1990's - to promote investment or as a countercyclical tool (see, among others, Andersson et al. (1998) and Kari et al. (2019)). Indeed, as for both the types of reserves, under both the M-I regimes the tax benefits are related to retained profits. However, under these regimes the benefits consist in a reduced corporate income tax rate on the part of taxable profits allocated to a capital reserve (and, under the first version, invested in specific assets) and the cash flow tax effects are not reversible. Instead, under the investment and the tax allocation reserves the tax benefits consist generally of the full deduction of the reserve from taxable income, but the cash flow effects are only temporary: the company pays less taxes today, but it will pay more taxes tomorrow when the investment is reduced or the reserve is not used to undertake investment within a certain period of time (investment reserve) or simply after a predetermined period of time (tax allocation reserve).

48 The tax base subject to the lower rate was limited to the net worth increase with respect to 2018.

49 Annex 3 provides an in-depth analysis of the first version of the M-I regime. Among other things, it shows that linking the tax benefit for retaining profits to tax depreciation could have affected the financial choices in a very peculiar way and actually increased the fragility of the financial structures, rather than strengthening them, pushing firms to rely initially more on debt to fund the investment.

Let us start from the dynamic equation of retained earnings and take into account the difference between the accrual- and cash-based definitions of corporate taxes and that only the increases of retained earnings were relevant for the tax benefit. Then, it is possible to show that the present value of the cash flows due to the new regime for a 1 Euro investment funded with retained earnings, MI^{RE}, is simply equal to the discounted value of the tax savings due to the lower taxation of a part of the corporate tax base (see Annex 3 for details):

$$MI^{RE} = \frac{(\tau_{cit} - \tau^{low})}{1+\rho} \qquad [15]$$

where τ^{low} is the tax rate on retained earnings. Notice that MI^{RE} does not depend on the depreciation rate of the funded asset, differently from the present value of the ACE deductions (see equation [11]). As will be shown in section 6.3, this has implications for the neutrality properties of the Mini-Ires regime across assets.

Under the Mini-Ires regime, for the computation of the cost of capital of an investment in machinery funded with retained earnings, MI^{RE} has to be added in for the evaluation of the overall tax savings due to the rules defining the tax base.

6. Results

6.1 Assumptions

For comparability, in the base scenario the economic assumptions for the computation of the cost of capital and the effective tax rates are largely based on ZEW-PWC (2020). The real interest rate is set at 5% and the inflation rate at 2%. As funding sources, retained earnings, new equity and debt are considered. For the summary measures, these finance sources have weights equal to 55%, 10% and 35%, respectively. Given the important role played by debt in the financial structure of Italian companies, a sensitivity analysis is undertaken to explore the effects of a different set of financing weights, with a larger weight given to debt (debt 70%, retained earnings 15%, new equity 15%)[50].

Differently from ZEW, with regard to investments, in the base scenario five equally-weighted generic assets are considered (with economic depreciation rates equal to 0%, 5%, 10%, 20% and 30%), and the economic depreciation rates are set equal to the fiscal depreciation rates. Indeed, since 2008 the possibility of temporary differences between tax and accounting values of the assets is not as important as before. A sensitivity analysis is undertaken considering other two asset structures, including that used in ZEW-PWC (2020)[51]. Moreover, given the relevance of the difference between fiscal and economic depreciation rates – not only for debt-funded investments, but also for the Italian ACE neutrality properties – two alternative scenarios are also explored with tax depreciation rates larger by 10% and 20% than the economic ones.

Since the asset with no depreciation can be interpreted both as inventories and as a financial asset, two different set of computations are undertaken to take into account the different tax treatment. In particular, in the computation of the present discounted value of the profits of the financial asset, only the CIT is considered - since these profits are not taxed under the IRAP - and, as from 2016, the ACE

[50] See JRC (2016: p. 21) for statistics at the European level of the debt/asset ratios for companies in the ORBIS database in 2012. In that year, Italy was the country with the highest ratio (about 68%).

[51] The assets and the related economic depreciation rates used in ZEW-PWC (2020) are the following: inventories (0%), financial assets (0%), buildings (3.1%), intangibles (15.35%) and machinery (17.5%). The other asset structure is taken from JRC (2016) and based on the Orbis dataset: buildings, 19.8%; machinery 25.3%; intangibles 9.9%; inventories 37.2%; land 7.8%. In this case, the depreciation rates are set equal to those in ZEW-PWC (2020) (and 0% for land).

does not apply, given the provisions introduced with the 2017 Budget Law. Moreover, for this asset - following ZEW-PWC (2020) - a correction for inflation is also considered to reflect the taxation of nominal interest rates (see Annex 4 for details)[52]. The summary measures consider the financial asset as the investment with a 0% depreciation rate. As regards the other investments, the asset with a 5% depreciation rate can be interpreted as industrial buildings, while the assets with 10%, 20% and 30% depreciation rates can be interchangeably interpreted as machinery, intangibles or equipment.

Only for the comparison in section 6.2 between the EMTR computed with the model derived in this paper and the EMTR in ZEW-PWC (2020), the computations are based on the same asset structure and the same relationship between tax and economic depreciation for the Italian system used in the ZEW reports.

As for the super-depreciation regime in the period 2016-2019 and the tax credit in 2020, since they basically regard machinery, they are not applied to assets with a tax depreciation rate equal to 5% (that could represent industrial buildings) and 30% (that could represent highly technological intangibles) and, by construction, to assets with no depreciation. Therefore, in the summary measures these regimes only apply to assets with depreciation rates of 10% and 20%[53]. For 2019 and 2020, in the base scenario it is assumed that the two regimes were fully operative ($\varepsilon = 1$), without considering that they were limited to investments up to Euro 2.5 million (super-depreciation) and Euro 2 million (tax credit)[54]. However, some results on the effects of these limits on the cost of capital are briefly discussed in the section 6.2. The assessment of the switch between super-depreciation and tax credit in 2020 has relied on the comparison of the sum of the discounted values of the related tax savings for assets with depreciation rates of 10% and 20%[55].

With regard to Mini-Ires regime, since the ACE was reintroduced only at the end of 2019, consistently with the forward-looking nature of the indicators of effective taxation, I assume that for 2019 the cost of capital and the other measures incorporate the new regime with a rate cut of 1.5% on retained earnings.

Table 2 shows the tax parameters used in the computations for the period 2010-2023. The extension to 2023 is due to the M-I regime that envisioned an increasing rate cut over time. As regards the IRAP: the tax rate is set at 4.2%, based on the available statistics on IRAP tax returns for the period 2010-2017, excluding public sector, financial sector and agriculture (3.9% basic rate + 0.3% of regional tax rate)[56]; the CIT statutory tax rate is adjusted to account for the possibility as of 2008 to deduct 10% of IRAP against the CIT base[57]. For the asset with a 5% depreciation rate (industrial buildings), the real estate tax is also taken into account, collapsing the nominal tax rate, the ratio between the tax value and acquisition cost and deductibility rules of the real estate against the CIT

52 The tax treatment of inventories in periods of inflation may also lead to something akin to a wealth tax. Typically, this happens if FIFO (first in, first out) accounting is used, as in the UK. In case of LIFO accounting or equivalently whenever it is possible to choose between LIFO and FIFO - as in Italy - this problem is not relevant (see King and Fullerton, 1984: p. 21 and ZEW-PWC, 2020, pp. B3-B4).

53 Notice that – based on tax return data for 2017 – the average lifetime of the asset benefiting of the tax incentives to machinery is about 7 years that corresponds to a linear depreciation rate of about 17% (see the accompanying material of the first draft of the 2020 Budget Law released in October 2019).

54 For 2019, the provision limiting the tax benefit to investments undertaken in the period April-December has also not been considered in the computations.

55 For the comparison with the tax credit, for the super-depreciation I have also considered the provision allowing to deduct only half of the tax depreciation rate in the first year of the investment.

56 See https://www1.finanze.gov.it/finanze3/pagina_dichiarazioni/dichiarazioni.php.

57 In particular, the modified CIT statutory rate, τ_{cit}^* , is computed as $\tau_{cit}^* = \tau_{cit} \cdot (1 - 10\% \cdot \tau_{irap})$.

base into an effective tax rate of real estate taxation. Notice that as from 2019 the deductibility of the real estate tax against the CIT base increases over time, reaching 100% in 2023 (see Annex 4 for more details on the calibration of the real estate tax).

Table 2. Tax parameters 2010-2023

	Tax rates (%)		ACE notional rate %	Super-Depreciation % (γ)	Tax Credit % (τ_c)[b]	Mini-Ires Rate cut (%)	Real estate Effective tax rate (%)[c]	Deductibility interests % (β)
	CIT	IRAP[a]						
2010	27.5	4.2	-	-	-	-	0.18	98
2011	27.5	4.2	3.0	-	-	-	0.18	98
2012	27.5	4.2	3.0	-	-	-	0.30	98
2013	27.5	4.2	3.0	-	-	-	0.33	98
2014	27.5	4.2	4.0	-	-	-	0.31	98
2015	27.5	4.2	4.5	-	-	-	0.32	98
2016	27.5	4.2	4.75	40	-	-	0.32	98
2017	24.0	4.2	1.6	40	-	-	0.33	98
2018	24.0	4.2	1.5	30	-	-	0.34	98
2019	24.0	4.2	1.3	30	-	1.5	0.32	98
2020	24.0	4.2	1.3	-	6	2.5	0.31	98
2021	24.0	4.2	1.3	-	-	3.0	0.30	98
2022	24.0	4.2	1.3	-	-	3.5	0.30	98
2023	24.0	4.2	1.3	-	-	4.0	0.27	98

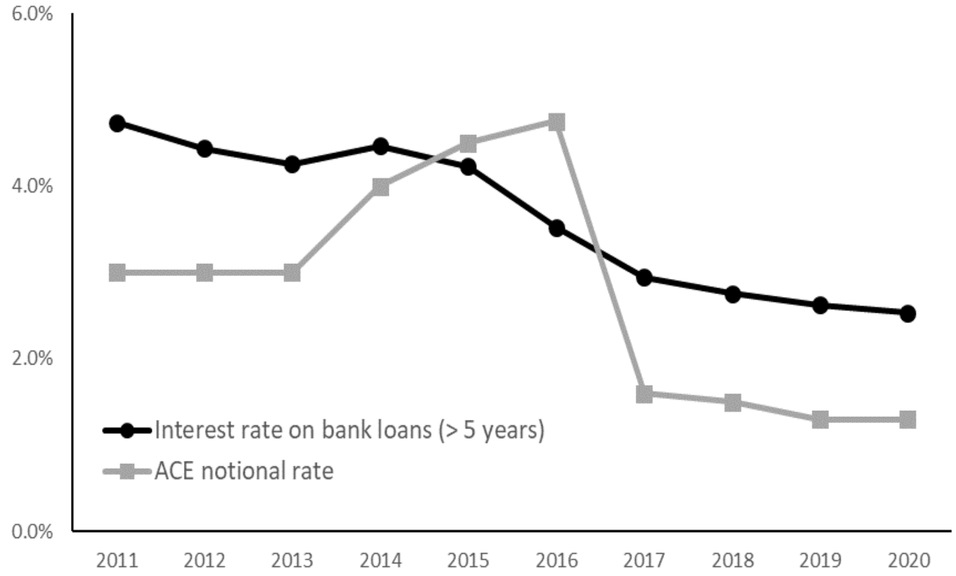
Notes: Grey cells represent assumptions. (a) The IRAP tax rate is composed of the basic rate (3.9%) and an average regional tax rate (0.3%). The regional rates are computed on the statistics on tax returns for the period 2010-2017, excluding the public sector, the financial sector and agriculture; (b) the tax credit is spread over a 5-years period; (c) the effective tax rate is computed considering the statutory real estate tax rate, the time-varying ratio between cadastral values and market prices and the rules for the deductibility of the real estate tax against the CIT base.

As regards the calibration of the earning stripping rule, based on the analysis of tax returns data, the correction factor of the value of interest deductibility (the β parameter) is set at 98% (see Annex 5 details). A sensitivity analysis explores the effects of alternative scenarios.

For the evaluation of the ACE regime, I follow the indications of the Mirlees review to consider a long-term interest rate on corporate debt as a reference for the ACE notional rate (Griffith et al, 2010). The ratio between the notional rate and the relevant discount factor (i_{ace}/ρ) is calibrated using the rate on bank loans to non-financial companies with a maturity of over 5 years. Figure 2 compares the ACE notional rate and the reference market interest rate for the period 2011-2020. It shows that in 2015, with a notional rate equal to 4.5%, on average the corporate tax system was providing approximately the "right" incentive to equity. While the reductions of the ACE rate from 2017 are consistent with the decrease of the average cost of indebtedness that occurred since 2015, these reductions might have been "excessive", re-opening again a significant asymmetry between debt and equity, that may have been particularly damaging for small and medium size enterprises[58].

