

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

Michael P. Devereux* and Simon Loretz†

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Abstract

This paper assesses the recent reform proposals of the European Union to introduce international loss consolidation and formula apportionment in terms of efficiency. For this exercise we extend the effective tax rate methodology of Devereux and Griffith (1999) to include a potential loss and use a large firm level data set to identify the distortions under the current system and after the proposed tax reforms. While allowing international loss consolidation in the current system would signify a move to the worse in terms of efficiency, a formula apportionment system would increase capital export neutrality. At the same time capital ownership neutrality would be violated because, the wide spread of statutory tax rates in the Member States would translate into different tax burdens for different companies.

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*Oxford University Centre for Business Taxation; Park End Street, OX1 1HP Oxford, England, e-mail: Michael.Devereux@sbs.ox.ac.uk

†Oxford University Centre for Business Taxation; Park End Street, OX1 1HP Oxford, England, e-mail: Simon.Loretz@sbs.ox.ac.uk

1 Introduction

Reform plans in the European Union are more and more shaping towards a common consolidated tax base. However, the process of harmonisation has been slow and is facing a lot of opposition from various Member States. Therefore 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. It is widely accepted that this would significantly 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 received scant attention so far.

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 a number of different dimensions: (i) in terms of *capital export neutrality* (CEN), which demands that capital should be taxed to the same extent regardless where it is invested. (ii) *capital import neutrality* (CIN), which requests that capital invested in a certain jurisdiction should face the same tax burden, regardless of the residence of the investor and finally (iii) *capital ownership neutrality* (CON), which stipulates that a capital owner should face the same tax burden, regardless where she invests.¹

We start with the effective tax rates as developed by Devereux and Griffith (1999) and extend this methodology introducing a potential loss. Further we make use of a large micro-level dataset to identify the current 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 under the current system would largely increase the spread of the effective tax burdens, which would represent a move away from both capital export neutrality and capital ownership neutrality. Combining international loss consolidation with formula apportionment would correct most of these new distortions and signify a substantial improvement in terms of capital export neutrality. However, the same move would, because of differences in statutory corporate tax rates across Member States, imply reduced capital ownership neutrality. Given the existing tax saving opportunities under the current system, which would no longer exist under the formula apportionment system, this change for the worse would only be minor.

2 Methodology

2.1 The effective tax rate approach

The effective average tax rate (henceforth *EATR*) literature builds on the cost of capital approach of Jorgensen (1963) and Hall and Jorgensen (1967) which was further developed to measure the tax burden on discrete investment choices by Devereux and Griffith (1999).² The OECD (1991 and Yoo 2003) and the Commission

¹The concepts of capital import neutrality and capital export neutrality at least date back to Musgrave (1969). The concept of capital ownership neutrality is introduced in Devereux (1990) and further discussed in Desai and Hines (2003).

²We 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.

of the European Union (1992 and 2001) employed and discussed this methodology in detail, therefore we only summarize it very briefly.

The underlying model assumes that the cross-border investment increases the capital stock in an existing foreign subsidiary for only one period. Hence an increase in investment in period t of $dI_t = 1$ implies 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 stands for the nominal inflation rate.³ The perturbation in the capital stocks generates an additional output in period $t + 1$ of $(p + \delta)(1 + \pi)$ where p represents the real economic rent. In the absence of taxation and assuming that purchasing power parity holds the net present value of the additional income stream is

$$R^* = -1 + \frac{1}{1+i} \{(1+\pi)(p+\delta) + (1+\pi)(1-\delta)\} = \frac{p-r}{1+r} \quad (1)$$

where $i = (1+r)(1+\pi) - 1$ denotes the nominal interest rate.⁴

With taxation the return is subject to the corporate tax in the host country τ_n , which reduces the return in period $t + 1$ to $(p + \delta)(1 + \pi)(1 - \tau_n)$.⁵ Define A_n as the net present value of tax allowances per unit of investment, discounted with the shareholders nominal discount rate ρ .⁶ If the investment is financed through retained earnings the shareholder needs to give up $(1 - A_n)$ of dividends in period t . The difference between these two changes represents the additional dividend flow to the parent which is potentially subject to taxation upon repatriation. Define σ_{jn} as the total tax due because of repatriation to the parent. The extent of this tax burden depends the method of the method of double taxation alleviation

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

where c_n describes the withholding tax on dividends. Hence the net present value of the after tax income stream can be written as

$$R = (1 - \sigma_{jn}) \left[-(1 - A_n) + \frac{1}{1+\rho} ((1+\pi)(p+\delta)(1-\tau_n) + (1+\pi)(1-\delta)(1-A_n)) \right] \quad (3)$$

Other forms of finance: If the investment is financed through new equity the cost of raising 1 unit new equity is $(1 - \tau_n \phi_n)$, where ϕ_n denotes the tax depreciation in the first period. In turn the dividend is not reduced by $(1 - \tau_n \phi_n)$ shareholder. In the second period the dividend is reduced by $(1 - \tau_n \phi_n)$ in order to pay the newly raised equity of $(1 - \tau_n \phi_n)$ back. 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 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

³For 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 purchasing power parity holding, hence the real exchange rate is equal to unity and we drop the subscripts for the inflation rate.

