INCREASED EFFICIENCY THROUGH CONSOLIDATION AND FORMULA APPORTIONMENT IN THE EUROPEAN UNION?

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Increased efficiency through consolidation and formula apportionment in the European Union?

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Abstract

This paper assesses the efficiency properties of recent corporation tax reform proposals of the European Union to introduce international loss consolidation and formula apportionment. We extend the effective tax rate methodology of Devereux and Griffith (1999) to allow for a potential loss and use a large firm level data set to identify the distortions under the current system and following proposed tax reforms. We assess the efficiency of the overall tax system using the two concepts of capital export neutrality and market neutrality. Allowing international loss consolidation in the current system would signify a movement away from both notions of efficiency. A common consolidated tax base with formula apportionment system would move the system towards market neutrality, while improving capital export neutrality only little.

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1 Introduction

The European Commission's plans for corporation tax reform in the European Union are now firmly fixed on the common consolidated tax base. However, the process has been slow and has faced considerable opposition from various Member States. So the European Commission adopted a new strategy of stepwise reform proposals. Along these lines Agúndez-García (2006) discusses international loss consolidation and various forms of formula apportionment. These proposals aim to reduce compliance costs, mitigate problems with transfer pricing and enhance an efficient distribution of investment within the European Union. While some empirical research examines the impact of such tax reforms on the Member States tax revenues, the efficiency aspects have so far received little attention.

This paper tries to fill this gap by analysing the changes in efficiency through the introduction of international loss consolidation and formula apportionment. For our purpose we measure efficiency in two dimensions: (i) *capital export neutrality* (CEN), which - in this context - holds if capital invested by a company faces the same tax burden, regardless of where it invested, and (ii) *market neutrality* (MN), which holds if no company gains a competitive advantage over another due to differences in the taxes that they face. These concepts are introduced and developed further in Section 2.[1]

We assess the extent to which the European corporation tax system meets these criteria by analysing the variation in effective corporate tax rates. We use the methodology developed by Devereux and Griffith (1999) and extend it to allow for a potential loss on the hypothetical investment measured. We also extend it to make use of a large micro-level dataset to identify firm-specific effective tax rates, which allows us to examine the distribution of the effective tax burden across firms. This allows us to compare the distortions under the current system with the potential distortions under the new system with international loss consolidation and formula apportionment.

The introduction of international loss consolidation would increase the variation in effective tax burdens, which would represent a move away from both CEN and MN. However, combining international loss consolidation with a common tax base and formula apportionment would correct most of these new distortions and signify a substantial improvement in terms of MN. However, the same move would, because of differences in statutory corporate tax rates across Member States, fail to improve significantly in terms of CEN. However, cross border loss consolidation would open substantial tax saving opportunities, which would only be mitigated under the formula apportionment system; we do not evaluate the benefit of this change.

2 Efficiency concepts

The starting point for any analysis of optimal tax systems is the Diamond and Mirrlees (1971) framework which demonstrated that, within a single country, it is optimal to preserve production efficiency. This holds when it is not possible to increase total output by reallocating inputs to different uses, and implies that the marginal pre-tax rate of return is the same on all investments. However, the Diamond-Mirrlees theorem relies on two critical assumptions: that there are no restrictions on the use of tax instruments available to the government, and that

[1] The concept of capital export neutrality dates back to Musgrave (1959) and Richman (1963).

economic rent is fully taxed at 100%[2] (or there is no economic rent). Keen and Piekola (1996) analyse optimal tax rates between co-operating countries when economic rents exist but cannot be taxed at a rate of 100%. In this case, the optimal tax system depends on similar factors to those identified by Horst (1980); namely the elasticity of the supply of savings and the elasticity of the demand for capital in each jurisdiction. Keen and Piekola also show that the optimal tax structure depends on the rate at which economic rents are taxed.

A further caveat was introduced in an international context by Keen and Wildasin (2004). They point out that the Diamond-Mirrlees model does not directly apply in an international setting, since there is no longer a single government budget constraint, but each country has its own budget constraint. They analyse the case in which lump sum transfers between governments are ruled out, but where transfers can instead take place via trade taxes and subsidies. Under these circumstances, it may be the case that the optimal (Pareto-efficient) tax system does not generate production efficiency. However, as argued by Edwards (2005), if the aim is to generate a global optimum, it is not clear why governments should co-operate by adjusting their trade taxes, rather than agreeing to lump-sum transfers. In the latter case, we are effectively returned to the Diamond-Mirrlees setting of a single budget constraint.

Although the global optimality of production efficiency is an important issue, we leave these caveats to one side and instead focus on the implications for the design of international taxes on profit of a requirement for production efficiency within the European Union. We consider each member state to be a small open economy, with access to international portfolio investment. This implies that all companies are required to earn the same rate of return after source-based taxes on capital income. Specifically, if corporation tax are source-based, but personal taxes are residence-based, then the post-corporation tax rate of return is fixed for any company. We also assume that companies can choose where to locate their investments, and can also supply third country markets through exporting.

In this setting, Devereux (2008) discusses the properties of international corporation tax systems that would generate production efficiency. It is clearly the case that if the post-tax rate of return is fixed and production efficiency requires the pre-tax rate of return to be the same on all possible investments, then production efficiency requires the effective tax wedge between pre- and post-tax rates of return to be the same for all possible investments. This requires the complete harmonisation of all source-based corporation taxes.

However, in this paper we split this requirement into two elements, which illuminate the nature of the proposed tax reforms in Europe. The first element is capital export neutrality (CEN) (applied to corporation tax):[3] that is, any individual company must face the same effective tax rate on any investment, irrespective of the location of that investment. In the absence of CEN, taxes may induce a company to produce in a less efficient location.[4] We measure the extent to which the existing, and proposed, European corporation tax systems meet the requirement of CEN by considering the company-specific effective average and marginal tax rates (EATRs and EMTRs) facing any firm when investing either at home or in any of

[2] See Stiglitz and Dasgupta (1971).

[3] This concept was introduced by Musgrave (1959).

[4] In a setting without a distinction between portfolio and direct international investment, CEN can be sufficient to achieve production efficiency. However, with a fixed post-tax rate of return it is not a sufficient condition.

the other 26 EU member states. For each measure, we take the standard deviation of the distribution of effective tax rates for each individual company (separately for the EATR and EMTR). CEN requires these standard deviations to be zero. We consider whether potential reforms move the overall system closer towards CEN by comparing the distribution of these standard deviations across companies under the existing and hypothetical tax systems.

The second element we consider we refer to as market neutrality (MN).[5] This is related to concepts of Devereux (1990) and, Desai and Hines, (2003). The concept of MN is that the tax system should not favour one company over another company with which it competes. If this did not hold, then a less efficient company may have a competitive advantage over a more efficient company. This of course requires there to be differences in efficiency between companies, a point emphasised by Desai and Hines (2003) in developing their concept of capital ownership neutrality (CON). Desai and Hines' concept of CON is that the tax system should not prevent a more efficient owner acquiring an asset from a less efficient owner. If all assets were indeed owned by their most efficient owner, then distortion to competition would be irrelevant. However, this is clearly not the case in practice: companies with different levels of efficiency do co-exist. If they do co-exist, the production efficiency requires the broader concept that there is no distortion in the market, so that the competitive advantage of more efficient companies is not undermined. In the absence of international trade, the condition for the absence of any distortion in the market is capital import neutrality (Richman, 1963): that all firms operating in a given jurisdiction should face the same effective tax rate. But with international trade, companies producing in different countries may nevertheless compete with each other in third countries. In that case, production efficiency requires that any company competing (or potentially competing) with any other in a given market must face the same effective tax rate; this is market neutrality.

To consider how close existing and hypothetical tax systems are to MN, we identify a single effective tax rate facing each company as it competes in any potential market: we measure this by the average or minimum effective tax rate across all possible investment locations. We also consider separately both the effective average tax rate (EATR) and the effective marginal tax rate (EMTR). We then consider the variation in the distribution of these single tax rates across companies. If there were no variation at all, then the tax system would exhibit market neutrality; the more variation, the further the tax system is from market neutrality.

As noted above, both CEN and MN are required for production efficiency. By investigating the proximity of the existing and hypothetical tax systems to each of these, we believe that it is possible to identify the strengths and weaknesses of alternative tax systems.

3 Methodology

3.1 The effective tax rate approach

The measures of effective average and marginal tax rates used here build on the cost of capital approach of Jorgensen (1963) and Hall and Jorgensen (1967), which was further developed by King and Fullerton (1984) and by Devereux and Griffith

[5] This concept was called capital ownership neutrality by Devereux (1990); however, we relabel it here as market neutrality.

(1999).[6] The OECD (1991), Yoo (2003) and the Commission of the European Union (1992 and 2001) have employed and discussed this methodology in detail; therefore we only summarize it briefly.

We consider a one-period investment by a firm in the home country through a subsidiary in a host country. We model this as an increase in investment in period t of $dI_t = 1$ followed by a reduction of the investment in period $t+1$ of $dI_{t+1} = -(1-\delta)(1+\pi)$ where δ denote the economic depreciation and π is the nominal inflation rate.[7] The perturbation in the capital stocks generates an additional nominal output in period $t+1$ of $(p+\delta)(1+\pi)$ where p represents the real financial return. In the absence of taxation and assuming that purchasing power parity holds the net present value of the additional income stream is

$$R^* = -1 + \frac{1}{1+\rho}\left\{(1+\pi)(p+\delta) + (1+\pi)(1-\delta)\right\} = \frac{p-r}{1+r} \qquad (1)$$

where ρ is the shareholder's discount rate. In general in this paper, we abstract from personal taxes, so that the discount rate is simply the nominal interest rate, $i = (1+r)(1+\pi) - 1$.[8]

In the presence of taxation the return is subject to the corporate tax in the host country τ_n, which reduces the return in period $t+1$ to $(p+\delta)(1+\pi)(1-\tau_n)$.[9] Define A_n as the net present value of tax allowances per unit of investment. If the investment could be financed through retained earnings the net present value of the cost of the investment in period t would be $(1-A_n)$. The reduction in investment in period $t+1$ generates a comparable reduction in allowances. We assume that the subsidiary repatriates post-tax income to the parent in the form of a dividend. Define σ_{jn} as the tax due on one unit repatriated to the parent. This depends on the method of double taxation alleviation, as follows:

$$\sigma_{jn} = \begin{cases} c_n & \text{exemption} \\ max\left\{\frac{\tau_j - \tau_n}{1-\tau_n}, c_n\right\} & \text{credit with limitation} \\ \tau_j(1-c_n) + c_n & \text{deduction} \end{cases} \qquad (2)$$

where c_n describes the withholding tax on dividends. Hence the net present value of the after tax income stream if the investment could be financed by retained earnings can be written as

$$\begin{aligned} R_{RE} &= (1-\sigma_{jn})\left[-(1-A_n) + \frac{1}{1+\rho}((1+\pi)(p+\delta)(1-\tau_n)\right. \\ &\quad \left. + (1+\pi)(1-\delta)(1-A_n))\right] \qquad (3) \end{aligned}$$

Other forms of finance: However, in this paper we consider the case in which the investment in the subsidiary is financed externally, rather than by retained earnings. We assume that the external finance is provided by the parent, and also take into account the costs to the parent of raising additional finance. The amount of finance required is $(1-\tau_n\phi_n)$, where ϕ_n denotes the tax depreciation in the first

[6] We mainly use the notation of Devereux and Griffith (2003) which is somewhat simplified. See Devereux and Griffith (1999) for a detailed description of the model.

[7] For simplicity reasons the inflation rate is assumed to be the same for capital and output. Further simplifying assumptions are that inflation and economic depreciation are identical across countries and that purchasing power parity holds, so that the real exchange rate is equal to unity. We can then drop subscripts for the inflation rate.