[58] Medium-small companies have typically greater difficulties in accessing credit and therefore face relatively higher financing costs (see Banca d'Italia, 2016, *Report on Financial Stability, No. 2*).

Figure 2. Long-term interest rates on bank loans and ACE notional rate, 2011-2020



Data source for interest rates: Banca d'Italia, BDS (TRI30840 and MIR0600). Since the time series for the interest rate on bank loans with a maturity over 5 years is only available until March 2019, the data points for 2019 and 2020 are computed scaling the data point in 2018 based on the percentage change in 2019-2020 of the interest rate on bank loans with a maturity over 1 year.

6.2 Effective corporate taxation and the debt bias over the period 2010-2020

The first set of results show the overall dynamic of cost of capital and effective taxation over the period 2010-2020, as well as an indicator of the asymmetric tax treatment between debt and equity over the same period. These results provide an indication of the extent to which on average the tax incentives to investment and financial choices changed over time.

As mentioned before, for the interpretation of the most recent developments notice that, since the restoration of ACE was only decided at the end of 2019, I have assumed that for 2019 the Mini-Ires regime (henceforth, M-I regime) with a rate cut of 1.5% on retained earnings shaped the tax incentives to capital accumulation and to the change of the financial structure.

Cost of capital. Figure 3 shows the average cost of capital across sources of finance and types of assets, under the base scenario[59]. Recall that in these computations the real interest rate in absence of taxation is equal to 5%.

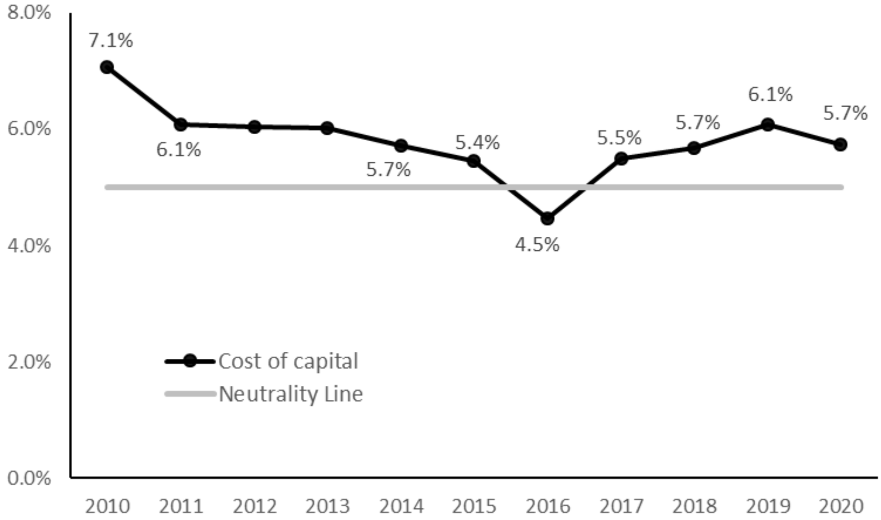
It is possible to identify two periods. From 2010 to 2016, there was a remarkable decrease of the cost of capital from 7.1% to 4.5% (-37%). This was due to the introduction of ACE in 2011 and its strengthening with the increase of the notional rate from 3% in the period 2011-2013 to 4%, 4.5% and 4.75% from 2014 to 2016. Since 2016, the super-depreciation regime provided a strong tax boost to investment in machinery. In 2016, this tax incentive actually brought the average cost of capital below the real interest rate (without super depreciation, in 2016 the cost of capital would have been equal to 5.3% rather than 4.5%). In the most recent period, from 2017 to 2019, there was a strong increase of the cost of capital, from 4.5% to 6.1%[60]. This increase was mainly due to the reduction of

[59] See Figure A7 in Annex 6 for the cost of capital across assets and sources of finance in 2020.

[60] In the period 2018-2019, the extra deduction under the super depreciation regime was reduced from 40% to 30% and this accounts for +0.2 percentage points of the increase of the cost of capital.

the ACE notional rate (from 4.75% in 2016 to 1.6% and 1.5% in 2017 and 2018, respectively) and to the temporary abrogation of ACE in 2019[61] [62]. In 2020, the cost of capital decreased from 6.1% to 5.7%, thanks to the reintroduction of ACE (see below for more results on the comparison between ACE and the M-I regime).

Figure 3. Cost of capital over the period 2010-2020



Notes: the cost of capital is the average across sources of finance (retained earnings new equity - and debt, with weights equal to 55%, 10% and 35%, respectively) and equally-weighted assets with tax depreciation rates of 0%, 5%, 10%, 20% and 30% (assumed equal to economic depreciation rates). Real interest rate = 5%. The cost of capital for 2019 is computed assuming the temporary abrogation of ACE and a Mini-Ires regime with a rate cut of 1.5%.

Effective marginal tax rate. One of the motivations of this paper is to provide more tailored measures of effective taxation for the Italian system. In this respect, Figure 4 compares the EMTR released by ZEW for the European Commission until 2019 (see also figure 1 above) and the EMTR computed with the model derived in this work under the same ZEW assumptions regarding financial structure, asset structure and relationship between tax and economic depreciation (ZEW-PWC, 2020; see par. 6.1 for details). Over the period 2016-2020, on average the tax incentives to machinery lowered the cost of capital for the assets with 10% and 20% depreciation rates by 1.6 percentage points (from 5.9% to 4.3%). In 2019 and 2020, the provisions phasing out the tax benefit at higher levels of investment in machinery (EUR 2.5 and EUR 2.0 million, respectively for super depreciation and tax credit) may have determined a higher cost of capital for larger firms. Focusing on the 2020 tax credit, the effect of these limiting provisions on the cost of capital for machinery is such that halving the share of the investment that benefit of the tax incentive (changing the parameter ε in equation [14]) halves the full effect of the tax allowance in percentage points (on average, in relative

[61] The increase of the effective tax rates in 2019 is in line with the results in ISTAT (2018).

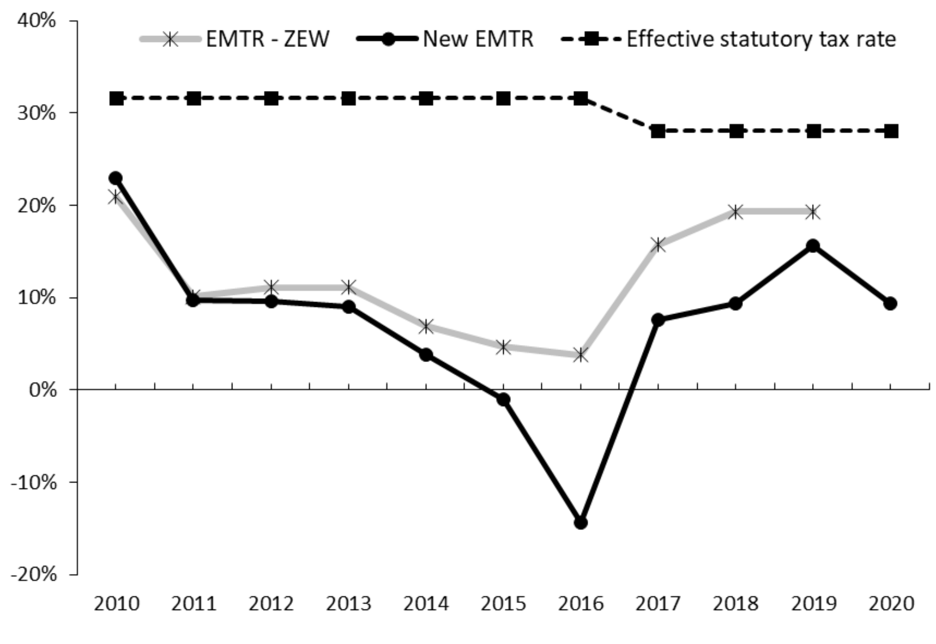
[62] UPB (2019b) provides results for 2019 of the effects of the tax changes of the 2019 Budget Law and the Law Decree 34/2019 on the tax revenues and implicit tax rates using a micro-simulation model based on 2016 information. Overall, the results indicate a decrease of the tax revenues of 0.6% (-0.2% in terms of implicit tax rate), composed of an increase of tax revenues for the abrogation of ACE (+2.4%) and decreases for the extension of super-depreciation (-0.3%), the new rules on the deductibility of the real estate tax (-0.7%) and the Mini-Ires regime as modified by the Law Decree 34/2019 (-2.1%). However, these results are not directly comparable with the results in terms of cost of capital and forward-looking effective tax rates, not least because they are affected by the initial conditions of the companies in terms – for instance – of retained earnings (presumably on the year 2015) and accumulated ACE base.

terms this corresponds to an increase of the cost of capital of about 15%). The change of the tax incentives to machinery in 2020 had negligible effects on the cost of capital, indicating that overall super depreciation and new tax credit may be not so different one from another. However, as noted above, the effects of the two types of incentive may differ across firms and the tax credit may determine a stronger effect for firms facing financial frictions and more generally for firms that value future cash flows using higher discount rates. Looking forward, notice that – all else equal – in 2021 there could be an increase of the aggregate cost of capital if the temporary tax credit will not be furtherly prolonged.

For most of the period, the two EMTRs share the same dynamic. Importantly, the new EMTR presents a much larger volatility. Apart from the missing tax effects for super depreciation since 2016 and the M-I regime in 2019, most notably the ZEW measure underestimates the ACE effect on effective taxation, as it is clear from the larger fall of the new EMTR in 2014-2015 due to the increase of the ACE notional rate.

Figure 4 also shows the effective statutory tax rate. In line with the previous description of the evolution of the corporate tax system, the comparison with the EMTR quickly allows grasping that the dynamic of cost of capital and effective taxation were mostly due to the changes of the tax base. Interestingly, the lowering effect of the statutory tax rate cut in 2017 (from 27.5% to 24%) on the cost of capital was more than offset by the combined effect of the decrease of the notional ACE rate from 4.75% to 1.6% and the reduction of the super-depreciation from 40% to 30% of the cost of the asset.

Figure 4. Effective Marginal Tax Rates (EMTR) and statutory tax rate 2010-2020



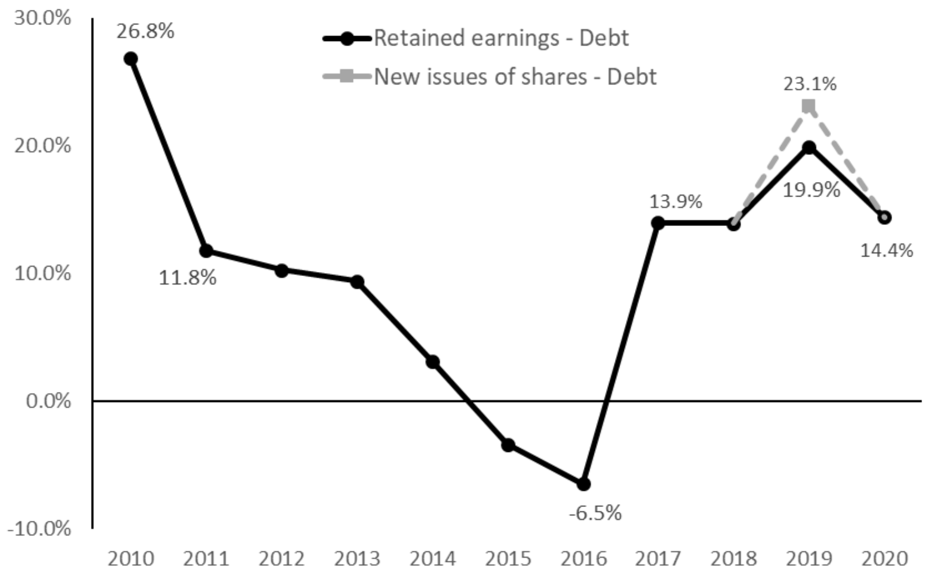
Notes: The EMTR-ZEW for the period 2010-2019 is drawn from ZEW-PWC (2020). The new EMTR for 2019 is computed assuming the temporary abrogation of ACE and a Mini-Ires regime with a rate cut of 1.5%. The new EMTR for the period 2010-2020 is an average across sources of finance (retained earnings: 55%, new equity: 10% and debt: 35%) and five equally weighted assets (financial asset, inventory, industrial buildings, machinery and intangibles). For the economic depreciation rates, see 6.1. Tax depreciation rates are also taken from ZEW-PWC (2020) based on the Italian legislation. The effective statutory tax rate considers the deductibility of 10% of IRAP against the CIT base.