⁴For the calculations we use parameter values of 0.05 for r and 0.025 for π .

⁵Note that throughout the paper n denotes the host country while j denotes the parent country.

⁶Abstracting from taxation at the shareholder level ρ equals to the nominal interest rate i .

be paid back, which amounts to $(1 - i(1 - \tau_j))$. If the subsidiary borrows at the parent company the interest payments are deductible there, however potential the additional tax burden because of withholding taxes and double taxation must be taken into account. It is therefore useful to define ω_{jn} as the total tax on interest payments from the subsidiary to the parent, again depending on the method of double taxation alleviation.

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

where $\bar{\omega}_n$ denotes the withholding tax on interest payments between subsidiaries and parent companies. Denoting the change in new equity as dN and the change in debt as dB for additional costs of financing in the parent or host country can therefore be written as

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

To extent which extent the investment is tax depreciable and therefore the size of A_n depends on the type of assets. Machinery is tax depreciated faster as buildings and inventories can not be depreciated at all. However, if the inventories are valued according to the FIFO method, the increase in value because of inflation is due to taxation and therefore R^{RE} needs to be adjusted to

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

Solving the after tax income stream R for the necessary economic rent to break even yields the cost of capital

$$\tilde{p} = \frac{(r + \delta)(1 - A_n)}{1 - \tau_n} - \delta + \frac{F(1 + r)}{(1 - \sigma_{jn})(1 - \tau_n)} \quad (7)$$

where F describes the additional costs of other forms of finance as defined in (5). In the case of a FIFO valuation of the inventories the adjustment term in equation (6) needs to be accounted for. The *EMTR* is then defined as

$$EMTR = \frac{\tilde{p} - r}{\tilde{p}} \quad (8)$$

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 in relation to the NPV of the pre-tax total income stream $p/(1 + r)$. Using the equations (1) and (3) the *EATR* is given through

$$\begin{aligned} EATR &= \frac{R^* - R}{p/(1 + r)} \\ &= \frac{\frac{p-r}{1+r} + (1 - \sigma_{jn}) \left[\frac{1}{1+r} ((p + \delta)(1 - \tau_n) - (1 - A_n)(r + \delta)) \right]}{p/(1 + r)} \end{aligned} \quad (9)$$

Equation (9) describes the *EATR* for a not further defined investment financed through retained earnings. Analogously the *EATR* for other forms of finance can

be calculated if the relevant additional costs of finance as defined in equation (5) are included. This allows to calculate *EATRs* for specific investments and for specific forms of finance. We adopt this convention throughout the rest of the paper.

2.2 Effective tax rates for a new subsidiary with potential losses

To fully capture the potential changes due to the introduction of a formula apportionment system we need to extend the 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 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 a possibility of q the new investment yields a positive outcome of $g > 0$. In the other cases the firm suffers a real economic loss $b < 0$. In order to compare it to the existing model we assume that the expected value of the outcome equals the assumed pre tax rate of return, i.e. that $p = qg + (1 - q)b$ holds.⁷

Good outcome: With a good outcome the subsidiary is profitable, i.e. $(g + \delta)(1 + \pi) > 1$, and therefore liable to taxation in period $t + 1$. The taxable loss of the first period (the taxable loss of period t equals to the depreciation allowances ϕ_n) can be offset against the profit in period 1. Therefore we need to adjust the net present value of the depreciation allowances A_n for this delay.

$$\hat{A}_n = A_n - \frac{i\phi_n\tau_n}{1 + \rho} \quad (10)$$

Apart from this delayed depreciation the good outcome is exactly the same as described above, therefore equation (3) can be rewritten using equation (10) and replacing p with g .

$$\begin{aligned} R_{GOOD} = & (1 - \sigma_{jn}) \left[-(1 - \hat{A}_n) + \frac{1}{1 + \rho} ((1 + \pi)(g + \delta)(1 - \tau_n) \right. \\ & \left. + (1 + \pi)(1 - \delta)(1 - A_n)) \right] \end{aligned} \quad (11)$$