[8] For the calculations we use parameter values of 0.05 for r and 0.025 for π.

[9] Note that throughout the paper n denotes the host country while j denotes the parent country.

period. In the case of new equity finance, and compared to the hypothetical case of retained earnings, the dividend is not reduced by $(1-\tau_n\phi_n)$ in the first period. However, the dividend is reduced by $(1-\tau_n\phi_n)$ in period $t+1$ in order to repay the newly raised equity of $(1-\tau_n\phi_n)$. Abstracting from taxation at the shareholder level, the net present value of the income stream is unaffected if the new equity is raised in the parent country, while raising new equity in the host country affects the timing of the repatriation tax σ_{jn}.

In the case of debt financing and again relative to the hypothetical case of retained earnings, the shareholder receives a $(1-\tau_n\phi_n)$ higher dividend in period t but in period $t+1$ the debt plus the tax deductible interest needs to be paid back, which amounts to $(1-i(1-\tau_j))(1-\tau_n\phi_n)$. If the subsidiary borrows from the parent company the interest payments are deductible, but there is an additional tax burden because of withholding taxes and the taxation of the receipt of the interest by the parent. We define ω_{jn} as the total tax on interest payments from the subsidiary to the parent, which again depends on the method of double taxation alleviation.

$$\omega_{jn} = \begin{cases} \overline{\omega}_n - \tau_n & \text{exemption} \\ max\left\{\tau_j, \overline{\omega}_n\right\} - \tau_n & \text{credit with limitation} \\ \tau_j(1-\overline{\omega}_n) + \overline{\omega}_n - \tau_n & \text{deduction} \end{cases} \tag{4}$$

where $\overline{\omega}_n$ denotes the withholding tax on interest payments between subsidiaries and parent companies. Denoting the proportion of the cost of the investment financed by new equity in the subsidiary as dN_n and the proportion financed by debt in the subsidiary as dB_n and the proportion ultimately financed by debt in the parent as dB_j, the additional costs of financing in the parent or subsidiary are

$$\begin{aligned} F &= \frac{(1-\tau_n\phi_n)}{1+\rho}\left[\rho - i(1-\tau_j)\right] dB_j + \frac{-\rho\sigma_{jn}}{1+\rho}(1-\tau_n\phi_n)dN_n \\ &+ \frac{(1-\tau_n\phi_n)}{1+\rho}\left\{\sigma_{jn}\left[1+i(1-\tau_n)-(1+\rho)\right] - \omega_{jn}i\right\} dB_n \end{aligned} \tag{5}$$

The size of A_n depends on the type of assets. Machinery is depreciated faster as buildings and inventories can not be depreciated at all. However, if the inventories are valuated according to the FIFO method, the increase in value because of inflation is due to taxation and therefore R^{RE} requires a further adjustment of

$$R_{INV} = -\frac{1}{(1+\rho)}\frac{\tau_n\pi}{(1-\tau_n)(1+\pi)} \tag{6}$$

Setting the NPV of the post-tax income stream,

$$R = R_{RE} + F + R_{INV} \tag{7}$$

equal to zero yields the cost of capital

$$\widetilde{p} = \frac{(r+\delta)(1-A_n)}{1-\tau_n} - \delta + \frac{F(1+r)}{(1-\sigma_{jn})(1-\tau_n)} \tag{8}$$

The $EMTR$ is then defined as

$$EMTR = \frac{\widetilde{p} - r}{\widetilde{p}} \tag{9}$$

The $EATR$ is defined as the difference between the NPV of the income stream in the absence of taxes and NPV of the income stream in the presence of taxes relative to the NPV of the pre-tax total income stream $p/(1+r)$. Using the equations (1) and (7) the $EATR$ is given through

$$\begin{aligned} EATR &= \frac{R^{*}-R}{p/(1+r)} \\ &= \frac{\frac{p-r}{1+r}+(1-\sigma_{jn})\left[\frac{1}{1+r}\left((p+\delta)(1-\tau_n)-(1-A_n)(r+\delta)\right)\right]}{p/(1+r)} \end{aligned} \quad (10)$$

3.2 Effective tax rates for a new subsidiary with potential losses

To capture the potential effects of the introduction of loss consolidation and formula apportionment we need to extend this standard effective tax rate framework. We depart from the original model insofar as we assume that the subsidiary is new, i.e. has neither earnings to be retained as a possible form of finance nor there are any existing profits where any tax depreciation in period t can be claimed. Therefore they present a taxable loss, that can be carried forward into the next period.

More importantly, however, we also introduce a potential loss to the model to account for the differences in the outcome under various different systems of group taxation. With probability q the new investment yields a good outcome of g; with probability $1-q$ it yields a bad outcome b. For the measurement of the $EATR$, in order to compare this to the existing framework, we choose values of q, g and b such that $p = qg+(1-q)b$.[10] We first analyse these two possible outcomes separately.

Good outcome: With a good outcome the subsidiary is profitable, i.e. $(g+\delta)(1+\pi) > 1$, and is therefore liable to taxation in period $t+1$. The taxable loss in period t (equal to the depreciation allowance ϕ_n) can be offset against the profit in period 1. The NPV of allowances, A_n, therefore needs to be adjusted for this delay, which we denote $\hat{A}_n$:

$$\hat{A}_n = A_n - \frac{i\phi_n\tau_n}{1+\rho} \quad (11)$$

Apart from this delayed depreciation the good outcome is exactly the same as described above, therefore the net present value of the investment financed by retained earnings is similar to equation (3) with replacing p with g and A_n with $\hat{A}_n$:

$$\begin{aligned} R^{n.c.}_{RE,GOOD} &= (1-\sigma_{jn})\Big[-(1-\hat{A}_n)+\frac{1}{1+\rho}\left((1+\pi)(g+\delta)(1-\tau_n)\right. \\ &\quad \left.+(1+\pi)(1-\delta)(1-A_n)\right)\Big] \end{aligned} \quad (12)$$

The additional term due to the use alternative forms of finance, (5), needs to be adjusted since the finance which needs to be raised is now 1 instead of $(1-\tau_n\phi_n)$.

[10] In particular we assume $g = 0.3$ and $b = -0.2$ with a probability of the good outcome of $q = 0.8$. The latter assumption is in line with the observation of approximately 20 percent of firms in ORBIS reporting a negative EBIT. Combined this implies a value of 0.2 for p which is in line with the value used in other studies.

$$F^{n.c.}_{GOOD} = \frac{1}{1+\rho}\left[\rho - i(1-\tau_j)\right] dB_j + \frac{-\rho\sigma_{jn}}{1+\rho} dN_n + \frac{1}{1+\rho}\left\{\sigma_{jn}\left[1 + i(1-\tau_n) - (1+\rho)\right] - \omega_{jn} i\right\} dB_n \tag{13}$$

Bad outcome: In the case of the bad outcome, the return on investment in period $t+1$ is $(b+\delta)(1+\pi)$, where b can be negative implying a real loss. As in the case of the good outcome, the taxable loss brought forward from period t is equal to the first year depreciation allowance ϕ_n. However, given that the project yields no taxable profits, these losses can not be used. Further we assume that after learning about the bad outcome the project is abandoned and the investment is sold. Therefore the difference between the real value and the tax depreciated value must be added as a balancing charge of $\tau_n\left[(1+\pi)(1-\delta) - (1-\phi_n)\right]$. For the hypothetical case of investment financed by retained earnings, taxable income is negative in period $t+1$ if

$$b < -\frac{\pi}{1+\pi} \tag{14}$$

We assume that this condition holds (in our central case we assume that $b = -0.2$ and $\pi = 0.025$). This also implies that the condition holds with other forms of finance. It also implies that the NPV of the investment is negative and that there is no dividend tax on the repayment of the equity in period $t+1$.[11] Consequently the NPV of the income stream with the bad outcome simplifies to

$$R^{n.c.}_{RE,BAD} = -1 + \frac{(b+\delta)(1+\pi) + (1-\delta)(1+\pi)}{1+\rho} = \frac{b-r}{1+r} \tag{15}$$

The additional costs for the other forms of finance simplify as well, as no dividend tax is due and only interest payments by the parent are tax deductible.

$$F^{n.c.}_{BAD} = \frac{\rho - i(1-\tau_j)}{1+\rho} dB_j + \frac{-\omega_{jn} i}{1+\rho} dB_n \tag{16}$$

Combining outcomes: The overall NPV of the investment project in the presence of tax combines the NPVs of the good and the bad outcomes, taking into account the NPV of the retained earnings case, given in equations (12) and (15), and the terms reflecting other sources of finance, (13) and (16):

$$R^{n.c.} = q\left(R^{n.c.}_{RE,GOOD} + F^{n.c.}_{GOOD}\right) + (1-q)\left(R^{n.c.}_{RE,BAD} + F^{n.c.}_{BAD}\right) \tag{17}$$

together with an adjustment for inventory valuation in the case of the good outcome. The new measure of the $EATR$ is then as set out above:

$$EATR_{n.c.} = \frac{R^{*} - R^{n.c.}}{p/(1+r)}. \tag{18}$$

To calculate the cost of capital we follow the same procedure as above, setting $R^{n.c.} = 0$, and in this case solving for g, given assumed values of b and q.[12] Using

[11] The way we model the bad outcome implies that losses after the closing down of a foreign subsidiary are irrecoverable. This extreme assumption might not hold in reality, but is maintained to illustrate the underlying mechanisms of loss consolidation.

[12] Clearly, it would be possible to solve for either q or b instead of g, as long as the other 2 values were assumed.

equations (12), (13), (15) and (16) the required real rate of return in the case of the good outcome without loss consolidation can be written as

$$\begin{aligned}\widetilde{g}_{n.c.} &= \frac{(r+\delta)(1-A_n)}{1-\tau_n} + \frac{i\phi_n\tau_n}{(1+\pi)(1-\tau_n)} - \delta \\ &-\frac{1+r}{(1-\sigma_{jn})(1-\tau_n)}\left[F^{n.c.}_{GOOD} + (R^{n.c.}_{RE,BAD} + F^{n.c.}_{BAD})\frac{1-q}{q}\right] \qquad (19)\end{aligned}$$

Combining with the assumed values of b and q yields the cost of capital

$$\widetilde{p} = q\widetilde{g}_{n.c.} + (1-q)b \qquad (20)$$

The $EMTR$ is then calculated using the standard equation as defined in (9).

3.3 Effective tax rates with international loss consolidation

We now consider two alternative tax regimes. First, we consider the case in which international consolidation of losses is permitted, without any other changes in the tax system. Second, we extend this to consider the case of formula apportionment. We begin with international loss consolidation. As in the base case, we consider the good and bad outcomes separately.