Debt bias. Several tax developments over the analyzed period have regarded the tax treatment of the different funding sources. It is therefore worthwhile looking at the overall dynamic of the asymmetry between debt and equity that may have affected the choice of the financial structures.

Figure 5 shows an indicator of the bias in favor of debt of the Italian corporate tax system over the period 2010-2020. The debt bias indicator is defined as the difference between the EMTR for an investment funded with equity (retained earnings or new issues of shares) and the EMTR for an investment funded with debt. The EMTR is computed from the average cost of capital across assets. In the computations, it is assumed that the limit to the deductibility of interests brings about a 2% reduction of the present value of interest deductibility ($\beta = 0.98$). The temporary tax incentives to machinery in the period 2016-2020 are not considered.

Consistently with the previous results, figure 5 shows that the ACE reduced substantially the debt bias over the period 2011-2016. In 2015-2016 the corporate tax system was likely favoring equity over debt, reversing the traditional bias present in the corporate tax system, due to a ratio between the ACE notional rate and the reference market interest rate which was larger than one. Since 2017, the strong reduction of the ACE notional rate re-established the bias in favor of debt. In 2019, the temporary abrogation of ACE and its substitution with the M-I regime (featuring a rate cut of 1.5% for retained earnings only) increased the bias not only for new issues of shares, but also for retained earnings (see below for more results on the comparison between ACE and M-I). In 2020, the ACE restoration brought about a reduction of the bias to a level comparable with the period 2017-2018.

Figure 5. Debt bias 2010-2020



Notes: the debt bias is defined as the difference between the EMTR for an investment funded with equity (retained earnings or new issues of shares) and the EMTR for an investment funded with debt. The debt bias for 2019 is computed assuming the temporary abrogation of ACE and a Mini-Ires regime with a rate cut of 1.5%.The EMTRs are computed from the average cost of capital across assets with tax depreciation rates (assumed equal to the economic depreciation rates) equal to 0%, 5%, 10%, 20% and 30%. $\beta = 0.98$. No super-depreciation (2016-2019) and tax credit in 2020. For the other assumptions and tax parameters, see par. 6.1 and table 2.

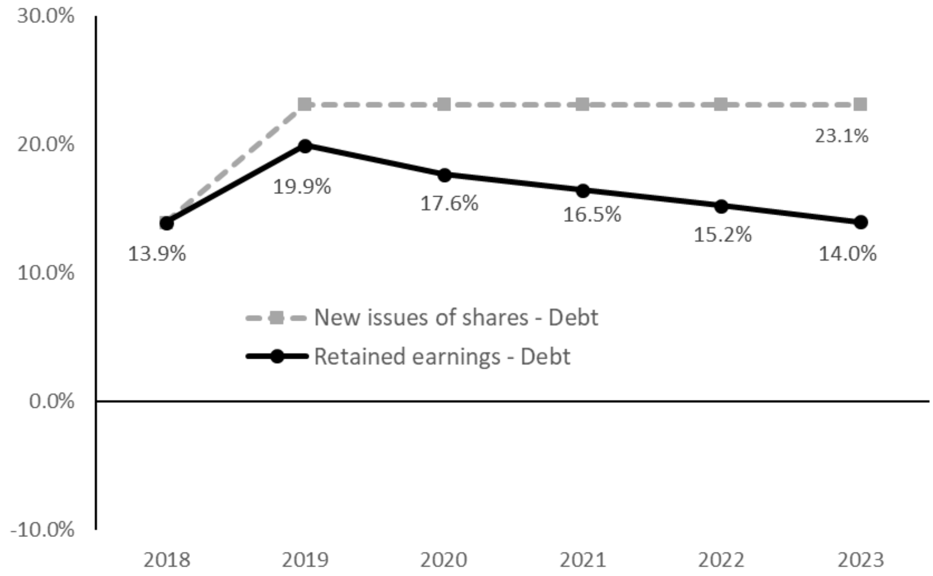
6.3 A focus on ACE and Mini-Ires

The second set of results regards the comparison between ACE and Mini-Ires (thereinafter, M-I regime) and it aims at providing some information on the counterfactual scenario without the reintroduction of ACE and at investigating the economic properties of the M-I regime.

From the previous results, the M-I system does not seem as powerful as the ACE, since in 2019 the cost of capital (and the EMTR) increased and the debt bias got worse. However, under the M-I regime the rate cut on retained earnings would have increased from 1.5% in 2019 up to 4% since 2023. Moreover, the difference between the two regimes was also affected by the relationship between market interest rates and ACE notional rate. Furthermore, since the M-I regime only referred to investments funded with retained earnings, its effects cannot clearly emerge from the averages across sources of finance shown in figures 3-5. For the above reasons, it is worthwhile to provide a clearer comparison between ACE and M-I. Since both regimes concern the tax treatment of the equity, the focus is at first on the counterfactual dynamic of the debt bias incorporating the increasing M-I rate cut over time. Then, additional results are provided controlling for the difference between market interest rates and ACE notional rates and isolating the role of tax depreciation rates and discount factor.

Figure 6 shows the debt bias indicator for new issues of shares and retained earnings over the period 2018-2023 if the ACE had not been reintroduced. Over the considered period, under the M-I regime the debt bias for retained earnings would have decreased, but it would have reached only in 2023 a level approximately similar to that in 2018 with the ACE. For the interpretation of this result, recall that in 2018 the ratio between the ACE notional rate and the reference market interest rate was about 50% (see figure 2).

Figure 6. A counterfactual scenario: Debt bias under the Mini-Ires regime in 2019-2023

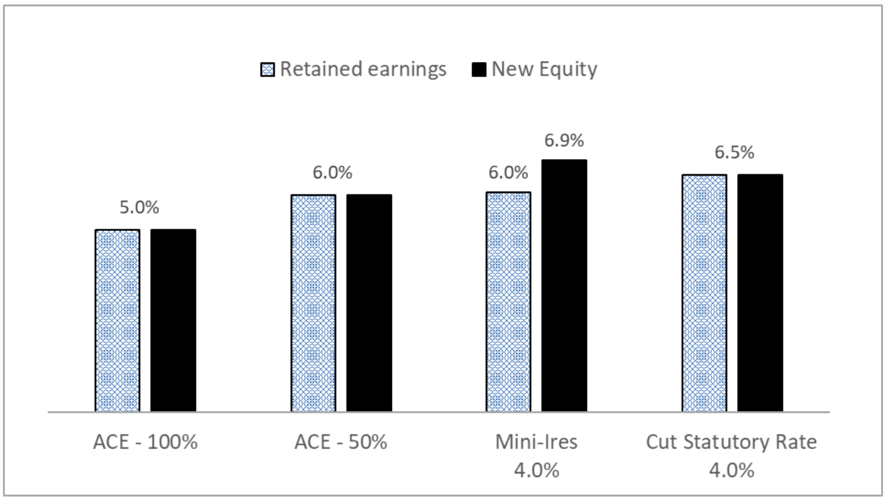


Notes: the debt bias is computed as the difference between the EMTR for an investment funded with equity (retained earnings or new equity) and the EMTR for an investment funded with debt. The EMTRs are computed from the average cost of capital across assets with tax depreciation rates (assumed equal to the economic depreciation rates) equal to 0%, 5%, 10%, 20% and 30%. β = 0.98. No super-depreciation (2018-2019) and tax credit in 2020. For the other assumptions and tax parameters, see par. 6.2 and tab. 4.

Building on the latter point, in order to gain more insights on the difference between ACE and M-I, figure 7 focuses on equity-funded investments and compares four different scenario: a fully operative ACE regime with a ratio between notional rate and the reference market interest rate equal to 1 ("ACE 100%"); an ACE regime with the latter ratio equal to 0.50 ("ACE 50%"); the M-I regime in 2023, namely a regime with a cut of the statutory rate on retained earnings equal to 4.0%; and a scenario with no ACE and no M-I, but with an across-the-board cut of the statutory tax rate equal to 4.0%. The computations refer to the average across the five different assets under the base scenario, with a discount factor of 7% (5% real interest rate + 2% inflation) and consider only the CIT.

Focusing on retained earnings, Figure 7 shows that on average the ACE is more powerful than the M-I regime in reducing the cost of capital (from 6.9% to 5.0% for ACE – 100% that makes the CIT neutral with respect to investments funded with equity; from 6.9% to 6.0% for M-I)[63]. An ACE system working at half of its potential is just as powerful as the full M-I regime (from 6.9% to 6.0%), in line with the previous results on the debt bias. Figure 7 also shows that the effects of the M-I regime on the cost of capital for investments funded with retained earnings are more powerful than a reduction of the statutory tax rate (-0.9 percentage points vs -0.4). This is because a lower statutory tax rate decreases the present value of depreciation allowances.

Figure 7. The cost of capital under ACE regimes and Mini-Ires, average across assets



Notes: Real interest rate = 5%. "ACE X%" refers to a regime where the ratio between notional rate and the reference market interest rate is X/100. Tax depreciation is equal to the economic depreciation rate. Only CIT. Average across five assets with depreciation rates equal to 0%, 5%, 10%, 20% and 30%.

As regards the tax treatment of the different funding sources, as seen also before (figure 5), differently from ACE the M-I regime would have introduced an asymmetric tax treatment between retained earnings and new equity at the corporate level. This tax favor to retained profits could have exacerbated the asymmetry existing at the personal level due to the tax deferral effect, i.e. the deferral of taxation of capital gains at the time of realization (given that dividends and capital gains are taxed at the same nominal tax rate). In principle, a larger tax asymmetry may lead to a worsening of the

63 This conclusion is in line with the results in UPB (2019b) derived with a more simplified static economic framework (tab. 4, p. 12). UPB (2019a, 2019b) and ISTAT (2018) provide results for 2019 on the comparison between Mini-Ires and ACE in terms of tax revenues and implicit tax rates using micro-simulation models based on 2016 data. For 2019 the results in UPB (2019b) show a larger ACE effect (in terms of tax revenues, +2.4% for ACE vs -2.1% for the Mini-Ires; in terms of implicit tax rates, +0.6% for ACE vs -0.5% for the Mini-Ires).

lock-in effect: financial resources generated by a firm could be more likely re-invested within the firm in relatively less productive projects than in alternative external investments, for the sole purpose of avoiding the burden of taxation deriving from their distribution. The increased asymmetry between dividends and undistributed profits may reduce the economic efficiency in the allocation of financial resources across the available investments[64]. These potential problems of the M-I regime at the corporate level were not present under the ACE regime, given the full symmetry between all forms of equity increases[65].

Compared with ACE, the effect of M-I on the cost of capital is different across assets. In order to analyze this feature, consider a simplified framework with no inflation where the cost of capital for equity-funded investments is constant across assets in a system with no incentives to equity. Figure 8 shows the cost of capital for equity-funded investments across assets for a full ACE (ACE-100%) and for the M-I 4.0% regime. While under the ACE the cost of capital is constant across assets (5%), under the M-I regime it is decreasing with the depreciation rate. The cost of capital for investments funded with retained earnings goes from 6.3% for an asset that does not depreciate to 4.8% for an asset with a 30% depreciation rate; for this latter asset, in these computations the cost of capital is even lower than that under the ACE system. For the interpretation of the above results, the comparison with the neutrality properties of the ACE is illuminating. Under the ACE system, the present value of the ACE deductions over the lifetime of the investment decreases with the depreciation rate (see equations [10] and [11] above). This effect exactly compensates the increase of the present value of depreciation allowances as the depreciation rate increases. As a result, under the ACE system the cost of capital is constant across assets, as the grey bars in figure 8 show. Under the M-I regime, the present value of the one-off tax saving does not depend on the depreciation rate. Therefore, the increase of the present value of the depreciation allowances drives an increasing difference between the cost of capital for investments funded with new equity and retained earnings, with an advantage for assets with shorter economic lives[66].