Concerning the additional cost because of different forms of finance equation (5) needs to be adjusted insofar, as the costs for one additional unit are now 1 instead of $(1 - \tau_n\phi_n)$.

$$\begin{aligned} F_{GOOD} = & \frac{1}{1 + \rho} [\rho - i(1 - \tau_j)] dB_j + \frac{-\rho\sigma_{jn}}{1 + \rho} dN_n \\ & + \frac{1}{1 + \rho} \{ \sigma_{jn} [1 + i(1 - \tau_n) - (1 + \rho)] - \omega_{jn}i \} dB_n \end{aligned} \quad (12)$$

Bad outcome: If the subsidiary has a bad outcome the return on investment in period $t + 1$ is $(b + \delta)(1 + \pi)$, where b can be negative implying a real loss. Identical to the case of the good outcome the taxable loss brought forward from period t

⁷In particular we assume $g = 0.3$ and $b = -0.2$ with a probability of the good outcome of $q = 0.8$. This implies a value of 0.2 for p which is usually used in the calculation of *EATRs*.

equals 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 nature of the 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. Accounting also for the tax deductibility of interest payments the taxable income is negative if the following condition is met.⁸

$$b < \frac{i dB_n - \pi}{1 + \pi} \quad (13)$$

Under the assumptions we use ($b = -0.2$ and $\pi_n = 0.025$) this condition is met even for no debt finance at all, i.e. $iB_{n0} = 0$. Further if this condition holds, the bad outcome is a real economic loss. Therefore there is no dividend tax on the repayment of the equity in period $t + 1$. Consequently the NPV of the income stream with the bad outcome simplifies to

$$R_{BAD} = -1 + \frac{(b + \delta)(1 + \pi) + (1 - \delta)(1 + \pi)}{1 + \rho} = \frac{b - r}{1 + r} \quad (14)$$

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

$$F_{BAD} = \frac{\rho - i(1 - \tau_j)}{1 + \rho} dB_j + \frac{-\omega_{jn}i}{1 + \rho} dB_n \quad (15)$$

The new measure of the *EATR* is then simply the probability weighted NPVs of the good and the bad outcome as in equation (11) respectively (14) in relation to the income in the absence of taxation. For the other forms of finance the additional cost as described in equation (12) respectively (15) need to be added.

$$EATR_{n.c.} = \frac{R^* - [qR_{GOOD} + (1 - q)R_{BAD}]}{p/(1 + r)} \quad (16)$$

To calculate the cost of capital we solve the expected net present value of the income stream for the necessary good outcome to break even. In doing so, we hold the bad outcome b and the probability of a good outcome q fixed.⁹ Using equations (11)(12)(14) and (15) the necessary return in the case of the good outcome without loss consolidation can be written as

$$\begin{aligned} \tilde{g}_{n.c.} = & \frac{(r + \delta)(1 - A_n)}{1 - \tau_n} + \frac{i\phi_n\tau_n}{(1 + \pi)(1 - \tau_n)} - \delta \\ & - \frac{1 + r}{(1 - \sigma_{jn})(1 - \tau_n)} \left[F_{GOOD} + (R_{BAD} + F_{BAD}) \frac{1 - q}{q} \right] \end{aligned} \quad (17)$$

Weighting the necessary good outcome and the fixed bad outcome with the probability yields the cost of capital

$$\tilde{p} = q\tilde{g}_{n.c.} + (1 - q)b \quad (18)$$

The *EMTR* is then calculated using the standard equation as defined in (8).

⁸Detailed derivations can be found in a technical appendix, available from the authors upon request.

⁹There are two other ways to calculate a measure of the cost of capital. Instead of fixing the bad outcome b , the good outcome g could be hold constant to calculate the worst outcome still breaking even (\tilde{b}). Alternatively, one can hold the good and the good and bad outcome constant and calculate the necessary probability (\tilde{q}) of a good outcome.