Good Outcome: With international loss consolidation, we assume that the depreciation allowance in the subsidiary in period t represent a taxable loss which can be transferred to the parent company. Define A^*_n as the net present value of the depreciation allowances in the host country if immediate group relief is claimed:

$$A^*_n = A_n - \phi_n\tau_n \qquad (21)$$

In addition to this, immediate group relief can be tax deducted by the parent leading to a tax relief of $\tau_j\phi_n$.[13] (Note that this group relief is not subject to dividend taxation.) In period $t+1$ the good outcome yields a taxable profit in the subsidiary, which is taxed in the normal way. The post-tax NPV for an investment financed by retained earnings is in this case

$$\begin{aligned}R^c_{RE,GOOD} &= \tau_j\phi_n + (1-\sigma_{jn})\left[-(1-A^*_n) + \frac{1}{1+\rho}\left((1+\pi)(g+\delta)(1-\tau_n)\right.\right. \\ &+ \left.\left.(1+\pi)(1-\delta)(1-A_n)\right)\right] \qquad (22)\end{aligned}$$

The additional costs of the other forms of finance are similar to those in the base case, except that the first year depreciation allowance, ϕ_n, is deducted at the parent country tax rate τ_j.

$$\begin{aligned}F^c_{GOOD} &= \frac{(1-\tau_j\phi_n)}{1+\rho}\left[\rho - i(1-\tau_j)\right]dB_j + \frac{-\rho\sigma_{jn}}{1+\rho}(1-\tau_j\phi_n)dN_n \\ &+ \frac{(1-\tau_j\phi_n)}{1+\rho}\left\{\sigma_{jn}\left[1+i(1-\tau_n)-(1+\rho)\right]-\omega_{jn}i\right\}dB_n \qquad (23)\end{aligned}$$

Bad Outcome: If the project is unsuccessful and sold after period $t+1$ the calculation of the NPV with international loss consolidation is more complicated. It is now possible that the group relief claimed in period t is large enough to imply

[13] Note that this implicitly assumes that the home country acknowledges the tax base of the host country. This is not necessarily the case in reality.

a balancing charge in period $t + 1$ that can turn the negative taxable income into a taxable profit. In contrast to condition stated in equation (14) there is no loss brought forward into period $t+1$ and therefore the balancing charge does not cancel out. Hence, assuming that group relief is claimed in period t, the taxable income in the host country in period $t + 1$, excluding financing costs, denoted T_n is

$$T_n = b + b\pi + \pi + \phi_n \tag{24}$$

which is negative if the following condition holds.

$$b < -\left(\frac{\phi_n + \pi}{1 + \pi}\right) \tag{25}$$

If this condition is met, the investment project is not subject to tax in the host country. However, the taxable loss can be offset against profit in the parent company. But if this condition does not hold, the balancing charge is large enough to create a tax liability in the subsidiary and no taxable loss exists to be offset against the profits in the parent.

The rest of the NPV of the income stream with the bad outcome is identical to the case described in equation (15). Hence the post-tax NPV of the income stream with the bad outcome and international loss consolidation, excluding financing costs, is

$$R^c_{RE,BAD} = \begin{cases} \tau_j\left[\phi_n - \frac{T_n}{1+\rho}\right] + \frac{b-r}{1+r} & \text{if} \quad T_n \leq 0 \\ \tau_j\phi_n - \frac{\tau_n T_n}{1+\rho} + \frac{b-r}{1+r} & \text{if} \quad T_n > 0 \end{cases} \tag{26}$$

These expressions are modified by including external financing costs. In line with the distinction above, the additional costs of external finance depend on whether the condition in equation (25) is met. Given that the taxable income in the subsidiary is positive the interest payments for debt raised at the subsidiary can be deducted at the subsidiary level against τ_n, up to the point at which taxable income becomes zero. If the taxable income is already negative the deduction of the interest payments increases the loss that can be offset against profits of the parent. These effects can be combined to generate an expression for the NPV of external financing costs in this case:

$$F^c_{BAD} = \frac{(1 - \tau_j\phi_n)}{1 + \rho}\left[\rho - i(1 - \tau_j)\right] dB_j + \frac{(1 - \tau_j\phi_n)}{1 + \rho}\left\{-ID - \omega_{jn}i\right\} dB_n \tag{27}$$

where

$$ID = \begin{cases} \tau_j i & \text{if} \quad T_n < 0 \\ \tau_n min\left[i, \left(i - \frac{T_n}{dB_n}\right)\right] & \text{if} \quad T_n \geq 0 \end{cases} \tag{28}$$

denotes the interest deductible in each case.

The expected NPV of the investment is again the probability weighted NPVs of the good and the bad outcome, $R^c = q(R^c_{RE,GOOD} + F^c_{GOOD}) + (1-q)(R^c_{RE,BAD} + F^c_{BAD})$. The $EATR$ is defined as normal, as

$$EATR_{l.c.} = \frac{R^* - R^c}{p/(1 + r)} \tag{29}$$

Following the same logic as in equation (19) the required rate of return in the good outcome, $\widetilde{g}_{l.c.}$ conditional on b and q, with international loss consolidation case is.

$$\begin{aligned}\widetilde{g}_{l.c.} &= \frac{(r+\delta)(1-A_n)}{1-\tau_n} + \frac{\phi_n \tau_n (1+r)}{(1-\tau_n)} - \delta \\ &- \frac{1+r}{(1-\sigma_{jn})(1-\tau_n)} \left[F^c_{GOOD} + \phi_n \tau_j + (R^c_{RE,BAD} + F^c_{BAD}) \frac{1-q}{q} \right] \end{aligned} \quad (30)$$

Using equation (30) in equations (20) and (9) then yields the $EMTR$ for the loss consolidation case.

The decision whether to participate: Given that international loss consolidation is currently allowed only in a small number of countries, notably in Austria and Denmark, and that even in these countries it is optional for the company, it seems reasonable to model participation as voluntary. We therefore assume that the firm can choose between the immediate group relief against the taxable profits of the parent company or carry the loss forward to relieve it against the potential future profits in the subsidiary. However, it is not possible to claim relief for the same loss at both the parent and the subsidiary level.

Leaving the loss in the subsidiary and carrying it forward allows the firm can claim relief against the taxable profit in the subsidiary in period $t+1$. The reduced tax burden in the subsidiary affects the dividend repatriated to the parent, which in turn is subject to σ_{jn}. However, the probability of a good outcome is only $q < 1$. Hence with probability $(1-q)$ the firm cannot claim a tax relief in the subsidiary and can only claim a group relief through consolidation with the parent.[14] Therefore the expected NPV of the initial depreciation allowance tax relief if no group relief is claimed is:

$$E_{no} = \frac{\phi_n}{1+\rho} \left\{ q \left[\tau_n (1-\sigma_{jn}) \right] + (1-q)\tau_j \right\} \quad (31)$$

If immediate group relief is claimed the value of the immediate tax relief is certain and amounts to $\tau_j \phi_n$. In period $t+1$ the additional balancing charge in the bad outcome can lead to a positive tax in the subsidiary if the condition in equation (25) does not hold. Therefore the positive taxable income is now subject to taxation in the host country rather than tax deductible as a loss in the home country.

$$E_{cons} = \tau_j \phi_n + \frac{1}{1+\rho} \left\{ -(1-q) max \left[T_n, 0 \right] (\tau_n - \tau_j) \right\} \quad (32)$$

Comparing these two outcomes, the firm will choose to immediately claim group relief if the expected tax relief in the future is lower than the certain immediate tax relief, taking into account that the balancing charge might lead to a positive taxable income in the bad outcome. Define the choice of the firm as η which takes the value 1 if the firm claims immediate group relief and 0 otherwise.

$$\eta = \begin{cases} 1 & \text{if } E_{no} < E_{cons} \\ 0 & \text{if } E_{no} > E_{cons} \end{cases} \quad (33)$$

If the firm chooses to participate the cost of capital and average effective tax rate are the same as described in equations (29) and (30). The cost of capital and

[14]We assume that a corporate group can again choose to participate in period $t+1$ if it did not participate in period t. Therefore it will participate in case of a bad outcome.

$EATR$ for a non-participating company closely resemble the case of no consolidation as described in equations (11) to (20). The only difference is, in the bad case the taxable loss of the subsidiary in period $t+1$ can be offset against the taxable profits at the parent level.[15] Therefore the $EATR$ and the required return in the good outcome with voluntary consolidation can be written as

$$EATR_{v.c.} = \begin{cases} EATR_{l.c.} & \text{if } \eta = 1 \\ \frac{R^* - \left[R^c - (1-q)(\tau_j \frac{b+b\pi+\pi}{1+\rho})\right]}{p/(1+r)} & \text{if } \eta = 0 \end{cases} \tag{34}$$

$$\widetilde{g}_{v.c.} = \begin{cases} \widetilde{g}_{l.c.} & \text{if } \eta = 1 \\ \widetilde{g}_{n.c.} + \frac{1-q}{q}\tau_j \frac{b+b\pi+\pi}{1+\rho} & \text{if } \eta = 0 \end{cases} \tag{35}$$

To obtain a measure of the cost of capital and the $EMTR$ equation (35) needs again be inserted in equation (20) and equation (9).

Consolidation with an already existing subsidiary: In the subsequent analysis we will use a large firm-level dataset which also allows us to identify whether a corporate group is already operating a potential host country. For these companies it is reasonable to assume that they conduct their investment through existing companies. Assuming that the existing business is profitable enough, the initial depreciation and any potential losses are offset against profits in the other subsidiary. Hence the $EATR$ and the cost of capital can be simplified to the case as described in equations (8) and (10).[16]

3.4 Effective tax rates under formula apportionment

The calculation of effective tax rates under a formula apportionment closely resembles the standard base case. This is due to the fact that first year depreciation allowances are now offset against the consolidated group profit, regardless of the profit situation of the new subsidiary. The most important difference is the applicable corporate tax rate, which now depends not only on the country where the investment takes place, but also on the other countries in which the group is located. In the extreme case where the investment considered does not affect the distribution of the factors used to determine the apportionment for the group as a whole, the applicable tax rate is independent from the tax rate in the host country. Defining $0 \leq \lambda \leq 1$ as the share of the new investment in terms of the existing investment the applicable tax rate can be written as

$$\tau_n^{FA} = \lambda \tau_n + (1-\lambda) \sum_{m=1}^{l} \tau_m \mu_m^X \tag{36}$$

where m now denotes all the countries the corporate group operates in and μ_m^X the share of the factor X across existing subsidiaries which is employed in country m.[17]

$$\mu_m^X = \frac{X_m}{\sum_{m=1}^{l} X_m} \tag{37}$$

In line with Agúndez-García (2006) we consider the following apportionment factors as X: number of employees, cost of employees, turnover, and total assets.

[15]The underlying assumption is, that if the firm did chose not to participate in period t, it chose again whether to participate in period $t+1$.

[16]The exact calculations are available from the authors upon request.

[17]For simplicity we assume that the new investment is proportional in the apportionment factor(s). Otherwise the λ becomes location specific and can not be moved in front of the summation.

Further we also follow the discussions in the European Commission in assuming that each member state continues to define its own tax rate. This implies that the net present value of the tax allowances is now not only host-country specific, as it is calculated with τ_n^{FA}. Further, as all the income is consolidated across countries and then apportioned, there is no longer any dividend tax. Using the applicable tax rate as defined in (36), the NPV from (3) can be rewritten as

$$\begin{aligned} R^{FA}_{RE,GOOD} &= -(1-A_n^{FA}) + \frac{1}{1+\rho}\big((1+\pi)(g+\delta)(1-\tau_n^{FA}) \\ &\quad + (1+\pi)(1-\delta)(1-A_n^{FA})\big) \end{aligned} \tag{38}$$

The tax effects of the other forms of finance are now significantly reduced, as the lending from the parent to the subsidiary cancels out because of the consolidation. The only remaining other form of finance that influences the income stream is external debt borrowed by the parent.[18] Note that these additional costs are identical for the good and the bad outcome.

$$F^{FA} = \frac{(1-\tau_n^{FA}\phi_n)}{1+\rho}\left[\rho - i(1-\tau_n^{FA})\right] dB_n \tag{39}$$

In the bad outcome the first year depreciation allowance ϕ_n can be offset against the consolidated group profit at the applicable tax rate τ_n^{FA}. However this reduces the taxable loss (increases the taxable profit) in period $t+1$ because of the balancing charge. In contrast to the separate accounting system, the taxable income is now subject to the factor weighted tax rate τ_n^{FA} regardless as to whether the income is positive or negative. Therefore the net present value of the income stream in the bad outcome can be written as

$$R^{FA}_{RE,BAD} = \tau_n^{FA}\phi_n + R^{n.c.}_{RE,BAD} - T_n\tau_n^{FA} \tag{40}$$

Regardless of the outcome, there is now an additional feedback effect of the investment, as the new investment may alter the applicable tax rate for the existing operations. Define Δ_R as the sum of the changes in the income streams in all existing locations due to the new investment with a relative size of λ.

$$\Delta_R = \sum_{m=1}^{l}\big(R_m(\tau^{FA}|\lambda>0) - R_m(\tau^{FA}|\lambda=0)\big) \tag{41}$$

This requires an assumption about the income stream of the existing operations. For the purpose of this paper we take two extreme positions. Firstly we assume that the existing operations take exactly the same form to the new investment. And secondly we assume that the new investment can be organized in a form which does not influence the distribution of the factors used to allocate the profits. Technically this is achieved through holding λ fixed at zero.