The neutrality properties of the M-I regime and the comparison with ACE are also affected by the discount factor. More precisely, it is possible to show that, as the discount factor decreases, the cost of capital for investments funded with retained earnings under the M-I regime decreases as well, and – depending on the rate cut – the cost of capital can actually became lower than the cost of capital for the same investments under the ACE regime. The explanation of these results is similar to that for the non-neutrality of the M-I regime across assets. A decrease of the discount factor increases the present value of depreciation allowances, while the present value of the cash flow related to the M-I regime does not decrease (it actually increases; see equation [15]). Instead, under the ACE regime,

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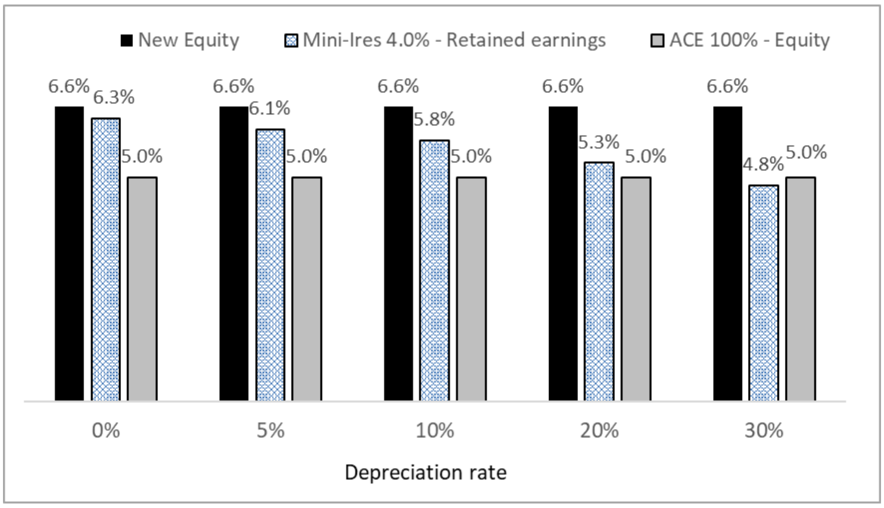
64 In corporations characterized by the separation between ownership and control, this inefficiency could be further worsened by the behavior of the management, which could find easier to finance unproductive projects (the so-called "pet projects") thanks to the greater availability of internal resources due to lower dividend distributions. On this potential inefficiency related to agency problems, see Chetty and Saez (2010), and Koethenbuerger and Stimmelmayr (2014).

65 The Mini-Ires regime also tends to discriminate between companies with different financial conditions. In particular, the effects on investments and financial choices may be different between companies that finance "at the margin" investments by retaining profits (in literature these are the companies considered in the so-called “new view” of corporate taxation) and companies that do not have enough internal resources and must therefore fund “at the margin” the investment with the issue of new shares (“old view” companies). On the different theories of corporate taxation, see, among others, Sørensen (1994).

66 This effect would have been even stronger under the former M-I regime introduced with the 2019 Budget Law since under this regime the present value of the M-I effect was increasing with the depreciation rate. See Annex 2 for details on the first draft of the M-I regime.

as the discount factor decreases, the present value of the allowances decreases as well, since the effect of the reduction of the ACE notional rate (linked to the discount factor) more than compensates the increase of the present value due to the lower discount factor. This is the reason why the neutrality properties of the ACE-100% regime are not affected by the discount factor. Since, as seen above, under the M-I regime the cost of capital for investments funded with retained earnings also decreases with the depreciation rate, it is possible to show that for each discount factor there is a given depreciation rate such that for larger (lower) depreciation rates the M-I regime is more (less) powerful than ACE. For instance, in the base scenario – with a discount factor of 7% (5% real interest rate + 2% inflation) – the M-I 4.0% regime is more powerful than ACE for depreciation rates approximately larger than 35%; with a discount factor of 4% (2%), this holds for depreciation rates larger than 20% (10%).

Figure 8. Cost of capital under ACE and Mini-Ires across assets



Notes: Real interest rate = 5%. ACE-100% refers to a regime where the ratio between notional rate and the reference market interest rate is equal to 1. Tax depreciation is equal to the economic depreciation rate. Only CIT. No inflation.

To sum up, leaving aside the issue of the possible different effects in terms of foregone tax revenues, the M-I regime is clearly inferior to ACE with respect to both its capacity to address the debt bias and to improve the tax incentives to investment. Another point of attention of the M-I regime is that it is implicitly non-neutral with respect to investments with different depreciation rates, favoring assets that depreciate more rapidly, and with respect to investments whose cash flows are discounted at different rates, favoring those with cash flows discounted at lower rates.

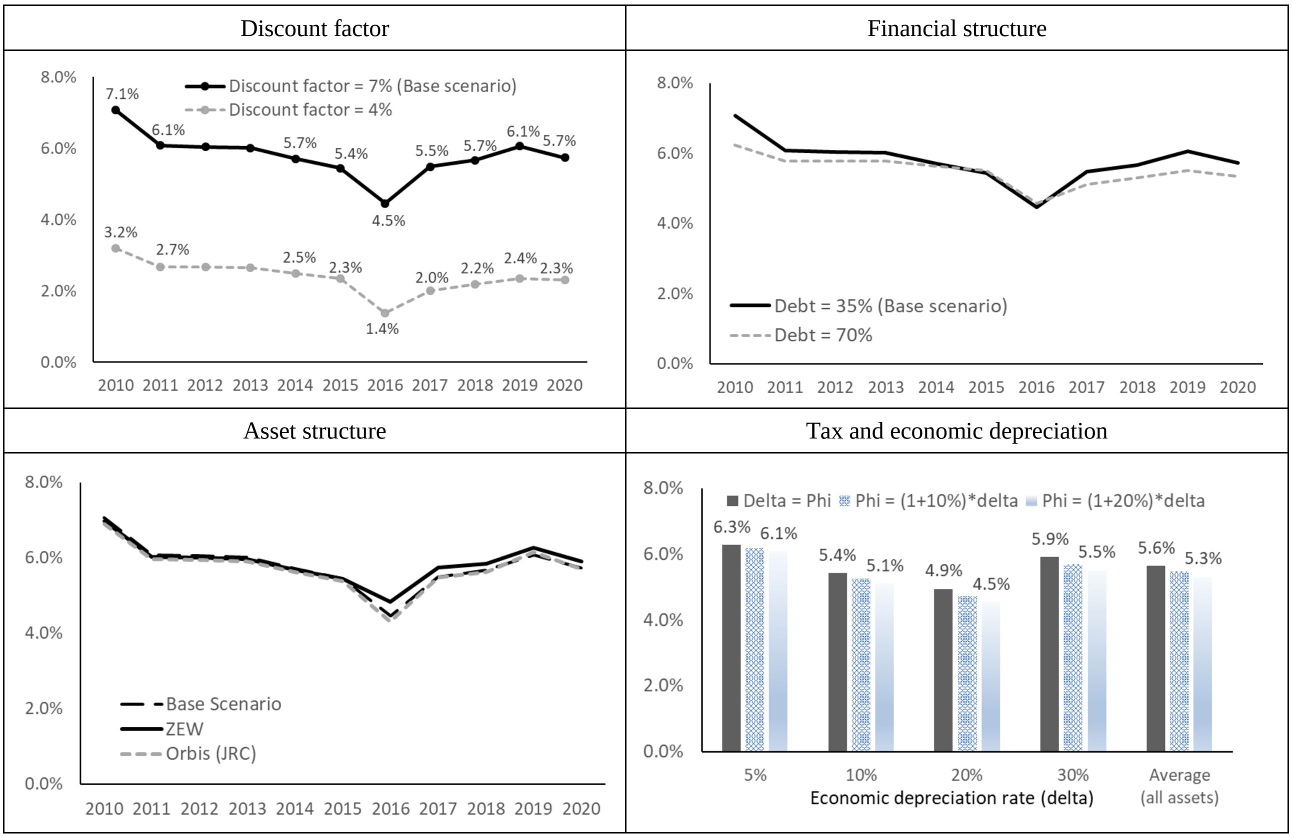
6.4 Sensitivity analysis

This section presents a sensitivity analysis to investigate how different values of the model parameters affect the results. In particular, the analysis considers the effects of discount factor, funding structure, asset structure, depreciation rates and the limits to interest deductibility. Figure 9 presents some of the results. Overall, the main conclusions are consistent with the base scenario. In what follows, some comments are provided on these alternative measurements.

The upper-left graph of figure 9 compares the cost of capital computed with discount factors of 7% (5% real interest rate and 2% inflation) and 4% (2% real interest rate). While the dynamic and its economic interpretation are identical, the cost of capital with a lower discount factor tends to be less volatile in absolute values. This partly reflects the narrower basis in the 4% case. However, the discount factor may also play an economic role and this may affect the changes in relative terms. For instance, in percentage terms the decrease of the cost of capital in the period 2010-2016 is larger with a lower discount factor (56% vs 37%). This is due to the stronger impact of the super-depreciation regime with a lower discount factor. Notice also the smaller changes of the lower cost of capital in the period 2018-2020 due to the implicit role that the discount factor plays in the M-I regime (in 2019) compared with the ACE (reinstated in 2020), as shown above in the comparison between the two regimes (see par. 6.3).

The upper-right graph of figure 9 compares the cost of capital in the base scenario (assuming a debt-asset ratio equal to 35%) with the cost of capital computed assuming a more leveraged financial structure with a debt-asset ratio of 70%. Not surprisingly, with a larger weight to debt the average cost of capital is lower (5.5% vs 5.8%). The small difference under the two scenario – which is actually nil in the period 2014-2016 – is due to the ACE regime in force in the period 2011-2018 and in 2020 that strongly reduced the asymmetry between the tax treatment of the different funding sources. For comparison, before the introduction of ACE in 2010, the difference was 0.9 percentage points (6.2% vs 7.1%).

Figure 9. The effects of changing the model's parameters on the cost of capital



Notes: for the calibration of the different measurements, see par. 6.1. For the lower-right graph: i) "delta" is the economic depreciation rate and "phi" is the tax depreciation rate; ii) the cost of capital is the average over the period 2010-2020.

The lower-left graph of figure 9 compares the cost of capital computed using three different asset structures. Overall, the dynamic is quite similar. The three measures are very close until 2015. Since 2016, the differences are due to the different weights of machinery that was tax-incentivized since

2016 and to the different weights of financial assets that since 2016 did not benefit of the ACE allowance.

Although the difference between tax depreciation and economic depreciation is not as relevant as in the past (before the 2008 tax reform), the analysis of its effects is interesting for several reasons. When tax depreciation is larger than economic depreciation, the corporate tax system may provide an over-incentive to investment (bringing the cost of capital below the real interest rate, typically for debt-funded investment). A sensitivity analysis provides information on the sensitivity of this over-incentive with respect to the tax parameters. Moreover, as already noted, given the definition of the ACE base in Italy, there was no correction in defining this base for the difference between tax and economic depreciation, as it should be under the textbook ACE. This means that in principle the "over-incentive" effect, which is exclusive to debt in standard corporate tax systems, is also present for equity-funded investments in some types of ACE systems, such as the Italian one (see par. 5.2). Overall, the results show that, on average across the five assets, a 10% difference between tax and economic depreciation (for instance, 10% vs 11%, 20% vs 22%) decreases the cost of capital by about 10 basis points. Notice that this latter effect is similar to the effect on the cost of capital of a 1 percentage point cut of the CIT rate. The effect of the difference between tax depreciation and economic depreciation is increasing with the depreciation rate (for a 10% difference, from 10 basis points for the asset with a 5% economic depreciation rate to about 20 basis points for the assets with 20%/30% economic depreciation rates). If the ACE base were defined as under the textbook ACE regime, on average the above effects would be more than halved (given that in the base scenario the equity weight is 65%), since the difference between tax and economic depreciation would not be relevant.

Finally, as regards the effects of the limits to the deductibility of interests on the cost of capital, they are rather limited and much lower than in Caiumi et al. (2015). Under the base scenario with a real interest rate in absence of taxation equal to 5%, a 5 percentage points reduction of the present value of interest deductions increases the cost of capital for a debt-funded investment by about 10 basis points (corresponding to an increase of the cost of capital of about 2%). Notice that for this result to hold a strong reduction of the average yearly deductibility of interest costs is needed (about -25 percentage points). Under the base scenario (with an average yearly interest deductibility of 75% and a 2% reduction of the present value of the deduction), the effect of the earning stripping rule on the cost of capital for a debt-funded investment is about 5 basis points. For comparison, this effect is about 1/6 of the overall effect on the cost of capital for a debt-funded investment of the un-deductibility of interest costs against the IRAP tax base and about ½ of the effect on the cost of capital for an equity-funded investment of an increase of the statutory tax rate of 1 percentage point. Recall that - as noted in section 5.1 - the actual economic cost of the limits to interest deductibility may be larger in some cases, such as for instance in presence of financial frictions.

7. Conclusions

Since 2011, the Italian corporate tax system has been subject to many changes. Some of these modifications, such as the reduction of the corporate tax rate from 27.5% to 24% and the introduction of the ACE regime, were likely conducive to growth by improving the tax incentives to invest and strengthen the financial structures. Yet, other developments went in the opposite direction.