2.3 Effective tax rates with international loss consolidation

Good Outcome: If the investment project is successful the first year depreciation allowances that are claimed as group relief in period t need to be deducted from the NPV of the depreciation allowances. Define A_n^* as the net present value of the depreciation allowances in the host country if immediate group relief is claimed.

$$A_n^* = A_n - \phi_n \tau_n \quad (19)$$

The immediate group relief can be tax deducted at the parent and therefore leads to a direct tax saving of $\tau_j \phi_n$. Note that the group relief is not subject to dividend taxation. Therefore the post tax rate of return with international loss consolidation can be written as

$$R_{GOOD}^r = \tau_j \phi_n + (1 - \sigma_{jn}) \left[-(1 - A_n^*) + \frac{1}{1 + \rho} ((1 + \pi)(g + \delta)(1 - \tau_n) + (1 + \pi)(1 - \delta)(1 - A_n)) \right] \quad (20)$$

The additional costs of the other forms of finance are similar to the one for the original model with the only difference that the first year depreciation ϕ_n allowance is now tax deducted at the parent country tax rate τ_j .

$$F_{GOOD}^r = \frac{(1 - \tau_j \phi_n)}{1 + \rho} [\rho - i(1 - \tau_j)] dB_j + \frac{-\rho \sigma_{jn}}{1 + \rho} (1 - \tau_j \phi_n) dN_n + \frac{(1 - \tau_j \phi_n)}{1 + \rho} \{ \sigma_{jn} [1 + i(1 - \tau_n) - (1 + \rho)] - \omega_{jn} i \} dB_n \quad (21)$$

Bad Outcome: If the project is unsuccessful and sold after period $t + 1$ the calculation of the effective tax rates with international loss consolidation is slightly more complicated. It is now possible that the group relief claimed in period t is large enough to imply a balancing charge in period $t + 1$ that turn the negative taxable income into a taxable profit. In contrast to condition stated in equation (13) there is no loss brought forward into period $t + 1$ and therefore the balancing charge does not cancel out. Hence the taxable income in the host country T_n is

$$T_n = b + b\pi + \pi + \phi_n - idB_n \quad (22)$$

which is negative if the following condition holds.

$$b < \frac{idB_n - \phi_n - \pi}{1 + \pi} \quad (23)$$

If the condition in equation (23) is met, the investment project is not subject to tax in the host country. However, the taxable loss can be offset against tax profit at the parent company. In contrast if the inequality in equation (23) does not hold, the balancing charge is large enough to create a tax liability at the subsidiary and no taxable loss exists to be offset against the parent profits.

The rest of the NPV of the income stream with the bad outcome is identical to the case described in equation (14). Hence the after-tax NPV of the income stream with the bad outcome and international loss consolidation is

$$R_{BAD}^r = \begin{cases} \tau_j \left[\phi_n - \frac{T_n}{1 + \rho} \right] + R_{BAD} & \text{if } T_n \leq 0 \\ \tau_j \phi_n - \frac{\tau_n T_n}{1 + \rho} + R_{BAD} & \text{if } T_n > 0 \end{cases} \quad (24)$$

In line with the distinction above the additional costs of other finance forms depend now also on whether the condition in equation (23) 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 . If in contrast the taxable income is negative (because of the interest deduction) the deduction of the interest increases the loss that can be offset against the tax profits at the parent.

$$F_{BAD}^r = \frac{(1 - \tau_j \phi_n)}{1 + \rho} [\rho - i(1 - \tau_j)] dB_j + \frac{(1 - \tau_j \phi_n)}{1 + \rho} \{-ID - \omega_{jn}i\} dB_n \quad (25)$$

where

$$ID = \begin{cases} \min \left[i, \left(i - \frac{b + b\pi + \pi + \phi_n}{dB_n} \right) \right] \tau_j & \text{if } T_n < 0 \\ i\tau_n & \text{if } T_n \geq 0 \end{cases} \quad (26)$$

denotes the interest deductible depending on whether the condition in equation (23) holds. The *EATR* is again the probability weighted NPVs of the good and the bad outcome following the same logic as in equation (16).

$$EATR_{l.c.} = \frac{R^* - [qR_{GOOD}^r + (1 - q)R_{BAD}^r]}{p/(1 + r)} \quad (27)$$

Following the same logic as in equation (17) the necessary return in the good outcome for the loss consolidation case can be calculated.

$$\begin{aligned} \tilde{g}_{l.c.} &= \frac{(r + \delta)(1 - A_n)}{1 - \tau_n} + \frac{\phi_n \tau_n (1 + r)}{(1 - \tau_n)} - \delta \\ &\quad - \frac{1 + r}{(1 - \sigma_{jn})(1 - \tau_n)} \left[F_{GOOD} + \phi_n \tau_j + (R_{BAD} + F_{BAD}) \frac{1 - q}{q} \right] \end{aligned} \quad (28)$$

Using equation (28) in equations (18) and (8) then yields the *EMTR* for the loss consolidation case.