Under the assumption that the existing income stream is proportional to the new investment it can be shown that the actual size of λ becomes irrelevant. Similar to the calculation in equation (17), the income stream is given through the probability weighted average of (38) and (40), $R^{FA}_{RE} = qR^{FA}_{RE,GOOD} + (1-q)R^{FA}_{RE,BAD}$ plus the additional feedback term as defined in (41). Rearranging the NPVs of the income streams to separate the tax effects from the pre tax rate of return and using equations (36) and (41) the income stream can be written as

[18] Assuming that interest rates are equal across countries, it is in fact irrelevant where the debt is raised.

$$
\begin{aligned}
R_{RE}^{FA} &= R^{*} + \left(\lambda\tau_n + (1-\lambda)\sum_{m=1}^{l}\tau_m\mu_m^X\right) R^{TAX} \\
&\quad + \frac{1-\lambda}{\lambda}\left[R^{TAX}\left(\lambda\tau_n + (1-\lambda)\sum_{m=1}^{l}\tau_m\mu_m^X\right) - R^{TAX}\sum_{m=1}^{l}\tau_m\mu_m^X\right] \\
&= R^{*} + \tau_n R^{TAX} \qquad (42)
\end{aligned}
$$

where

$$
\begin{aligned}
R^{TAX} &= q\left[A^{FA} - \frac{1}{1+\rho}\left((1+\pi)(g+\delta)\right.\right. \\
&\quad \left.\left. + (1+\pi)(1-\delta)A^{FA}\right)\right] + (1-q)(1+\pi)b \qquad (43)
\end{aligned}
$$

collects all the bits of the income stream subject to taxes.[19] In sum, under the assumption of proportional income streams in the rest of the corporate group, and in the absence of debt finance, the NPV of the income stream including the feedback effect simplifies and only depends on the host country tax rate.[20]

The effective average tax rate under a formula apportionment system is then,

$$
EATR_{FA} = \frac{R^{*} - \left[R_{RE}^{FA} + F^{FA}\right]}{p/(1+r)}. \qquad (44)
$$

The necessary return in the good outcome is again obtained in solving the expected rate of return for g and can be written as

$$
\begin{aligned}
\widetilde{g}_{FA} &= \frac{(r+\delta)(1-A_n^{FA})}{1-\tau_n^{FA}} - \delta \\
&\quad - \frac{1+r}{1-\tau_n^{FA}}\left[F^{FA} + \frac{1-q}{q}(R_{RE,BAD}^{FA} + F^{FA}) + \frac{1-\lambda}{\lambda q}\Delta_R\right] \qquad (45)
\end{aligned}
$$

The $EMTR$ for formula apportionment is again calculated using (45) in equations (20) and (9).[21]

3.5 Firm-specific effective tax rates

Typically, effective tax rates are calculated for countries, or possibly for country pairs. However, these do not capture all the potential effects of a loss consolidation and a formula apportionment. Therefore we follow the concept of Egger et al. (2008) and develop firm-specific effective tax rate measures, using information about each company's asset, finance and ownership structure from the ORBIS database.

Define Θ_i^t, Θ_i^i and Θ_i^s to be the firm specific share of tangible fixed assets TFA_i, intangible fixed assets IFA_i and stocks STO_i:

[19] More detailed calculations are available from the authors upon request.

[20] Note that because of interest deductibility the size of the new investment has some influence on the results. For our calculations we chose a value of 0.25 for λ.

[21] This way of calculating the cost of capital additionally requires the fixation of the good outcome (0.3 in our case) in the existing operations. Alternatively one could solve the cost of capital for the good outcome of the overall company. These results are available from the authors upon request.

$$
\begin{aligned}
\Theta_i^t &= \frac{TFA_i}{IFA_i + TFA_i + STO_i} \\
\Theta_i^i &= \frac{IFA_i}{IFA_i + TFA_i + STO_i} \\
\Theta_i^s &= \frac{STO_i}{IFA_i + TFA_i + STO_i}
\end{aligned}
\tag{46}
$$

In order to exploit more information from the national tax laws we need to further distinguish between various forms of tangible fixed assets. To do so we use information about the industry- and size-specific structure of capital assets from a Canadian study by McKenzie, Mansour and Brule (1998).[22] Denoting the industry as k and size-specific weights as θ_k^b for buildings, θ_k^m for machinery and θ_k^l, the firm-specific share of tangible fixed assets θ_i^t can be decomposed into these three assets as:

$$
\begin{aligned}
\Theta_i^b &= \Theta_i^t \theta_k^b \\
\Theta_i^m &= \Theta_i^t \theta_k^m \\
\Theta_i^l &= \Theta_i^t \theta_k^l
\end{aligned}
\tag{47}
$$

Note, that these shares sum to 1: i.e. $\Theta_i^b + \Theta_i^m + \Theta_i^l + \Theta_i^i + \Theta_i^s = 1$. The weights can be used to calculate the firm-specific tax depreciation for the first year ϕ_i and the firm specific NPV of the depreciation allowances A_i

$$
\phi_i = \phi_n^b \Theta_i^b + \phi_n^m \Theta_i^m + \phi_n^l \Theta_i^l + \phi_n^i \Theta_i^i + \phi_n^s \Theta_i^s \tag{48}
$$

$$
A_i = A_n^b \Theta_i^b + A_n^m \Theta_i^m + A_n^l \Theta_i^l + A_n^i \Theta_i^i + A_n^s \Theta_i^s \tag{49}
$$

The parameter for the economic depreciation, δ_i, is also made firm-specific, using the same weights.[23]

To calculate the firm specific finance structure we define the share of debt finance dB_n at the subsidiary level as the sum of current liabilities CL_i and non-current liabilities NL_i over total assets TA_i

$$
dB_n = dB_i = \frac{CL_i + NL_i}{TA_i} \tag{50}
$$

It is now possible to calculate all the above introduced measures of the cost of capital and $EATR$s at the individual firm level by replacing A_n, ϕ_n, δ and dB_n with their firm-specific counterparts A_i, ϕ_i, δ_i and dB_i.

4 Data

The firm level data is from largest available set of firm level data Orbis, provided by the Bureau van Dijk. We start with 930,588 companies which report total assets higher than 2 million Euros in two consequent years 2001 to 2005.[24] As we use

[22] See Egger et al. (2008) for the matching of the industry codes and for the used weights.

[23] In line with the OECD (1991) we use the following assumptions for economic depreciation; machinery 12.25 percent, industrial buildings 3.61 percent, intangibles 10 percent and no economic depreciation for inventories.

[24] The dataset is very similar to the one in Devereux and Loretz (2007), we therefore only present it very briefly here.

information at the firm level only for the weights used in the calculation of effective tax rates, we average the data over time and use only the cross-sectional variation. This sample, including non-European companies, is then used to identify the group structures. A company is treated as part of a group if the database reports a majority shareholder (more than 50% direct or indirect shareholding) that is within our sample. Further a company is considered to be part of a group if the database reports a global owner which itself has a BvD identification number.

We include all 27 EU Member States, which leaves us with a sample of 410,222 companies for which all the necessary data is reported.[25] Of these, 114,853 companies are part of 28,703 corporate groups. We combine these data within the groups to end up with 323,442 observations. Each of these observations is then attributed to the country of the headquarter company, unless the corporate owner is outside Europe. In these cases we treat the national groups within this multinational group as individual companies. Table 1 summarises the country coverage and the relevant variables that are used for the weighting of the firm specific $EATR$s.

This sample includes 4,567 corporate groups that operate in more than one European country. For these groups we calculate the applicable tax rate under a formula apportionment system. For this purpose we weight the corporate tax rate in the countries the group operates with the shares of the apportionment factors employed there. As in Devereux and Loretz (2008), we use a composite apportionment factor with weights of one third for turnover, one third for total assets, one sixth for number of employees and one sixth for cost of employees.

The applicable tax rates under the formula apportionment depend on the existing pattern of investment. Additionally they potentially depend on the location of the new investment, but only if the new investment alters the overall distribution for the relevant apportionment factors. For the illustrative purpose in Table 1 we assume that this is not the case, i.e. we assume that λ is zero. Regardless of the impact of the new investment on the distribution of the apportionment factors, the applicable tax rate under a formula apportionment must always be a weighted average of the statutory corporate tax rates in the individual Member States. Therefore they are bound with the highest and the lowest rate in the EU, Italy and Cyprus respectively. Companies located in a high tax country would generally benefit from a lower tax rate under a formula apportionment system, while the companies located in a low tax country would face an increased tax rate.

[25] In addition to all observations that report missing values for the relevant variables we also exclude corporate groups that report more than 100% debt or report zero in all three asset variables, i.e. stocks, tangibles and intangibles.

Table 1: **Descriptive Statistics: Country coverage and average weights**

Country	**Observations** all firms	parents	**Tax rate** (τ_n)	(τ_i^{FA})	**buildings** (θ_i^b)	**machinery** (θ_i^m)	**land** (θ_i^l)	**inventories** (θ_i^s)	**intangibles** (θ_i^i)	**leverage** (dB_i)
Austria	1,461	128	25.0%	27.2%	0.220	0.279	0.074	0.374	0.052	0.683
Belgium	10,761	371	34.0%	32.7%	0.239	0.257	0.095	0.364	0.046	0.686
Bulgaria	1,101	0	10.0%	n.a.	0.239	0.305	0.090	0.337	0.028	0.631
Cyprus	92	4	10.0%	15.7%	0.363	0.198	0.128	0.199	0.113	0.419
Czech Republic	6,459	12	24.0%	24.4%	0.239	0.319	0.116	0.305	0.021	0.524
Germany	14,054	669	36.4%	33.3%	0.247	0.241	0.099	0.368	0.044	0.676
Denmark	5,073	254	25.0%	26.5%	0.339	0.241	0.151	0.213	0.056	0.590
Spain	62,650	305	33.0%	32.6%	0.231	0.214	0.101	0.360	0.093	0.610
Estonia	1,025	15	22.0%	20.8%	0.314	0.273	0.135	0.264	0.014	0.543
Finland	5,242	135	26.0%	26.5%	0.240	0.254	0.094	0.335	0.076	0.539
France	48,199	621	33.3%	32.9%	0.194	0.179	0.081	0.402	0.144	0.630
United Kingdom	22,353	425	30.0%	30.0%	0.283	0.248	0.116	0.309	0.044	0.636
Greece	7,940	32	25.0%	24.1%	0.212	0.268	0.079	0.393	0.049	0.624
Hungary	4,118	9	16.0%	18.3%	0.221	0.315	0.099	0.332	0.032	0.566
Ireland	1,126	44	12.5%	24.9%	0.286	0.231	0.112	0.338	0.032	0.601
Italy	95,158	568	37.3%	35.6%	0.177	0.228	0.072	0.440	0.083	0.773
Lithuania	866	5	18.0%	21.0%	0.206	0.342	0.076	0.366	0.009	0.529
Luxembourg	493	42	29.6%	30.8%	0.235	0.235	0.087	0.365	0.078	0.656
Latvia	724	2	15.0%	16.7%	0.235	0.329	0.091	0.333	0.012	0.592
Malta	107	0	35.0%	n.a.	0.316	0.180	0.127	0.371	0.006	0.555
Netherlands	3,949	486	25.5%	30.3%	0.275	0.220	0.111	0.334	0.061	0.669
Poland	7,710	14	19.0%	20.8%	0.264	0.329	0.101	0.277	0.028	0.512
Portugal	6,060	48	26.5%	27.6%	0.198	0.300	0.075	0.397	0.030	0.695
Romania	2,552	0	16.0%	n.a.	0.221	0.374	0.082	0.303	0.019	0.622
Slovak Republic	1,641	4	19.0%	20.6%	0.270	0.307	0.149	0.258	0.016	0.498
Slovenia	1,786	7	23.0%	23.5%	0.234	0.386	0.082	0.271	0.028	0.556
Sweden	10,742	367	28.0%	28.0%	0.270	0.236	0.113	0.333	0.046	0.615
Europe	**323,442**	**4,567**	**24.2%**	**26.0%**	**0.218**	**0.233**	**0.091**	**0.379**	**0.079**	**0.664**

Notes: τ_n denotes the statutory corporate tax rates including local profit taxes.
τ_i^{FA} denotes the applicable tax rates under a formula apportionment system. Only multinational companies included.