This paper provides an economic assessment of the evolution of the Italian corporate tax system over the last decade through the computations of new and updated measures of effective taxation. The analysis is undertaken with a standard model of investment, adapted to the Italian corporate tax. Compared with the existing literature, the model takes into account the specificities of the Italian ACE regime, it considers the evolution of market interest rates to evaluate the ACE neutrality properties and it relies on a new method to measure the effect of the provisions limiting the deductibility of the cost of debt.

Over the period 2010-2020, the legislative changes translated to a high volatility of the indicators of effective taxation. This volatility is much larger than that observed in the existing empirical literature. A clear U-shaped pattern is detectable. Until 2016, the cost of capital strongly declined. From 2017 to 2019, there was a worsening of the tax incentives to invest, followed in 2020 by a partial improvement. The same pattern can be also seen for the debt bias indicator shaping the tax incentive in the choice of the financial structures.

The dynamics of the indicators of effective taxation and debt bias were mostly driven by the evolution of the ACE regime. Taking as a reference for the ACE neutrality properties the interest rate on long-term bank loans, the paper shows that the ACE substantially improved the economic properties of the corporate tax system and it made it approximately neutral on investment and financial choices in 2014-2015. In 2016, the regime likely provided an over-incentive to invest and it even reversed the debt bias. In the same way, the decrease of the notional rate from 2017 deteriorated the incentive to invest and the asymmetry between debt and equity. This development may have been particularly unfavorable for firms featuring structurally higher financing costs. The analysis also shows that ACE has better economic properties than the Mini-Ires regime introduced in 2019 and therefore that its restoration decided by the 2020 Budget Law is a positive evolution.

Since 2016, the temporary tax incentives to machinery extended on a yearly basis strongly reduced the cost of capital for such assets and stimulated investment. However, the provision in 2019 and 2020 that phased out the incentive at higher-levels of investment may have reduced their effectiveness for larger firms, with a possible negative impact on the aggregate investment rate. In 2020, the switch from a depreciation-based incentive to a tax credit may have especially benefited firms facing financing constraints, typically smaller firms, young innovative firms and R&D intensive firms. This development may be particularly valuable in the current economic phase in which the probability of tax losses has dramatically increased.

Looking forward, given the pivotal role played by ACE in the corporate tax system and its revenue impact, more empirical analyses would be welcomed in order to better understand its effects on investment and financial choices and the possible differences across firms. In the current economic climate, in order to increase the effectiveness of ACE, two possible lines of reform to be assessed could be broadening the possibility to transform into tax credits the accrued ACE deductions that cannot be immediately used because of the strong likely reduction of the tax base, and differentiating the notional rate across specific groups of firms to take into account the structurally different level of financing costs. As regards the tax incentives to invest, given their extensive use and potentially high costs, understanding how these policies affect investment and assessing empirically their effects at the aggregate level, as well as across firms and types of investment, would be also important to policy makers.

Despite their limitations due to the simple used model, the results shown in this paper could be a useful starting point for empirical analyses of the effects of the corporate tax system on investment and financial choices, exploiting the documented variability of the measures of effective taxation along several dimensions, following the lines of the existing international empirical literature.

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Annex 1: Main corporate tax measures in Italy in the period 2011-2020

This Annex presents the chronology of the main corporate tax measures taken in Italy over the period 2011-2020. All the listed measures below have been analyzed in the paper, but those marked with the asterisk (mostly, tax incentives to innovation that are out of the scope of the analysis).

2010-Dec: "Aiuto alla Crescita Economica" regime introduced from 2011. The notional rate was set at 3% for the years 2011-2013.

2013-Dec: (i) Increase of the ACE notional rate to 4%, 4.5% and 4.75% in 2014, 2015 and 2016. Since 2017 the ACE notional rate would have been set considering the interest rates on public bonds, plus 3 percentage points to compensate the larger risk of firms' debt; (ii) deductibility of 20% of the real estate tax (IMU) against the CIT base from 2014; (iii) tax credit for R&D introduced for the years 2015-2019 (*);

2014-Jun: (i) "super-ACE" introduced for newly listed companies consisting of an increase of 40% of the ACE base for three years (*); (ii) possibility to transform the "unused" ACE deduction into a tax credit against the IRAP liability and to use it over five years (*);

2014-Dec: (i) a Patent Box regime providing preferential tax treatment of intangibles was introduced from 2015 (*); (ii) change of the tax credit for R&D with lower rate and broader scope (*);

2015-Dec: (i) decrease of the CIT rate from 27.5% to 24% from 2017; (ii) super-depreciation equal to 40% of the asset value for machinery investment in 2016;

2016-Dec: (i) the ACE notional rate was set at 2.3% in 2017 and 2.7% from 2018; (ii) No reference anymore to the interest rates on public bonds and the larger risk of firms' debt for setting the ACE notional rate (*); (iii) deduction from the ACE base of the investments in financial assets; (iv) extension of the super-depreciation regime to 2017; (v) "hyper-depreciation" temporary regime introduced in 2017 for "Industry 4.0" investments (*); (v) change of the tax credit for R&D with an increase of the credit rate and an extension to 2020 (*).

2017-Apr: (i) change of the ACE regime from 2017 moving from an incremental ACE (base year 2010) to a regime with an ACE base computed considering the equity increase over the last five years;

2017-Jun: (i) repeal of the previous change of the ACE base; (ii) change of the ACE rate: 1.6% in 2017 and 1.5% in 2018;

2017-Dec: (i) extension to 2018 of the super-depreciation regime, with a decrease of the additional asset value from 40% to 30%; (ii) extension to 2018 of the hyper-depreciation regime (*);

2018-Dec: (i) Ace repeal from 2019; (ii) Mini-Ires regime introduced, granting tax benefits to retained earnings – invested in machinery or increase of labour costs – with a cut of the statutory tax rate equal to 9 pp; (iii) extension to 2019 of the hyper-depreciation regime with modifications (*); (iv) changes of the R&D tax credit lowering the tax benefit (*); (iv) Deductibility of 40% of the real estate tax (IMU) against the CIT base from 2019;

2019-Apr: (i) change of the Mini-Ires regime with no conditions on the use of retaining earnings and with a reduction of the statutory tax rate equal to 1.5 pp in 2019, 2.5 pp in 2020, 3 pp in 2021, 3.5 pp in 2022 and 4% from 2023; (ii) extension to 2019 of the super-depreciation regime with changes; (iii) Deductibility of 50% of the real estate tax (IMU) against the CIT base in 2019, 60% in 2020-2021 and 70% from 2022;

2019-Dec: (i) repeal of Mini-Ires from 2019; (ii) ACE regime revived from 2019 with a notional rate equal to 1.3%.

Annex 2: AGI-type regimes and a comparison with ACE

In April 2017, the government tried to enact a substantial change of the ACE regime by modifying the rules for the computation of the ACE base to which the notional rate is applied to calculate the ACE deduction. The ACE base would have been computed considering only the equity increases over the previous five years, rather than all the equity increases starting from 2010. This mechanism was similar to the one envisaged under the Allowance for Growth and Investment (AGI) proposed in 2016 by the European Commission within the new proposal for the introduction of a Common Consolidated Corporate Tax Base (CCCTB) at the European level (see European Commission, 2016).

The proposed modification of the ACE regime was then cancelled during the conversion of the decree into law. Instead, in order to limit the ACE revenue impact the decree reduced the notional rate. Even if the AGI-type regime was not implemented, it is interesting to analyze quantitatively its economic features since it is a new type of corporate tax system[67].

Long-run revenue impact of AGI-type systems. With respect to the ACE, the AGI regime entails a reduction of the base for the computation of the deduction. In order to derive its long-run revenue effects, the first step is to compute this reduction in the long-run.

Consider a standard incremental ACE regime where the ACE base at time $t+i$ is equal to the difference between the stock of equity at time $t+i$ and the stock of equity at time t:

$$ACE\ BASE_{t+i} = E_{t+i} - E_t \qquad [A1]$$

In the long-run, the ratio between the ACE base and the stock of equity – defined as Ω^{ACE} – clearly converges to 1, regardless of the growth rate of the latter. Formally:

$$\Omega^{ACE} = \lim_{i\to\infty} \frac{E_{t+i}-E_t}{E_{t+i}} = 1 \qquad [A2]$$

Under the AGI regime, only the last n years are considered for the computation the base:

$$AGI\ BASE_{t+i} = E_{t+i} - E_{t+(i-n)} \qquad [A3]$$

Assume a stock of equity growing at a rate φ so that $E_{t+i} = E_0 e^{\varphi(t+i)}$, where E_0 is the equity in the initial period. Then, in the long-run, under the AGI regime the ratio between AGI base and total equity, Ω^{AGI}, can be expressed as follows:

$$\Omega^{AGI} = \lim_{i\to\infty} \frac{E_{t+i}-E_{t+(i-n)}}{E_{t+i}} = 1 - e^{-n\cdot\varphi} \qquad [A4]$$

Given a fixed path of investment in the evaluation horizon, this ratio should approximate the long-run revenue impact of AGI-type systems with respect to a full-stock ACE[68].

Table A1 shows the values of the long-run ratio between the AGI base and the stock of equity under the system originally proposed in April 2017 (n = 5), under different hypotheses on the growth of the stock of equity. As a comparison, the CCCTB case n = 10 is also considered.

Table A1. The long-run revenue impact of AGI-type systems:
the ratio between the AGI base and the stock of equity ($\Omega^{AGI} / \Omega^{ACE}$)

Growth rate of equity φ	**AGI Italy (*n = 5*)**	**AGI – CCTB (*n = 10*)**
2%	0.10	0.18
3%	0.14	0.26
4%	0.18	0.33

As table A1 shows, for reasonable long-run trends, in equilibrium the AGI regime entails a strong reduction of the revenue impact with respect to the ACE regime. For instance, assuming a 4% growth

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67 For an economic analysis of the AGI regime proposed by the European Commission, see Kari *et al*. (2018).

68 In the Impact Assessment of the CCCTB proposal the computation of the part of the equity stock benefiting of the allowance is approximated as the product of n and φ (European Commission, 2016: 48-52; 155).

rate, the revenue impact of the AGI-5 system would be about 1/5 of the ACE's; for the AGI-10 system, it would be about 1/3.

The cost of capital in an AGI-type system. As regards the impact of AGI-type systems on the cost of capital, this will depend not only on the specific design of the regime (as for the ACE), but also on the depreciation rate and the discount factor. Clearly, if depreciation is quick then the AGI limit becomes immaterial.

In order to compute the impact on the cost of capital, take as reference point a textbook ACE letting the asset value to decay at the rate θ. Differently than under the ACE, since AGI deductions are only possible for *n* years, their present value is the following:

$$PVAGI = \int_0^n i_{ace} \cdot \tau \cdot e^{-(\theta+\rho)u} du = \frac{\tau \cdot i_{ace}}{\theta+\rho}\left[1 - e^{-(\theta+\rho)n}\right] \quad [A5]$$

According to equation [17], in the computation of the cost of capital the present value of the deductions under the AGI system is equal to the present value of the deductions under the ACE system, scaled down by the factor $\left[1 - e^{-(\theta+\rho)n}\right]$ that depends on θ, ρ and n[69].

For the Italian system, considering the way the ACE base was defined, θ has to be replaced by δ in the factor formula[70]. Based on equation [12] for the ACE system in the main text, the present value of deductions in the AGI-*n* regime can be then expressed as follows:

$$A^{AGI\_n} = \frac{\tau}{\theta+\rho}\left[\theta + \rho\left(\frac{i_{ace}}{\rho}\right)\frac{\theta+\rho}{\delta+\rho}\left(1 - e^{-(\delta+\rho)n}\right)\right] - \tau_{irap}\rho\frac{\tau_{irap}}{\delta+\rho}\left(\frac{i_{ace}}{\rho}\right)\left(1 - e^{-(\delta+\rho)n}\right) \quad [A6]$$

Table A2 provides some computations on the effects of AGI-type systems on the present value of the ACE deductions, showing the value of the correction factor under different assumptions on the discount factor, the depreciation rate and the number of years considered for the AGI base. The results show how the effects of AGI on the cost of capital (and therefore on investment, financial structures, and ultimately macroeconomic outcomes) depend on the number of periods for which the tax benefit is granted (clearly, a longer period makes the regime less stringent), as well as on the discount factor and the depreciation rate (larger discount factors and depreciation rates make the AGI limit less stringent). Overall, the AGI-type systems reduce the incentive to invest and to strengthen the financial structures, but in some cases this reduction is very low. This happens, for instance, for assets with high depreciation rates, such as highly technological assets.

The distance between the effects on the cost of capital – which in some cases are very limited, as table A2 shows - and the strong long-run revenue-savings impact of AGI-type systems compared with the ACE regimes (table A1) is somehow striking. However, this can be explained considering the fact that in one case – effects on the cost of capital – the focus is on the *present* incentive to invest and a *single* investment, while in the other case the focus is on the *long-run* revenue effects referred to the *whole* economic system[71]. To somehow reconcile the two set of computations, for the AGI-5 system proposed in Italy, consider as an example an average depreciation rate of approximately 8% (based on the average asset structure of Italian companies in the Orbis database)[72]. With this overall

69 The correction of the present value of the ACE deductions under the AGI regime is not present in Spengel et al. (2018) where the cost of capital and effective tax rates are derived using the Devereux-Griffith's single period framework.

70 In principle, even the AGI -10 in the European CCCTB proposal should be evaluated using the economic depreciation rate in the formula of its cash flows effects. Indeed, the AGI base in the CCTB proposed Directive (art. 11) refers to the "capital and reserves" of the Directive 2013/34/EU (on the annual financial statements) or to the "equity" of IFRS, without mentioning any adjustments to tax values. Therefore, under the AGI-10 of the CCTB there would not be any correction for the time pattern of tax depreciation, differently than in the textbook ACE. This conclusion is different from those of the analyses to date on the economic effects of AGI (Spengel et al., 2018, footnote 57; Kari et al., 2018, equation 4, p. 6).

71 This aspect is also mentioned in the Impact Assessment of the CCCTB proposal where the impact of AGI is computed as the effect of an ACE applied to a percentage of equity derived approximately in a way similar to the one derived above. Doing this "underestimates the economic effects because in reality the AGI would be granted fully on new financing operations" (European Commission, 2016: 155).

72 Combining information from Orbis and EUROSTAT, JRC (2016) estimated the average asset structure of industrial firms in Europe in order to calibrate the CORTAX model used in the Impact Assessment of the effects of the CCCTB

depreciation rate, the results in table A2 imply a reduction of the present value of deductions of about 50% compared to the ACE. This represents the cost in terms of incentive to invest and to strengthen financial structures; it should be weighed against the benefit in terms of lower tax revenue losses in the long-run which - for instance for a growth rate of equity equal to 4% - are estimated to be 20% of the revenues losses of an ACE system (see table A1).

Table A2. Correction AGI factor $\left[1 - e^{-(\theta+\rho)n}\right]$ of the present value of the ACE deductions

Depreciation rate	Discount factor (ρ)			
	4%		7%	
	AGI Italy (n = 5)	AGI – CCTB (n = 10)	AGI Italy (n = 5)	AGI – CCTB (n = 10)
0%	0.18	0.33	0.30	0.50
5%	0.36	0.60	0.45	0.70
10%	0.50	0.75	0.57	0.82
20%	0.70	0.91	0.74	0.93
30%	0.82	0.97	0.84	0.98

Notes: discount factors are derived assuming a 2% inflation rate and real interest rates equal to 2% and 5%. Tax depreciation = Economic depreciation.

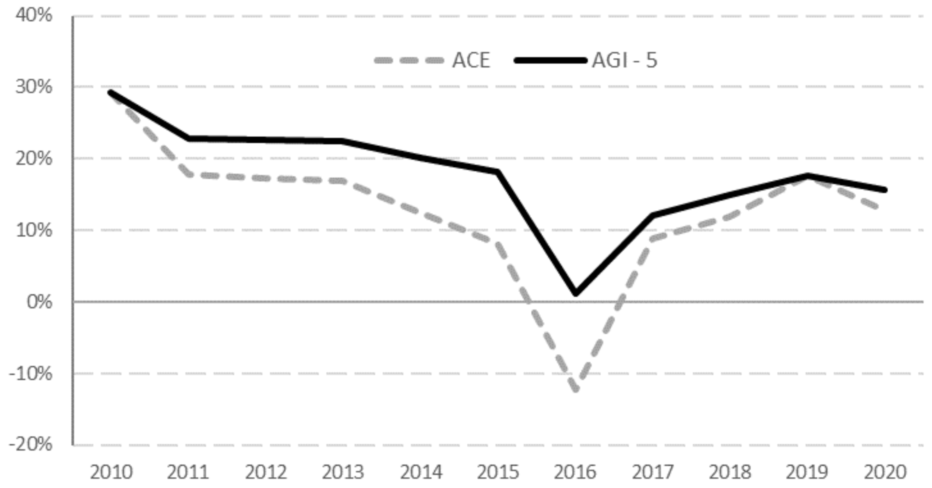
A comparison between ACE and AGI-type regimes. As seen above, the cost of capital for an AGI-type system can be computed by scaling down the present value of the ACE deductions by a factor that depends on the number of years taken into account for the computation of the moving ACE base, the depreciation rate and the discount factor.

Figure A1 compares the average EMTR for all the period under analysis (this is the EMTR corresponding to the cost of capital in Figure 3 in the main text) and the EMTR computed substituting the AGI-5 regime to the ACE in the period 2011-2018 and 2020. As expected, the AGI-5 regime brings about an increase of the cost of capital and therefore of the EMTR. More precisely, the average aggregate cost of capital over the ACE period increases from 5.6% to 6.0% and the average EMTR from 10.4% to 16.7%. This is the order of magnitude of the negative effects of the AGI-5 regime with respect to the ACE in terms of the tax incentives to invest and to rebalance the financial structures; these negative effects should be compared with the larger corporate tax revenues in the long-run associated with the AGI-5 regime due to the broader tax base (see table A1).

Another set of computations considers equity-funded investments in assets with different depreciation rates (equal to 0%, 5%, 10%, 20% and 30%) to show how the effects of the AGI-type systems vary across assets. Indeed, these regimes – differently from the ACE – imply a cost of capital and effective tax rates that depend on the depreciation rates. In order to provide a clearer comparison between ACE and AGI-5, the following computations take into account only the CIT regime; moreover, the ratio between the notional equity rate and the market interest rate is set equal to 1 (ACE-100%). For these computations, inflation is set equal to zero in order to have a cost of capital constant across assets in a system with no incentives to equity. Consistently with the formal analysis in section 4.3 and the previous results, figure A2 shows that the aggregate cost of capital for an AGI-5 regime is larger than the cost of capital under the ACE regime (on average, 5.7% vs 5.0%). The difference of the cost of capital across the two regimes is decreasing with the depreciation rate and goes from 1.2% for an asset with no depreciation to 0.3% for an asset with a 30% depreciation rate.

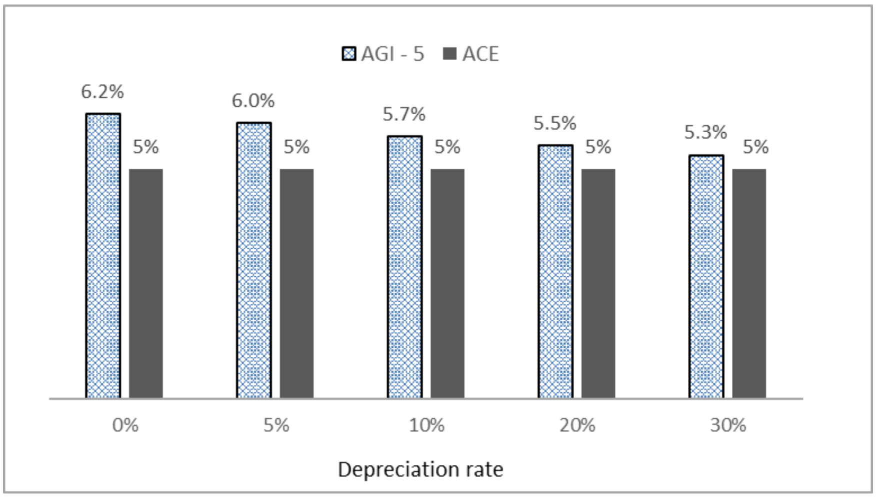
proposed by the European Commission. For Italy, in 2012 the asset structure was the following: Buildings, 19.8%; Machinery 25.3%; Intangibles 9.9%; Inventories 37.2%; Land 7.8%. Applying depreciation rates equal to 5%, 20%, 20%, 0% and 0% (respectively) to the above assets, one gets an average depreciation rate of approximately 8%.

Figure A1. EMTR in ACE and AGI-5: 2010-2020



Notes: AGI-5 is an incremental ACE system where only the equity increases of the last 5 years are relevant. The computations are based on the actual tax parameters (table 2) and the actual ratio between ACE notional rate and market interest rate (figure 2). For the AGI-5 system, the corrections factors of the ACE cash flow effects are taken from table A2. The EMTR is an average across sources of finance (retained earnings: 55%, new equity: 10% and debt: 35%) and equally weighted assets with tax depreciation rates of 0%, 5%, 10%, 20% and 30% (assumed equal to economic depreciation rates). For details on the calibration of the model, see par. 6.1.

Figure A2. Cost of capital for equity-funded investments in ACE and AGI-5 (only CIT)



Notes: Only CIT. AGI-5 is an incremental ACE system where only the equity increases of the last 5 years are relevant. Ratio between notional rate and the reference market interest rate set equal to 1. For the AGI-5 system, the corrections factors of the ACE cash flow effects are taken from table A2. Economic depreciation = Tax depreciation. No inflation. For details on the calibration of the model, see par. 6.1.

Annex 3: The Mini-Ires regimes

This Annex shows the derivation of the cash flow effect of the Mini-Ires regime (thereinafter, M-I regime) of equation [27]. It also provides an analysis of the first version of the M-I regime introduced by the 2019 Budget Law that was changed just after a few months.

The cash flow effect of the M-I regime. For the analysis of the M-I regime, the first step is to derive a dynamic equation for retained earnings since this is the basis for the computation of the part of the tax base that will be subject to the lower tax rate. Define retained earnings as RE. The change over time of retained earnings ($\dot{RE} \stackrel{\text{def}}{=} dRE/dt$) can be written as follows:

$$\dot{RE} = F(K) - iB - \delta K - T^{accr} - D \qquad [A7]$$

where *F(K)* measures revenues as function of the stock of capital, *i* is the nominal interest rate paid on the stock of debt B, δ is the economic depreciation rate, T^{accr} measures corporate taxes in accruals terms (so called *imposte di competenza*) and D measures dividends. Given the implicit legislative reference to accounting income, in equation [A7] the accrual definitions of depreciation and corporate taxes are used.

Equation [A7] can be re-written using the equation measuring the flows of cash dividends to shareholders:

$$D - N = F(K) - I + \dot{B} - iB - T^{cash} \qquad [A8]$$

where N measures new issues of shares, I measures gross investment, $\dot{B}$ is the change of the stock of debt and T^{cash} is the corporate tax bill.

Using equation [A8] into equation [A7] gives:

$$\dot{RE} = I - \delta K - \dot{B} - N - (T^{accr} - T^{cash}) \qquad [A9]$$

The next step is to derive the difference between the accrual definition and the cash definition of corporate taxes. Under the M-I regime, the corporate tax bill, T^{cash}, can be written as follows:

$$T^{cash} = \tau^{low} \max[\dot{RE}, 0] + \tau_{cit}[F(K) - iB - \theta K^T - \max[\dot{RE}, 0]] + $$
$$+\tau_{irap}[F(K) - \theta K^T] \qquad [A10]$$

where τ^{low} is the tax rate applied to the previous year's retained earnings (lower than the standard corporate income tax rate) and K^T measures the tax-written-down value of capital stock ($\dot{K^T} = I - \theta K^T$). Notice that only the increases of retained earnings are considered, since the M-I regime provides a one-off reduction of taxation, rather than a simple deferral of taxation. Equation [A10] can be re-written to isolate the effect of the new regime:

$$T^{cash} = \tau_{cit}[F(K) - iB - \theta K^T] + \tau_{irap}[F(K) - \theta K^T] - (\tau_{cit} - \tau^{low}) \cdot \max[\dot{RE}, 0] \qquad [A11]$$

where τ is the overall tax rate (CIT + IRAP).

The accrual-based definition of corporate taxes is instead the following:

$$T^{accr} = \tau_{cit}[F(K) - iB - \delta K] + \tau_{irap}[F(K) - \delta K] - (\tau_{cit} - \tau^{low}) \cdot \max[\dot{RE}, 0] \qquad [A12]$$

Based on [A11] and [A12], equation [A9] can be re-written as follows:

$$\dot{RE} = I - \delta K - \dot{B} - N - \tau(\theta K^T - \delta K) \qquad [A13]$$

According to equation [A13], the retained earnings relevant for the application of the M-I regime are equal to the part of net investment ($I - \delta K$) that is not funded out of new debt ($\dot{B}$), new issues of shares (N) and the difference between the accrual and cash definition of corporate taxes ($\tau(\theta K^T - \delta K)$). Since only the increases of retained earnings are considered in the evaluation of the effects of the M-I regime (the depreciation of the asset and the resulting reduction of retained earnings over time are not relevant) and since in the initial period the difference between tax and economic depreciation is given, the only relevant component for the application of the regime is the part of the gross investment (I) funded with retained earnings.