5 Results

We are mainly interested in the dispersion of the tax burden under the current and the proposed tax systems and less so in the bilateral tax burden for a specific country combination. Therefore we only present very summarised results. The next section includes some numerical results for the $EATR$s and a graphical presentation of the results. The results for the cost of capitals are subsequently presented only in graphical form.[26] Finally we also discuss the importance of the existing investment under a formula apportionment system, if firms are in a position to organise their investment such as it does not affect the distribution of apportionment factors.

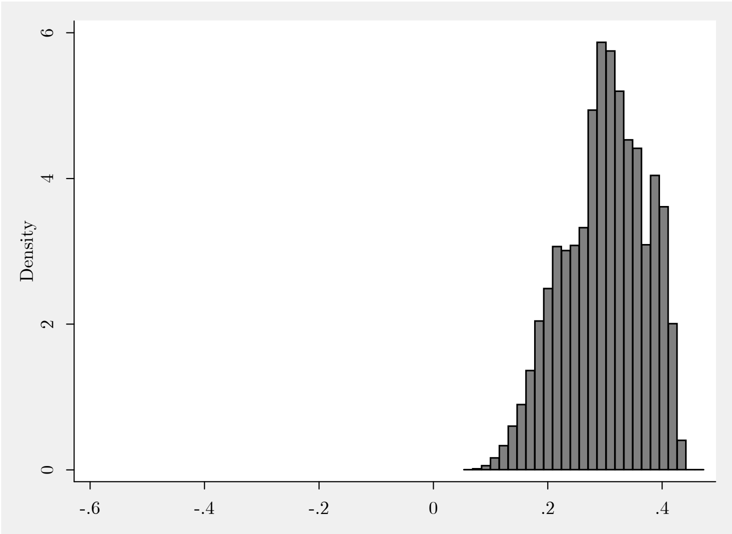
5.1 Effective Average Tax Rates

To get a first impression of the impact of the different tax systems it is useful to look at the overall dispersion of the tax burden across all companies. We do so for three different scenarios: the current system, i.e. without the possibility of international loss offset; a system of voluntary international loss consolidation without formula apportionment; and a system with a common consolidated tax base and formula apportionment.[27]

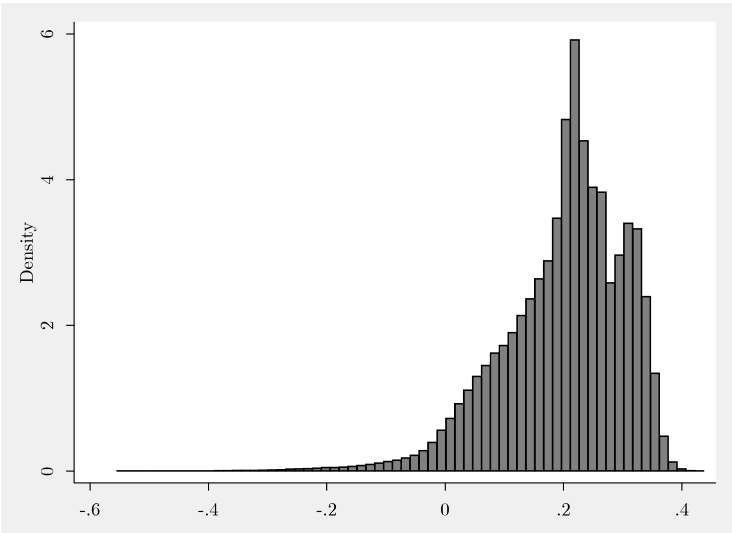
Figure 1 shows histograms of the $EATR$s for these three scenarios. Each histogram shows the dispersion of more than 8.7 million tax rates as we calculate the potential tax burden for 323,442 companies investing in all 27 European countries. As in all the figures, the graphs are arranged as follows. The upper part of the figure displays the results for the current system, the middle part for the voluntary loss offset and the lower part for the formula apportionment system. Moving from the top downwards two main changes can be observed. First the distribution shifts to the left, because allowing loss consolidation reduces the effective tax burden. Further the middle part of Figure 1 show that the introduction of loss consolidation without formula apportionment would significantly increase the dispersion of the tax burdens. Note that because of the fact that the loss consolidation would be voluntary, the distribution only widens at the lower tail. The lower part of the figure indicates that the overall tax burden under a formula apportionment system is significantly reduced. However, in contrast to the voluntary consolidation, the lower tail is less pronounced. This reflects the fact that excessive tax savings because of loss consolidation is not possible under a formula apportionment system.

[26]More detailled results are available from the authors on request.

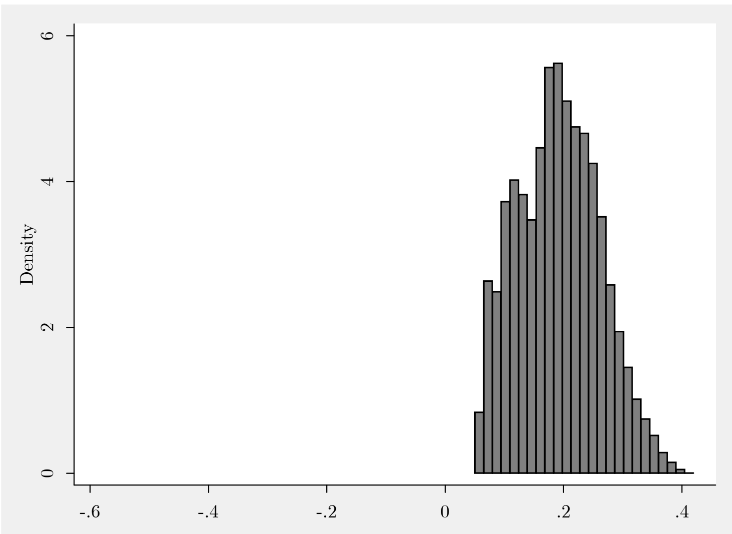
[27]Specifically we use the following assumptions as discussed by the CCCTB Working Group (2007): Buildings are depreciated according to a straight line schedule over 40 years, plant and machinery according to a declining balance scheme at a rate of 20 percent, intangibles are written down straight line over 15 years and inventories are valuated according to a weighted average.



Existing system ($EATR_{n.c.}$)



Voluntary consolidation ($EATR_{v.c.}$)



Formula Apportionment ($EATR_{FA}$)

Figure 1: **Histograms of** $EATR$

Table 2: **Summary of Results: Domestic and Bilateral $EATR$s for domestic, inbound and outbound investment**

	domestic investment		outward FDI			inward FDI		
country	**current system**	**formula apportionment**	**current system**	**voluntary consolidation**	**formula apportionment**	**current system**	**voluntary consolidation**	**formula apportionment**
Austria	18.8%	19.7%	27.6%	21.0%	19.0%	30.0%	21.5%	19.8%
Belgium	24.2%	26.8%	30.2%	19.1%	18.6%	38.0%	30.0%	27.2%
Bulgaria	10.1%	8.0%	27.0%	25.0%	19.9%	22.2%	9.3%	7.7%
Cyprus	8.8%	8.9%	28.0%	26.2%	22.1%	17.7%	7.3%	7.7%
Czech Republic	20.8%	20.5%	31.2%	25.0%	20.6%	29.6%	21.1%	19.0%
Germany	27.3%	28.9%	30.4%	18.1%	18.6%	40.9%	34.0%	29.2%
Denmark	21.3%	20.4%	27.7%	21.3%	19.7%	31.4%	18.0%	19.8%
Spain	27.3%	27.1%	28.4%	18.1%	19.4%	38.1%	30.6%	26.2%
Estonia	22.2%	18.5%	27.8%	22.5%	20.4%	30.3%	23.8%	17.4%
Finland	21.9%	22.0%	27.8%	21.0%	20.4%	32.2%	22.6%	20.6%
France	26.0%	27.2%	29.9%	19.1%	19.3%	38.4%	30.5%	26.5%
United Kingdom	24.1%	24.2%	35.6%	26.4%	19.2%	36.2%	27.5%	23.9%
Greece	21.7%	20.4%	31.9%	25.2%	19.7%	29.5%	20.6%	19.8%
Hungary	13.4%	13.3%	27.7%	24.3%	20.5%	22.9%	13.0%	12.5%
Ireland	10.0%	10.2%	27.1%	24.6%	20.1%	19.6%	9.1%	9.7%
Italy	25.8%	28.3%	31.2%	18.0%	17.6%	40.5%	34.6%	30.5%
Lithuania	14.0%	13.4%	27.8%	23.9%	20.9%	24.6%	3.8%	12.3%
Luxembourg	21.8%	23.6%	28.1%	19.4%	19.0%	34.1%	25.3%	23.6%
Latvia	11.6%	12.3%	27.6%	24.5%	20.2%	21.7%	4.7%	11.7%
Malta	28.3%	29.6%	40.6%	30.0%	19.9%	39.8%	32.6%	28.0%
Netherlands	21.6%	20.1%	27.5%	20.9%	19.0%	30.6%	20.9%	20.2%
Poland	16.0%	16.2%	29.0%	24.7%	20.8%	25.0%	15.6%	14.9%
Portugal	19.8%	20.8%	28.6%	21.3%	18.9%	31.3%	21.5%	21.1%
Romania	12.5%	12.9%	27.8%	24.4%	19.8%	30.3%	10.2%	12.5%
Slovak Republic	15.7%	16.4%	28.1%	23.8%	21.0%	24.9%	14.2%	14.9%
Slovenia	18.1%	19.3%	28.0%	22.1%	20.3%	28.2%	18.8%	18.2%
Sweden	22.5%	22.8%	28.1%	20.4%	19.5%	34.0%	24.3%	22.2%
Europe	**24.6%**	**25.6%**	**30.2%**	**19.9%**	**18.9%**	**30.2%**	**19.9%**	**18.9%**

Notes: The value for Europe refers to the weighted average and therefore is influenced by the country coverage.

To assess the impact on the $EATR$s in the individual Member States Table 2 compares the average tax burdens for a domestic investment, and for inbound and outbound foreign direct investment. We assume that the domestic investment is undertaken through the existing profitable parent company, which allows the losses to be offset. Further we assume that if the parent has an existing subsidiary in another country, then further investment in that country takes place in the existing subsidiary and that any losses can be offset there. In contrast if the company has no existing subsidiaries in the country, we assume that no loss consolidation is possible under the current system.[28] For the domestic investment the current system and the voluntary consolidation lead to the same outcome as it is possible to consolidate domestic losses under the current system. Further, it is always beneficial to use losses immediately in a domestic subsidiary because the loss carry forward could only be used against the same tax rate in the future. Even under formula apportionment the tax burden for domestic investment changes little, which is partly due to the fact the majority of our sample are domestic firms, for which the applicable tax rate remains unchanged. As a result the differences in the domestic $EATR$ across countries persist and are only reduced insignificantly.