Based on equations [A11] and [A13], the present value of the cash flows due to M-I regime for a 1 Euro investment funded with retained earnings ($\dot{B} = N = 0$), MI^{RE}, is simply equal to:

$$MI^{RE} = \frac{(\tau_{cit} - \tau^{low})}{1+\rho} \quad \text{[A14]}$$

The M-I 1.0 regime. The first version of the "Mini-Ires" regime (henceforth "M-I 1.0") - released with the 2019 Budget Law - had several features that are not present under the new regime introduced in April 2019 with the Law Decree 34/2019. In what follows, the analysis considers the effects on the cost of capital and on financial preferences.

Effects on the cost of capital. As under the regime that was finally implemented, also under the M-I 1.0 regime the previous year's retained earnings would have been taken into account for the computation of the part of income to tax at a lower statutory tax rate (in the M-I 1.0 regime, $\tau_{MI1.0}^{low}$ =15%). The equation of motion of retained earnings derived above [A13] is therefore still valid as a starting point for the analysis of this regime. However, under the M-I 1.0 regime, the tax base subject to the lower statutory tax rate would not have been the whole retained earnings, but the sum of the yearly tax depreciations related to the new investments made as from 2019 and the additional yearly labour cost related to an expansion of the firm's labor force as from 2019. In the following, the focus is on the investment component of the regime.

Given the reference to the yearly fiscal depreciation related to the new capital expenses, under the M-I 1.0 regime the cash flow benefits would have been spread over the lifetime of the investment, rather than being concentrated at the beginning of the investment period (at time *t+1*), as under the M-I regime actually implemented. Crucially, in order for these cash benefits to materialize, a specific firm's overall financial policy would have also been necessary, requiring at the margin over the lifetime of the investment an increase of retained earnings at least equal to the investment's tax depreciation θ[73]. The analysis of this regime is therefore more complicated than under the final M-I regime since the cost of capital depends on future choices regarding the firm's financial structure.

Assume that the company would have to incur the additional financial costs to access the tax benefits of the regime. This is equivalent to assume that, when the firm decides to undertake a new investment, it is already choosing optimally its future financial policy; therefore, by changing the financial structure there would have been additional financial costs at the margin.

In this case, the present value of the cash flow benefits is the following:

$$MI1.0^{RE-D} = \int_0^\infty \theta \cdot [(\tau_{cit} - \tau^{low}) - \rho] \cdot e^{-(\theta+\rho)u} du = \frac{\theta \cdot [(\tau_{cit} - \tau^{low}) - \rho]}{\rho + \theta} \quad \text{[A15]}$$

Notice that the cash flow effect of the M-I 1.0 regime is increasing with the depreciation rate, while the effect of the actual M-I regime (equation [A14]) does not depend on the depreciation rate. This implies that the M-I 1.0 regime would have been more favorable for assets with larger depreciation rates.

Comparing equations [A14] and [A15], the ranking between the two M-I regimes depends crucially on the discount factor. If the discount factor is larger than $(\tau_{cit} - \tau^{low})$ then the cost of accessing the M.I 1.0 regime is too high, compared with the benefits. In this case, for the company it is optimal not to access the M-I 1.0 regime, and the actual M-I regime is strictly preferable to the M-I 1.0 regime. Instead, if the discount factor is lower than $(\tau_{cit} - \tau^{low})$ then it is optimal for the company to take advantage of the M-I 1.0 regime, and the ranking between the two M-I regimes depends on the level

[73] Moreover, in order for these cash benefits to materialize, not only a specific financial structure is necessary over the lifetime of the investment – but a specific firm's overall investment policy would have also been necessary. Indeed, another condition specified in the law was that the yearly tax depreciation related to the new investments from 2019 could not be higher than the increase of the net stock of capital with respect to the base year (2018). This further limit has not been explicitly modelled. In the above discussion it is assumed that over the investment horizon gross investments are at least equal to the depreciation of the stock of capital existing in the base year so that the previous limit is not binding.

of the discount factor. In general, in this case it is possible to show that M-I 1.0 tends to be preferable, especially for assets with larger depreciation rates.

Effects on the financial structure. The above analysis of the possible effects of M-I 1.0 on the cost of capital has considered a particular kind of investment, fully funded with retained earnings. For this investment, the financial preference between debt and retained earnings depends – as above the ranking between the two M-I regimes – on the cost of the additional reserves necessary to access the tax benefits of the regime during the lifetime of the investment. By comparing the present value of interest deductions for debt (equation [8] in the main text and equation [A15] above for retained earnings, it is possible to show that, for the investments fully funded with retained earnings, there is a cut-off value of the discount factor such that for larger values debt is strictly preferred to retained earnings, while for lower values the opposite holds true for large enough depreciation rates.

However, the analysis of the financial preferences under the M-I 1.0 regime could be trickier. Since under the M-I 1.0 regime initially setting aside 1 Euro would have given access to tax savings only on a percentage of this reserve equal to the tax depreciation rate, in principle a firm could have tried to maximize the overall tax benefits (debt and equity) using a mixed financial strategy: funding initially (at time *t*) the investment with debt, but for the part necessary to access the tax benefits of the M-I 1.0 regime in the next period (at time *t+1*); retiring then the debt at a rate that would have allowed to benefit as much as possible of debt finance, while at the same time fully accessing the M-I 1.0 regime. In doing so, no additional reserve costs to access the tax benefits of the M-I 1.0 regime would have been incurred.

In order to analyze quantitatively this case, it is necessary to formally characterize the average financial structure over the lifetime of the investment described above. As first step, compute the present value of the interests paid to fund this type of investment[74]. Assume that initially the investment is funded by a proportion equal to $(1-\theta)$ with debt and a proportion equal to θ with retained earnings. In this way, it will be possible to access the full possible benefits of the M-I 1.0 regime in the next period. Then the firm retires the debt at a rate equal to $(\theta+\delta)$. This allows maintaining debt as a funding source as much as possible and, at the same time, accessing the full benefits of the M-I 1.0 regime. Under these assumptions, the present value of the interests is equal to $\int_0^\infty (1-\theta)\cdot i\cdot(1-\tau_{cit})\cdot e^{-(\rho+\theta+\delta)u}du = i(1-\tau_{cit})(1-\theta)/(\rho+\theta+\delta)$. Assume now that a share μ of the asset is debt-funded and debt retirement is undertaken in a way that maintains constant at μ the ratio between debt and the replacement value of the asset (so that, for discounting, the economic depreciation rate and the inflation rate – assumed common to output and capital goods – have to be considered). In this case, the present value of the interests is equal to $\int_0^\infty i\cdot(1-\tau_{cit})\cdot\mu\cdot e^{-(\rho-\pi+\delta)u}du = i\cdot(1-\tau_{cit})\cdot\mu/(\rho-\pi+\delta)$. By equating the previous two present values, it gives the average proportion of debt finance over the life of the investment:

$$\mu = \frac{\rho-\pi+\delta}{\rho+\theta+\delta}(1-\theta) \qquad \text{[A16]}$$

The cost of capital for an investment funded with the mixed financial strategy can be then computed by considering both the present value of interests' deduction for a debt-funded investment (equation [8] in the main text with $\beta = 1$), scaled down by the weight μ (equation [A16]), and the present value of the cash flows due to the M-I 1.0 regime, with no financial cost of the additional equity reserves (equation [A15] without ρ at the numerator). Formally, the overall present value would be the following:

$$MI1.0^{RE-D} = \frac{\theta\cdot(\tau_{cit}-\tau^{low})}{\rho+\theta} + \mu\cdot\frac{\tau\cdot i}{\delta+\rho} \qquad \text{[A17]}$$

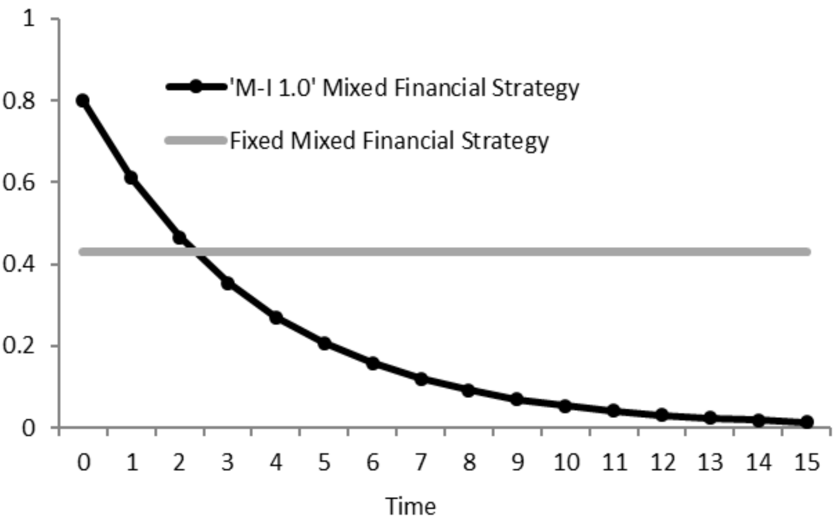
Clearly, the present value of the tax benefits for the investment funded with the mixed financial strategy is larger than the present value of the tax benefits for an investment funded only with retained

[74] This approach to derive the average leverage ratio – in present value terms – over the investment lifetime was originally proposed by Södersten (1982) in the analysis of the effects of accelerated depreciation on the cost of capital.

earnings ($MI1.0^{RE-D} > MI1.0^{RE}$). More interestingly, it is possible to show that the present value of the tax benefits deriving from using both debt and equity with the mixed financial strategy is also larger than the max present value of interest deductions for a debt-funded investment (see equation [8]). Therefore, the cost of capital for the investment funded with debt and retained earnings, and with a specific pattern of the two funding sources over time, is lower than the cost of capital for a debt-funded investment. For the comparison between the two M-I regimes, this implies that the effect of the M-I 1.0 regime on the reduction of the cost of capital could potentially be much larger than under the actual M-I regime.

Just to give some numerical examples, with an inflation rate of 2% and a nominal discount factor of 7%, with the mixed financial strategy the average leverages are equal to 50%, 43% and 37% for assets with tax depreciation rates (set for simplicity equal to the economic depreciation rates) equal to 10%, 20% and 30%, respectively. The mixed financial strategy described above implies a specific pattern over time of the debt/asset ratio of the investment (leverage), with a larger role for debt in the initial periods. As an example, Figure A3 shows the leverage ratios of two investments with a depreciation rate of 20%, sharing the same *average* financial structure, but with different financial structures in each point in time over the investment horizon: one with fixed proportions of debt and retained earnings (43% and 57%, respectively) and another with variable proportions. The figure shows that under the mixed financial strategy that allows exploiting the M-I 1.0 regime, while at the same time sacrificing the minimum level of debt funding, the actual leverage ratio is higher than the average leverage for the first three periods.

Figure A3. Leverage under financial structures equivalent in present value terms



Notes: depreciation rate = 20%; discount factor = 7%; inflation rate = 2%.

To sum up, on average under the M-I 1.0 regime the tax incentive to increase equity funding through retained earnings would have been stronger than under the M-I regime (where the debt remains the tax-preferred source of finance), since the tax-preferred financial structure includes both debt and retained earnings in given proportions. However, the M-I 1.0 regime could have affected the time pattern of the financial structure of the investments, favoring debt in the initial periods, with the consequence of making the financial structures more fragile in the initial stages. This effect is somehow at odds with one of the original goals of the regime, namely promoting more robust financial structures.

Annex 4: Real estate tax and the taxation of nominal interest rates

Real estate tax. For industrial buildings (the asset with a 5% depreciation rate), the model takes into account the real estate tax. For the period 2010-2011, the real estate tax was the ICI (*imposta comunale sugli immobili).* As from 2012, ICI was replaced by IMU (*imposta municipale sugli immobili*). For ICI, the tax rate varied between 0.4% and 0.7%. In the computations, the average rate 0.55% is used. For IMU, the standard rate is 0.76%. As regards the taxable base of the two real estate taxes, it is assumed an amount equal to 1/3 of the acquisition cost for in the year 2010 (as for the residential building) (see Guerrieri, 2016), and then for the following years the ratio is adjusted based on the dynamic of the pricing for industrial buildings taken from the "Rapporto Immobiliare" published by Agenzia del Terrirorio and then by the Agenzia delle Entrate (Years 2010-2018)[75], as well as the changes of the cadastral values in 2012 and 2013 in the transition from ICI to IMU. Differently from ZEW-PWC (2020), the effective tax rates are computed considering the rules for the deductibility of the real estate tax against the CIT base. More precisely, in the period 2014-2018 20% of the wealth tax was deductible against the corporate income tax base. The 2019 Budget Law increased the percentage of deductibility to 40%. After a few months the Law Decree "Crescita" (DL 34/2019) changed substantially the tax benefit, increasing the percentage of deductibility to 50% in 2019, 60% in the period 2020-2021, 70% in 2022, and 100% from 2023.