Comparing the domestic $EATR$ under the current system with that for either outbound or inbound investment it is evident that the lack of international loss consolidation increases the $EATR$ for international investment. This is clearly at odds with capital export neutrality because domestic investment receives more favourable tax treatment. While the $EATR$ for domestic investment ranges between 8.8% for Cyprus and 28.3% in Malta, the country averages of $EATR$s for outbound investment range between 27.0% in Bulgaria and 40.6% in Malta. Similarly the country averages of $EATR$s for inbound investment vary from 17.7% in Cyprus to 40.9% in Germany.

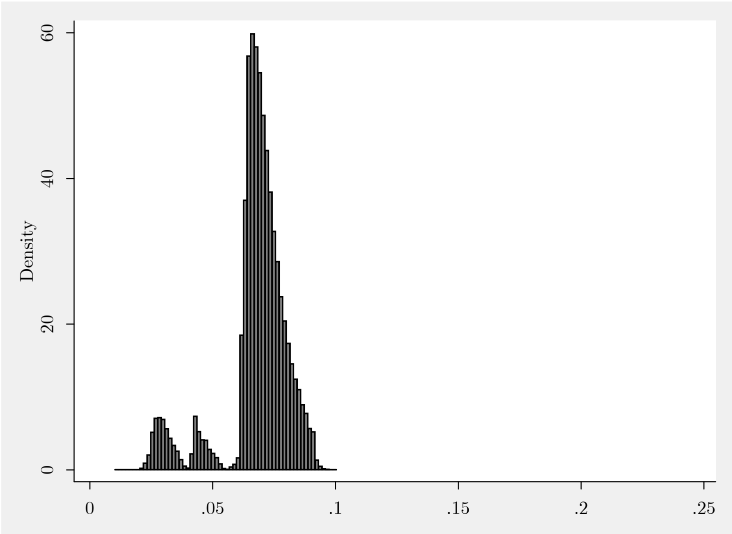
Moving to a system of voluntary loss consolidation without formula apportionment would overcorrect the distortion between domestic and foreign investment, as foreign investment would receive on average a more favourable tax treatment. Further, the overall reduction in the tax burden of five percentage points relative to domestic investment is very unevenly distributed. In fact outbound investment from high tax countries would face a significantly reduced tax burden, while outbound investment from low tax countries would still face a high tax burden. Overall, the spread of the average $EATR$ for outbound investment is comparable to the current system, with values between 18.0% for Italy and 30.0% for Malta. The other side of this phenomenon is that the attractiveness of low tax countries for inbound investment is amplified. For countries with a combination of generous depreciation allowances and low statutory tax rates, for example Lithuania, the average tax burden for inbound investment would be very low. This leads to an extremely large differential between country averages of $EATR$ for inbound investment, with values as low as 3.8% for Lithuania on the one hand and tax burdens as high as 34.6% in Italy.

A switch to a formula apportionment system would almost eliminate the differences in the $EATR$ between domestic investment and inbound investment. However, while the tax differential between domestic and inbound investment is reduced, the $EATR$ still varies significantly across the different member states. Country averages range from as little as 7.7% for investment into Bulgaria to 30.5% for investment into Italy. However, for the outbound investment the dispersion is sig-

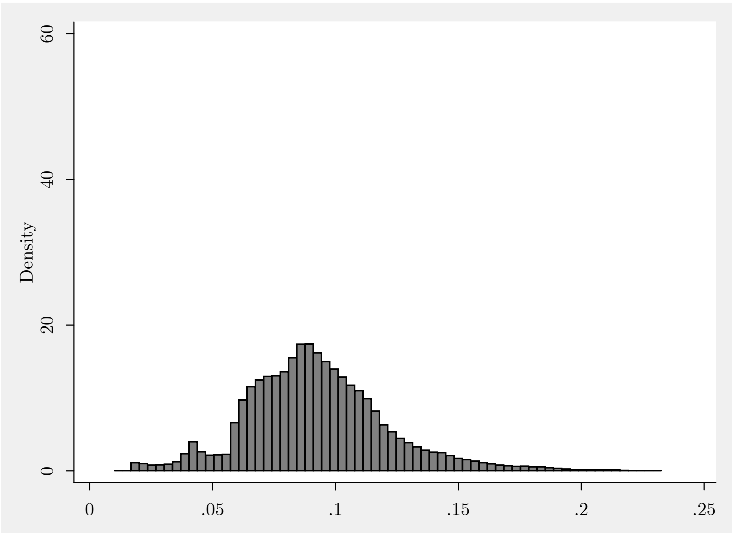
[28] For simplicity reasons and to allow a better comparison we also do not allow loss consolidation in countries like Austria and Denmark, which do allow some form loss consolidation.

nificantly reduced, with a lowest average $EATR$ of 17.6% in Italy and a highest average of 22.1% in Cyprus.

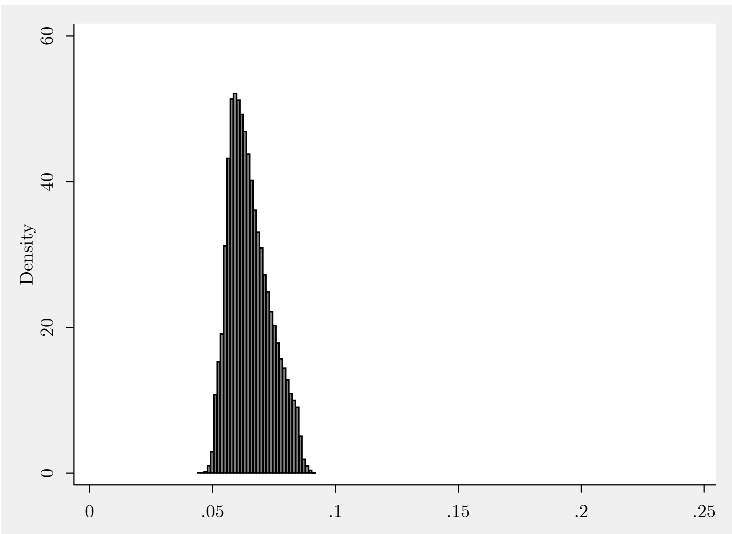
Capital export neutrality: It is, however, not possible to evaluate the efficiency only from country averages of $EATR$s. Instead, we exploit the firm level information and examine capital export neutrality and market neutrality across individual companies. From a company perspective capital export neutrality holds if an investment faces the same tax treatment regardless where it takes place. This can be measured as the variation between the $EATR$s a single firm is facing on its investment across all possible country locations, including its home country. The lower this variation, the closer the overall tax regime is to exhibiting capital export neutrality. The first three columns of Table 3 summarise the standard deviation between the $EATR$s for each of the 323,442 firms under the three tax systems considered for each home country. Figure 2 further shows the dispersion of these standard deviations for all firms.



Existing system ($sd[EATR_{n.c.}]$)



Voluntary consolidation ($sd[EATR_{v.c.}]$)



Formula apportionment ($sd[EATR_{FA}]$)

Figure 2: **Histograms of standard deviation of** $EATR$

Table 3: **Summary of Results: Standard deviation, average and minimum $EATR$s for the individual corporations**

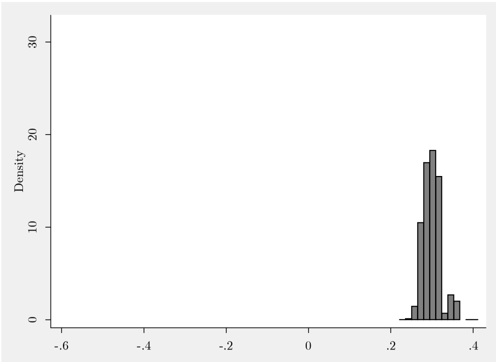
	Standard deviation			**average $EATR$**			**minimum $EATR$**		
country	**current system**	**voluntary consolidation**	**formula apportionment**	**current system**	**voluntary consolidation**	**formula apportionment**	**current system**	**voluntary consolidation**	**formula apportionment**
Austria	0.080	0.098	0.064	27.3%	20.9%	19.0%	13.0%	3.3%	7.7%
Belgium	0.072	0.100	0.065	29.9%	19.3%	18.9%	16.2%	-0.5%	7.6%
Bulgaria	0.080	0.078	0.065	26.3%	24.4%	19.4%	9.9%	9.1%	8.0%
Cyprus	0.083	0.082	0.072	27.3%	25.6%	21.6%	8.8%	8.8%	8.9%
Czech Republic	0.049	0.062	0.069	30.8%	24.9%	20.6%	20.8%	14.2%	8.4%
Germany	0.069	0.099	0.065	30.2%	18.5%	19.0%	16.5%	-2.1%	7.5%
Denmark	0.077	0.094	0.066	27.5%	21.3%	19.7%	12.7%	3.8%	8.1%
Spain	0.075	0.103	0.067	28.4%	18.4%	19.7%	13.7%	-1.9%	7.9%
Estonia	0.078	0.089	0.068	27.6%	22.5%	20.3%	12.3%	5.5%	8.3%
Finland	0.078	0.098	0.069	27.6%	21.0%	20.4%	12.6%	3.0%	8.3%
France	0.073	0.103	0.067	29.8%	19.4%	19.6%	15.6%	-1.7%	7.8%
United Kingdom	0.030	0.049	0.066	35.2%	26.3%	19.4%	24.1%	14.1%	7.8%
Greece	0.044	0.056	0.066	31.6%	25.1%	19.7%	21.7%	14.9%	8.0%
Hungary	0.080	0.082	0.068	27.2%	23.9%	20.2%	11.7%	7.7%	8.3%
Ireland	0.078	0.077	0.066	26.5%	24.1%	19.7%	10.0%	9.9%	8.1%
Italy	0.067	0.097	0.062	31.0%	18.3%	18.0%	17.7%	-2.4%	7.0%
Lithuania	0.085	0.089	0.069	27.3%	23.6%	20.6%	11.4%	5.9%	8.5%
Luxembourg	0.075	0.100	0.065	27.9%	19.5%	19.2%	13.7%	0.9%	7.7%
Latvia	0.080	0.081	0.067	27.0%	24.1%	19.9%	10.8%	8.0%	8.2%
Malta	0.026	0.037	0.069	40.1%	29.9%	20.2%	28.3%	18.0%	8.1%
Netherlands	0.077	0.094	0.064	27.3%	20.9%	19.0%	13.3%	4.3%	7.7%
Poland	0.066	0.073	0.069	28.5%	24.3%	20.7%	16.0%	13.3%	8.5%
Portugal	0.076	0.092	0.064	28.3%	21.2%	18.9%	13.8%	3.8%	7.7%
Romania	0.074	0.076	0.066	27.2%	24.0%	19.6%	12.5%	12.1%	8.0%
Slovak Republic	0.081	0.087	0.070	27.6%	23.5%	20.8%	11.8%	6.6%	8.6%
Slovenia	0.081	0.097	0.068	27.6%	21.9%	20.3%	12.5%	4.6%	8.3%
Sweden	0.076	0.095	0.066	27.9%	20.5%	19.6%	13.2%	2.6%	8.0%
Europe	**0.068**	**0.093**	**0.065**	**30.0%**	**20.0%**	**19.1%**	**16.3%**	**1.2%**	**7.7%**

In the top part of Figure 2, showing the distribution of company standard deviations under the current system, a rather peculiar distribution can be observed. In fact, there are three distributions within this histogram. Starting from the left, the first peak at a standard deviation of around 0.03 there are firms with their headquarter in countries with a credit system and a relatively high tax rate, like the United Kingdom, Greece or Malta. The smaller second peak at a standard deviation of approximately 0.05 represents firms in a country with a credit system and a moderate tax rate, e.g. the Czech Republic or Poland. The large bulk of companies is located in either a country with an exemption system, or in a country with a relatively low corporate tax rate, which effectively exempts foreign income from home country tax for most outbound investment. These countries have a standard deviation of their $EATR$s between 0.06 and 0.1. Therefore, under the current system, capital export neutrality is to some extent fulfilled for high tax credit countries, but less so for exemption countries.

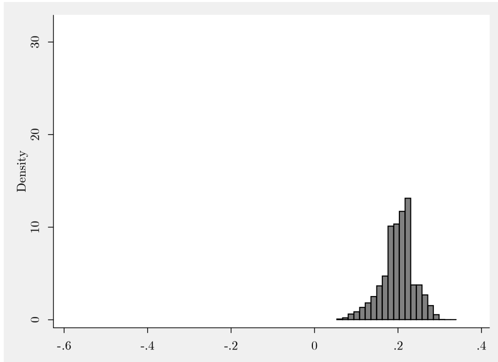
The middle part of Figure 2 displays the distribution of standard deviations under voluntary loss consolidation. Compared to the current system, there is a widening in the right hand side of the distribution, and an increase in the average standard deviation. This represents a movement away from capital export neutrality, as the standard deviations are generally higher. There is also an increase in the spread of tax rates, which stems from the fact that low tax countries will not gain significantly from loss consolidation, while the high tax countries will benefit most. Therefore, the firms that face a low domestic tax burden, will face relatively high tax burdens for outbound investment. At the same time firms with a relatively high domestic tax burden will have increased low tax opportunities. This results in a average standard deviation of almost 0.1, with values up to more than 0.2 for some firms. The three distinct peaks for the different combinations of double taxation and tax rate combinations are no longer apparent.

The lower part of Figure 2 presents the distribution of standard deviations under a formula apportionment system. The overall distribution is only slightly further left than under the current system. However the two smaller peaks of the credit countries disappear which implies that the overall improvement in terms of capital export neutrality is only minor. This can also be seen in the third column in Table 3 with a slightly reduced overall standard deviation of 0.065.

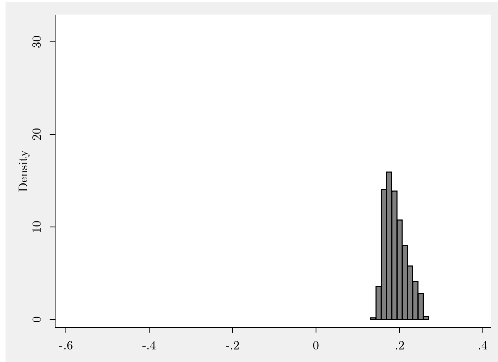
Market Neutrality: To assess whether these tax reforms would represent a movement towards market neutrality we follow two approaches. First we follow a more conservative approach and stipulate that the requirements for market neutrality are met if all potential competitors face the same tax burden on average. That is, we suppose that in supplying any given market, a company faces its average $EATR$ from investing in all 27 locations - the home country and all the other 26 European countries. By comparing the distribution of the average $EATR$ for each company, we can then observe the extent to which some companies gain a competitive advantage over others. The results of this approach are presented graphically in the upper row of Figure 3 and on a more detailed basis for each country in the middle three columns of Table 3.



Existing system ($av[EATR_{n.c.}]$)

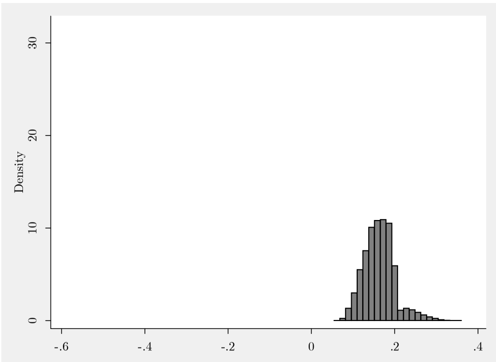


Voluntary consolidation ($av[EATR_{v.c.}]$)

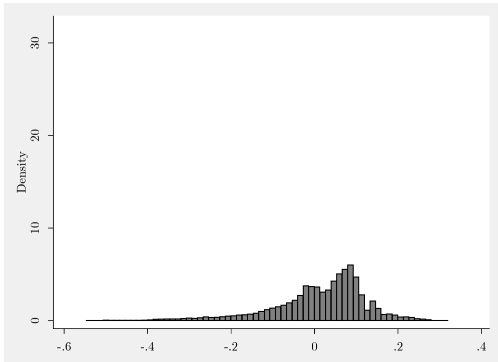


Formula Apportionment ($av[EATR_{FA}]$)

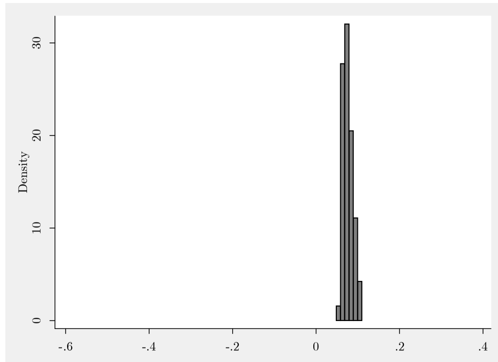
Averages of $EATR$s



Existing system ($min[EATR_{n.c.}]$)



Voluntary consolidation ($min[EATR_{v.c.}]$)



Formula Apportionment ($min[EATR_{FA}]$)

Minimums of $EATR$s

Figure 3: **Histograms of average and minimum** $EATR$

Second, we instead assume that each company will invest in that location which generates its lowest $EATR$. In this case, market neutrality depends on the distribution of the minimum $EATR$s across all companies potentially operating in each market. The results from this second approach are presented graphically in the lower row of Figure 3 and for each country in the last three columns of Table 3.

The upper left of Figure 3 presents the distribution of the averages of the $EATR$ in all potential location decisions for each firm under the current system without loss consolidation. Most of the firms face an average $EATR$ between 25% and 35% and both the upper and lower tail are relatively short. This implies that the current system performs reasonably well in terms of MN. The country averages in Table 3 strengthen this impression, as they vary only moderately between 26.3 % in Bulgaria and 40.1 % in Malta.

In comparison, the lower left part of Figure 3 depicts the distribution of the minimum $EATR$ for each company under the current system for each firm. Relative to the average $EATR$ in the upper row the distribution is shifted to the left and more dispersed. This is also reflected in the country averages in Table 3 where the differences across countries are now larger than for the averages of the $EATR$ spreading from 8.8 % in Cyprus to 28.3 % in Malta. Further comparing the minimum $EATR$s with those for domestic investment in Table 2 it can be seen that the values are identical for all credit countries. This reflects the fact that under the current system with no consolidation domestic investment is the tax optimal strategy.

Introducing a voluntary system of loss consolidation would decrease both the average and minimum $EATR$s but simultaneously increase their dispersion. From the upper middle part of Figure 3, it becomes evident that most of the increased variation in the average $EATR$s would be in the lower tail. This is due to the voluntary nature of this tax reform, which implies that firms claim no immediate group relief if this will increase their effective tax burden. Hence, companies located in a high tax countries with an exemption system could on average benefit more from the loss consolidation. The fact that a high home country tax rate implies bigger tax savings through loss consolidation is also reflected in the country averages in Table 3. The high tax and exemption countries - Germany, Italy and Spain - become the home countries with the lowest averages, all below 20 %. At the other end of the spectrum are the high tax and credit countries like Malta with 29.85 % or the United Kingdom and Greece. This is due to the fact that credit countries can only benefit to a limited extent through claiming losses in lower-taxed subsidiaries against highly taxed home country profits, because the absence of loss carry forward increases the subsequent tax burden in the subsidiary. And in contrast to the exemption countries these taxable profits are also subject to the higher tax rate of the home country upon repatriation. Further, low tax countries like Cyprus or Ireland also cannot benefit from loss consolidation and therefore face relatively large tax burdens. The increased dispersion of the average $EATR$s represents a movement away from market neutrality (using this measure), as the dispersion across firms rises.

The lower middle part of Figure 3 displays the dispersion of the minimum $EATR$s under a voluntary loss consolidation system and even more highlights the tax planning opportunities available under this system by relocating real investment. More than half of the firms can direct the investment to a country where it faces a negative effective tax burden. On the other hand some firms cannot benefit to that extent from the loss consolidation and face positive (minimum) $EATR$s of more than 30 %. This increased dispersion of the minimum $EATR$s again represents a movement away from market neutrality. From the second last column in Table 3 it can be seen that on average firms have a tax-optimal investment location with an $EATR$ of 1.2 %. High tax exemption countries like Spain, Italy, Germany and France gain most, while credit countries, like Malta, United Kingdom, Greece or the Czech Republic gain less from the new tax incentives and face on average a higher minimum $EATR$.

Under the assumption that formula apportionment would be introduced as an obligatory measure, the distribution of the average $EATR$s would somewhat widen, as can be seen in the upper right part of Figure 3. This increased dispersion indicates a small movement away from market neutrality. Comparing the distribution with the current system shows a significant decrease in the average tax burden. This is also apparent in Table 3 where the country averages now vary from 18% in Italy to 21.6 % in Cyprus.

The distribution of the minimum $EATR$s, depicted in the lower right of Figure 3, is much narrower than for average $EATR$s. This is due to the fact, that loss consolidation is now possible and that there are no taxes on repatriation. Further, in contrast to a system of voluntary loss consolidation system without formula apportionment, no large tax benefits of loss consolidation exist (since it is not possible to offset a loss in a low tax rate country against a profit in a high tax rate country). Hence there are no negative minimum $EATR$s and the distribution in the lower right part of Figure 3 is substantially less dispersed than for the current system. This reflects that under a formula apportionment system most companies have similar low tax investment opportunities. On this measure then, there is a substantial improvement towards market neutrality.

Interestingly, the peak of the distribution is also further on the left than under the current system, implying that firms face on average a substantially lower minimum $EATR$. In the last column in Table 3 it can be observed that the country averages of the lowest $EATR$ and the averages of $EATR$s under a formula apportionment system are very similar across countries. This is due to the fact that under our current assumptions the effective tax burden is determined to a large extent by the host country tax rate. Consequently the tax burdens vary only little within a given country, which is in line with the requirement for capital import neutrality. However, the persisting differences amongst tax rates in the Member States imply that the effective tax burden are varying substantially across countries. In this sense it is the same features of the tax system that violate the capital export neutrality and achieve market neutrality.

5.2 Cost of Capital

The methodology described in section 3 also allows us to calculate the cost of capital and the $EMTR$.[29] These measures indicate the effect of the tax on the incentive to undertake an additional marginal investment. We can consider the proximity of the European tax system to capital export neutrality and market neutrality following the same approach as for the $EATR$. Indeed, comparisons based on the cost of capital are arguably more consistent with optimal tax theory in that the cost of capital is the relevant measure in the absence of economic rent, and therefore in

[29] The $EMTR$ as defined in equation (9) becomes meaningless in case of negative cost of capital. Given that in our voluntary consolidation scenario negative cost of capital are easily possible and also observed, we only report results for the cost of capital.