In terms of modelling, given a certain percentage of deductibility (d_1), the CIT rate τ and the nominal wealth tax rate τ_w, the effective tax rate τ_w^{eff} is computed as follows[76]:

$$\tau_w^{eff} = \tau_w(1 - d_1 \cdot \tau) \qquad [A18]$$

Table A3 summarizes the nominal and effective tax rate for the wealth tax for industrial buildings.

Table A3. Real estate tax for companies, 2010-2023

	Statutory tax rate (%)	% deductibility	Tax Value/ Acquisition cost (a) (%)	Effective tax rate (%)
2010-2011	0.55	0	33	0.18
2012	0.76	0	39	0.30
2013	0.76	0	43	0.33
2014	0.76	20	43	0.31
2015	0.76	20	44	0.32
2016	0.76	20	45	0.32
2017	0.76	20	46	0.33
2018	0.76	20	47	0.34
2019	0.76	50	47	0.32
2020-2021	0.76	60	47	0.31
2022	0.76	70	47	0.30
2023	0.76	100	47	0.27

Notes: (a) The assumption on the ratio between tax value and acquisition cost are based on Guerrieri (2016) and the dynamic of the price for industrial building for the period 2010-2018.

Based on the effective tax rate τ_w^{eff} of equation [A18] the cash flow effects of the wealth tax are the following:

$$T^W = \int_0^\infty \tau_w^{eff} \cdot e^{-(\delta+\rho-\pi)u} du = \frac{\tau_w^{eff}}{(\delta+\rho-\pi)} \qquad [A19]$$

[75] See https://www.agenziaentrate.gov.it/portale/web/guest/schede/fabbricatiterreni/omi/pubblicazioni/rapporti-immobiliari-non-residenziali.

[76] See also the discussion in King and Fullerton (1984: p. 20).

Based on equation [1] in the main text, the net present value of taxes for industrial building can be written as follows:

$$NPVT = \frac{\tau(p+\delta)}{\rho+\delta-\pi} - A + \frac{\tau_w^{eff}}{(\delta+\rho-\pi)} \qquad [A20]$$

The inflation tax on financial assets. Inflation may lead to a higher tax burden for financial assets, reflecting the taxation of nominal interest rates. In order to deal with this, for financial assets ZEW-PWC (2020) considers an additional tax of $\tau \cdot \pi$ per annum in the computation of the present discounted value of the profits of the investment, net of taxes, that has the following general form[77]:

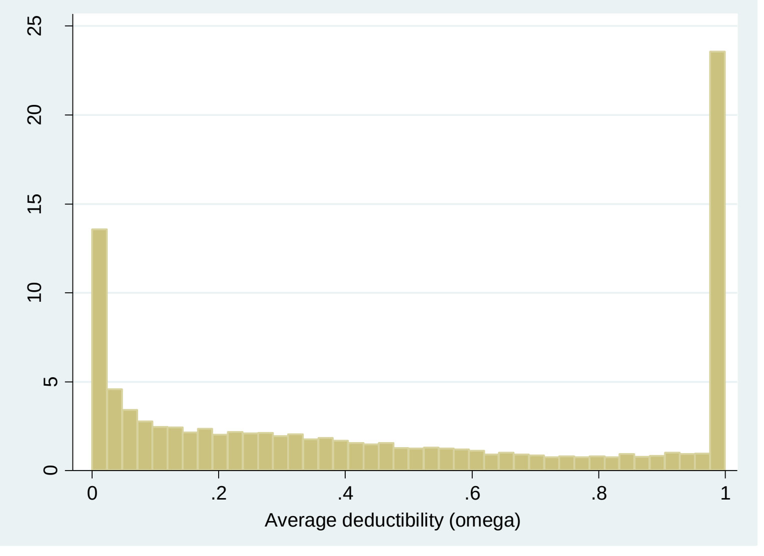
$$V = \frac{(p+\delta)(1-\tau) - \tau \cdot \pi}{\rho+\delta-\pi} \qquad [A21]$$

Annex 5: Calibrating the earning stripping rule for interest costs

In order to get some insights on the reduction of the present value of interest deductibility due to the earning stripping rule (the β parameter; see par. 5.1 in the main text), it is possible to rely on publicly available tax data on the average deductibility for single companies (in the model this corresponds to the ω parameter). The information can be only recovered at the level of province, economic sector and turnover (compressing more than 1 million tax returns into approximately 28,000 cells)[78]. The average deductibility is computed as the ratio between the deducted interests (interest expenses corresponding to interest incomes plus the interest expenses corresponding to 30% of EBITDA – Earnings Before Interests, Taxes, Depreciation and Amortization) and interests which could be deducted in absence of restrictions (interest expenses accrued in the period plus interests carried forward from the previous periods).

Figure A4 shows the distribution of the average deductibility in 2016 (the latest available) across the cells for which the information on interests is available (about 18,000 cells). The mean of the distribution is equal to 38% (median 47%). Cells with a deductibility close or equal to zero count for about 14% of the sample. Clearly, this feature of the distribution, as well as the large probability mass on lower deductibility levels, is strongly affected by the possible presence of loss making companies (about 1/3 of the total number of companies) in each of the cells.

Figure A4. Average deductibility of interest costs against corporate income tax base (year 2016)



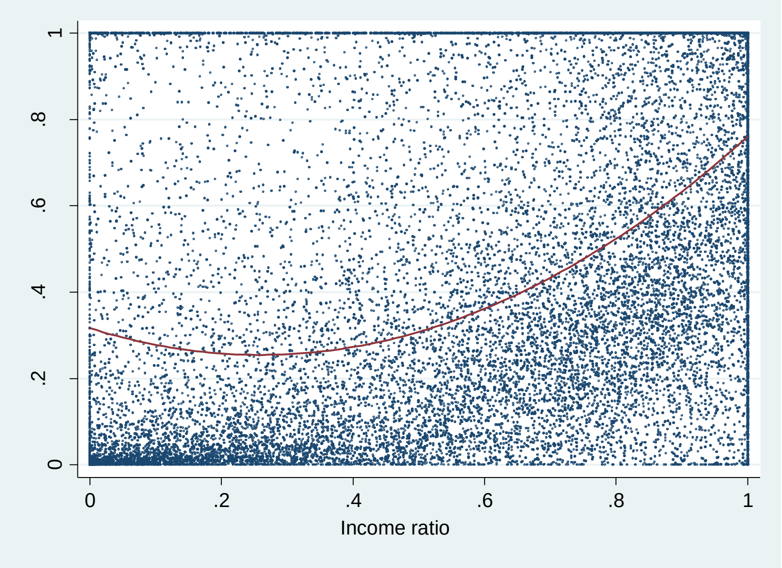
Source: own elaborations on tax data (www.portaledelfederalismo.it).

77 See also the discussion in King and Fullerton (1984: p. 21; equation 2.22).
78 Data source: "Portale del federalismo" (*https://www.portalefederalismofiscale.gov.it/portale*).

In order to isolate the effects of loss-making companies, it is possible to measure the relative relevance of tax incomes and tax losses for each of the identified cell. Figure A5 shows the average deductibility as a function of an "income ratio" computed at the cell level as the ratio between total income and the sum of total income and total losses. As the figure shows, indeed deductibility increases as taxable income becomes more important at the cell level.

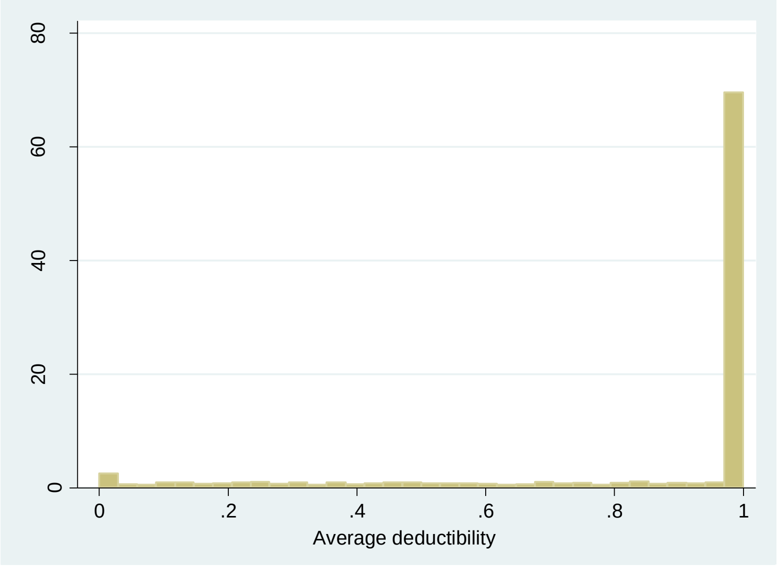
Focusing only on those cells with no loss-making companies shows a very high probability of full deduction (see figure A6): indeed, for 70% of the cells the average deductibility is equal to 1. However, for the remaining 30% the deductibility is distributed almost uniformly from zero to 0.9. The average deductibility for cells with no loss-making companies is equal to 0.78.

Figure A5. Average deductibility of interest costs and the income ratio



Source: own elaborations on tax data (www.portaledelfederalismo.it).
Notes: the income ratio is computed at the cell level as the ratio between total income and the sum between total income and total losses.

Figure A6. Distribution of average deductibility of interest costs for cells with no loss-making companies



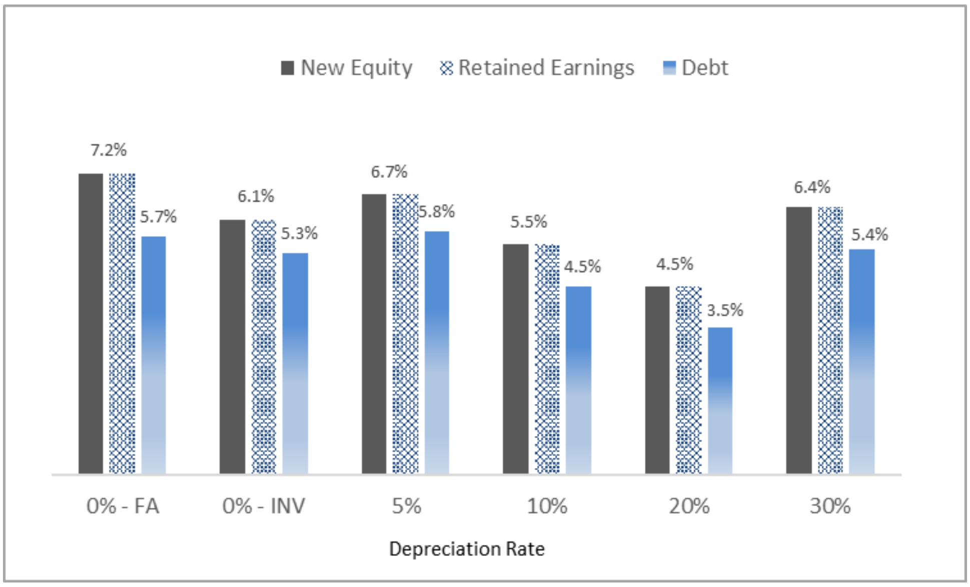
Source: own elaborations on tax data (www.portaledelfederalismo.it).
Notes: the income ratio is computed at the cell level as the ratio between total income and the sum between total income and total losses.

In the evaluation of the deductibility it is also important to consider that about 20% of interests that are not deducted at the level of single companies are deducted at the group level within the tax consolidation regime (Euro 9.4 bn on Euro 44.6 bn).

Against the previous discussion, in the base scenario the deductibility parameter ω is set at 75%. A sensitivity analysis is carried out for the laxer scenario ω = *100%* and for several stricter scenarios (see par. 6. 4).

Annex 6: Detailed results on the cost of capital in 2020

Figure A7. Cost of capital across assets and sources of finance, 2020



Notes: 0% - FA refers to financial asset; 0% - INV refers to inventories. Real interest rate = 5%; inflation rate = 2%. For details on the calibration of the model, see par. 6.1.

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