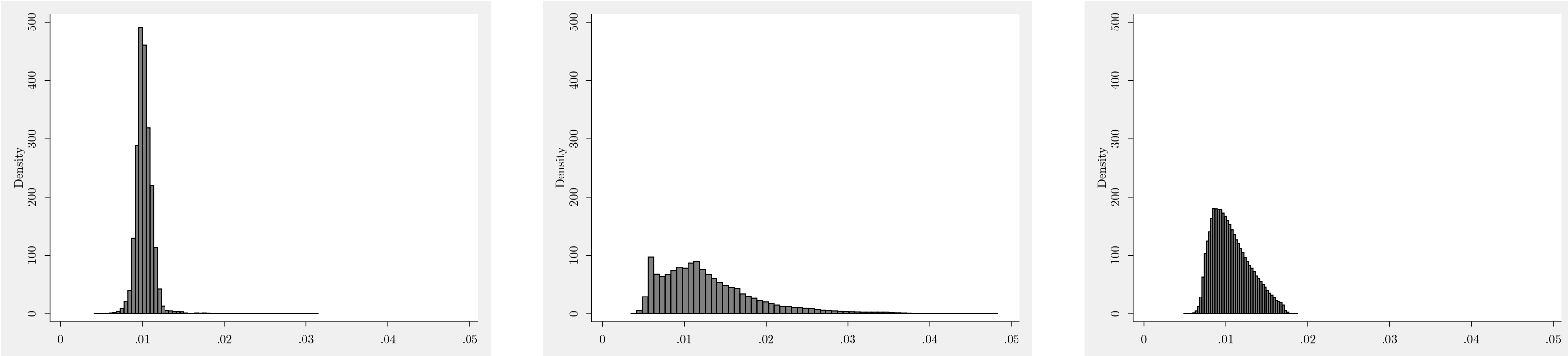
conditions in which production efficiency is held to be optimal. In fact, the comparisons based on the cost of capital are similar to those based on the $EATR$. We therefore present the results briefly and highlight where additional insight can be gained.

Capital Export Neutrality: We follow the same approach as for the $EATR$ logic to measure the extent to which the various tax systems are consistent with capital export neutrality. That is, we consider the standard deviation for any individual company over the costs of capital which it would face in each of the 27 possible investment locations: capital export neutrality holds for an individual firm if the standard deviation is zero. Figure 4 displays the distribution of these standard deviations for the three scenarios considered in this paper. Comparing the left hand side part of Figure 4 to the upper part of Figure 2 is can be seen that the current system appears to match capital export neutrality rather better when the measure of comparison is the cost of capital, rather than the $EATR$. This reflects the fact that the cost of capital depends relatively more on the tax base and less on the tax rates than the $EATR$. This narrower distribution reflects the fact that there is less variation in European tax base definitions than in tax rates.[30]

Further the three distinct peaks in the distribution for the $EATR$ under the current system are now longer visible, indicating that the double taxation system is less important for a marginal investment. Moving right in Figure 4 the same phenomena as for the $EATR$ can be observed for the cost of capital. Introducing a voluntary system of loss consolidation without formula apportionment tends to increase the standard deviation for a large proportion of the sample, and therefore represents a movement away from capital export neutrality. A formula apportionment system tends to correct some of this newly induced distortions, but still falls substantially short of achieving capital export neutrality. Despite the fact that the harmonized tax base is more relevant for the cost of capital, there is more variation in the standard deviation. This can be traced back two major sources of variation. First the additional finance cost matter more and secondly the variation in the asset structure of the companies in combination with the different tax rates across countries implies a significant move away from capital export neutrality.

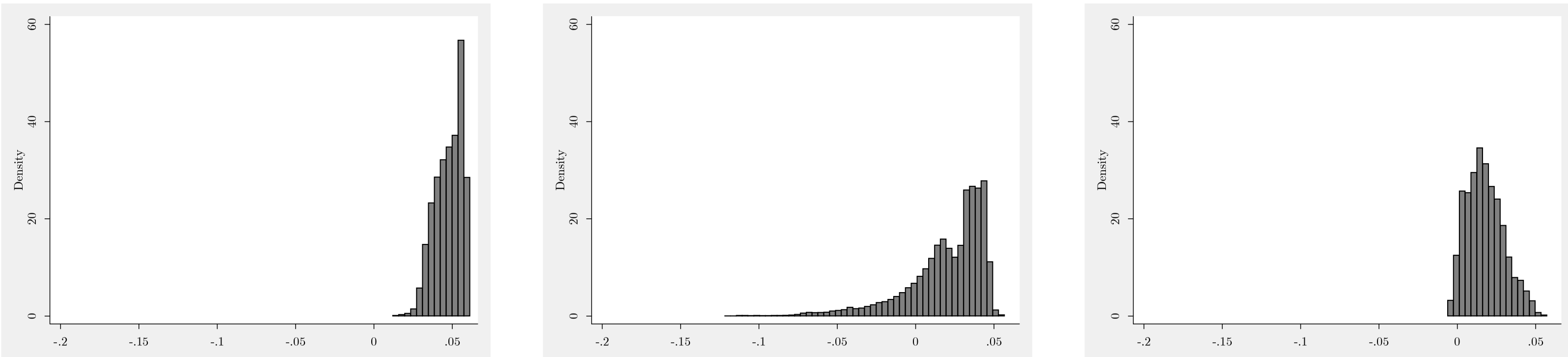
Market Neutrality: Here we measure the degree to which market neutrality is achieved by considering the distribution of the minimum cost of capital facing each company across its 27 possible investments. The distribution of this minimum cost of capital is shown in Figure 5, and is again in line with the findings for the $EATR$. The increase in the dispersion of tax burdens arising from introduction of a system with voluntary loss consolidation but no formula apportionment is now even more pronounced as the minimum cost of capitals in the current system are relatively concentrated around 0.05. This in itself is remarkably as with our parameterisation, i.e. a real interest rate of 5 percent, a cost of capital 0.05 translates into a $EMTR$ of zero. In the middle part of Figure 5, the distribution is more dispersed and shifted even further to the left. This highlights that almost all firms have at least one location where they face a negative $EMTR$ on a marginal investment.

[30]The one notable exception to this finding is Estonia with its distribution tax and no tax depreciation.



Existing system ($sd[\widetilde{p}_{n.c.}]$) Voluntary consolidation ($sd[\widetilde{p}_{v.c.}]$) Formula Apportionment ($sd[\widetilde{p}_{FA}]$)

Figure 4: **Histograms of standard deviation of cost of capital**



Existing system ($min[\widetilde{p}_{n.c.}]$) Voluntary consolidation ($min[\widetilde{p}_{v.c.}]$) Formula Apportionment ($min[\widetilde{p}_{FA}]$)

Figure 5: **Histograms of minimum cost of capital**

In contrast under the formula apportionment system the dispersion of the minimum cost of capitals is slightly wider than under the existing system, and the distribution is located more to the left. The fact that MN is achieved to a lesser extent that it was with the $EATR$ can be explained through the fact that the additional finance cost matters more for the cost of capital calculation. Further the feedback effect on the applicable tax rate does not completely cancel out for the way we calculate the cost of capital.[31] More generally the reduced cost of capital in combination with an increased dispersion, illustrate two main aspects of the introduction of a formula apportionment system. On the one hand MN would be violated because of the existing differences in tax rates, which would - through the channel of deducible finance costs and via the feedback effect - create variation in the potential minimum cost of capital. On the other hand the formula apportionment system implies some tax savings compared to the existing system through cross-border loss consolidation.

The analysis of the cost of capital highlights the importance of the assumption about the proportionality of the new investment in both apportionment factors and profitability. Hence we discuss the importance of the existing operations in the next subsection.

5.3 The importance of the existing operations

So far we assumed that the investment in the new subsidiary is completely proportional, in both profitability and factors, to the existing operations. This implies that the relative size of the new investment as measured in λ has only minor impact on the effective tax burden. However, it seems very likely that the new investment does not influence the distribution of the apportionment factors at all or is at least not perfectly in line with the existing company.[32] In this subsection we therefore consider the other extreme case, i.e. the one where the investment does not influence the distribution of apportionment factors. Technically this is achieved via holding λ fixed at zero.

Capital Export Neutrality: So far the formula apportionment system showed only a marginal improvement in terms of capital export neutrality, because of the persistent variation of the tax rates across countries. If we now consider the case where the new investment does not influence the apportionment factor, this implies that the applicable tax rate is the factor weighted tax rate of the countries where the company is already located. As our sample is dominated by companies, which are only active in the home country, i.e. are purely domestic, this is most of the time the parent countries tax rate. In any case the results are determined by the firm specific tax rates, as given through their distribution of apportionment factors, and the tax base, which is harmonised across all Member States. Consequently any given firm faces the same tax rate regardless where it invests. This implies that CEN is completely achieved.

Market Neutrality: Given the previous result of CEN completely achieved, the minimum and average tax burden are bound to be identical for each firm. Hence it is sufficient to analyse one of our two measures of MN. Consequently the histogram in Figure 6, displaying the minimum $EATR$s also describes the average

[31] As mentioned above, we hold the good outcome in the rest of the company fixed at 0.3 while solving for the necessary good outcome in the new subsidiary.

[32] In fact it is expected that the investment is strategically adjusted to influence the applicable tax rate of the overall company. In this paper, however, we do not address these issues, which should be subject to further research.

*EATR*s. Comparing the distribution in Figure 6 to the two graphs on the right hand side in Figure 3 two things become evident. First, there is a significant shift to the right, which is partly due to the geographical breakdown of our sample. The large number of companies in Italy, France, Spain and Germany translates, under these assumptions, into a overall higher tax burden. This holds especially true for the minimum tax rates, as the assumption of λ equal to zero pins down the tax rates and leave the firm no low tax location choices.

Figure 6: **Minimum and average EATR for the case** $\lambda = 0$

Secondly the distribution is much more dispersed than in Figure 3, indicating that a formula apportionment system would under the assumption of an unchanged distribution of apportionment factors represent a move away from MN. This is more or less the reversal of the result we found under the assumption of a completely proportional new investment. While the persisting tax rate differentials between the Member States led to a violation of CEN under the assumption of a proportional new investment, they now imply a move away from MN under the assumption of unchanged apportionment factors.

As mentioned above, both assumption of the existing investment are extreme cases. Abstracting from strategic behaviour of the firm, it still seems realistic that a cross border investment would imply some change in the distribution of the apportionment factors. Even if the new investment is not completely proportional to the existing firm, it is therefore important to factor in the feedback effect. Arguably, the cases of no feedback effect, i.e. λ equal to zero, and the proportional case, where λ turn out to be of minor relevance, can both be seen as benchmark cases. The lesson to be learned is that, depending on the size and form of the new investment, both the location of the existing operations and the location of the new investment potentially determine the applicable tax rate under formula apportionment. As a result either CEN or MN are not achieved, because of the existing differences in tax rates across Member States.

6 Conclusion

This paper aims to investigate whether international loss consolidation and a formula apportionment would increase the efficiency of the tax system in Europe. To evaluate the impact of such reforms we first develop the approach of Devereux and Griffith (1999) in measuring of effective average and marginal tax rates to allow for a potential loss in the hypothetical investment considered. We apply this methodology to cross border investments in Europe. Specifically, we compute the effective tax rates for a large number of companies in Europe in potential cross-border investments, using firm-specific data. We compare the existing system to two comprehensive tax reforms; a voluntary international loss consolidation under the current system and a obligatory system of international consolidation and formula apportionment. we assess these reforms by reference to how close the overall system is to two measures of efficiency: capital export neutrality and market neutrality.

We show that the current system gives an advantage to domestic investment because of the lack of international consolidation. As a result, the current system fulfills the requirements for neither capital export neutrality nor market neutrality. Changing to a system of voluntary consolidation would partly correct the distortion between domestic and international investment. However, such a tax reform would also introduce more distortions, which overall would imply a move away from both forms of neutrality.

In contrast, the change to a formula apportionment system would have some desirable efficiency effects. First, the tax differential between domestic and international investment would be mitigated, and there would be a movement small improvement towards CEN. For some measures of MN we can show a significant improvement. However, the results are highly depending on the assumptions of the existing operations. Assuming that the new investment is proportional to the existing operations, it is mainly MN which can be achieved. In contrast, under the assumption that the new investment is not influencing the distribution of the apportionment factors, it is CEN which could be achieved at the cost of a movement away from MN.

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