The decision whether to participate: Given that a international group relief is so far only allowed in few countries, most notably in Austria or Denmark, and even in these countries international loss consolidation is an option it seems plausible to model the participation as voluntary. Therefore we 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 relief it against 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. Hence the extent of the relief will depend on the choice of the firm.

Leaving the loss in the subsidiary and carry it forward to period $t + 1$ the firm can claim relief against the taxable profit at the subsidiary in period $t + 1$. Further the reduced tax burden at 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 $(1 - q) > 0$ the firm can not claim a tax relief in the subsidiary and can only claim a group relief with the taxable profit at parent company.¹⁰ Therefore the expected value of the tax relief if no group relief is claimed is:

¹⁰We 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.

$$E_{no} = \frac{\phi_n}{1 + \rho} \{q[\tau_n(1 - \sigma_{jn})] + (1 - q)\tau_j\} \quad (29)$$

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 (23) 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.

$$E_{cons} = \tau_j\phi_n + \frac{1}{1 + \rho} \{-(1 - q)\max[T_n, 0](\tau_n - \tau_j)\} \quad (30)$$

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.

$$\eta = \begin{cases} 1 & \text{if } E_{no} < E_{cons} \\ 0 & \text{if } E_{no} > E_{cons} \end{cases} \quad (31)$$

If the firm chooses to participate the cost of capital and average effective tax rate are the same as described in equations (27) and (28). The cost of capital and effective average tax rate for a non-participating company closely resemble the case of no consolidation as described in equations (10) to (18). 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.¹¹ Therefore the *EATR* and the necessary return in the good outcome with voluntary consolidation can be written as.

$$EATR_{v.c.} = \begin{cases} EATR_{l.c.} & \text{if } \eta = 1 \\ \frac{R^* - [qR_{GOOD} + (1 - q)(R_{BAD} - \tau_j \frac{b + b\pi + \pi}{1 + \rho})]}{p/(1 + r)} & \text{if } \eta = 0 \end{cases} \quad (32)$$

$$\tilde{g}_{v.c.} = \begin{cases} \tilde{g}_{l.c.} & \text{if } \eta = 1 \\ \tilde{g}_{n.c.} + \frac{1 - q}{q} \tau_j \frac{b + b\pi + \pi}{1 + \rho} & \text{if } \eta = 0 \end{cases} \quad (33)$$

To obtain a measure of the cost of capital and the *EMTR* equation (33) needs again be inserted in equation (18) and equation (8).

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 groups is already operating a potential host country. For these companies it is reasonable to assume that they are conducting their investment through the existing companies. Assuming that the existing business is profitable enough, the initial depreciation and any potential losses are offset against the subsidiary profits. Hence the *EATR* and the cost of capital can be simplified to the case as described in equations (7) and (9).¹²

2.4 Effective tax rates under formula apportionment

The calculation of effective tax rates under a formula apportionment quite closely resembles the standard unilateral effective tax rates. This is due to the fact that first year depreciation allowances are now offset against the consolidated group profit,

¹¹The underlying assumption is, that if the firm did chose not to participate in period t , it chose again whether to participate in period $t + 1$.

¹²The exact calculations are available from the authors upon request.

regardless the profit situation at the new subsidiary. The main and most important difference is the applicable corporate tax rate, which is now not only depending on the country where the investment takes place. In the extreme case where the investment is small enough to not significantly alter the distribution of the factors used to determine the apportionment, the applicable tax rate independent from the tax rate in the host country. Define $0 \leq \lambda \leq 1$ as the share of the new investment in terms of the existing investment the applicable tax rate can be written as

$$\tau_n^{FA} = \lambda\tau_n + (1 - \lambda) \sum_{m=1}^l \tau_m \mu_m^X \quad (34)$$

where m now denotes all the countries the corporate group operates in and μ_m^X the share of the factor X employed in country m .¹³

$$\mu_m^X = \frac{X_m}{\sum_{m=1}^l X_m} \quad (35)$$

In line with Agúndez-García (2006) we consider the following apportionment factors as X : number of employees, cost of employees, turnover, total assets and a measure of value added. Further we also follow Agúndez-García (2006) in assuming that each Member State is still allowed to define its own tax base and 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 (34), the income stream from (3) can be rewritten as

$$\begin{aligned} R_{GOOD}^{FA} &= -(1 - A_n^{FA}) + \frac{1}{1 + \rho} ((1 + \pi)(g + \delta)(1 - \tau_n^{FA}) \\ &\quad + (1 + \pi)(1 - \delta)(1 - A_n^{FA})) \end{aligned} \quad (36)$$

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 the outside debt raised at the parent level.¹⁴ Note that these additional costs are identical for the good and the bad outcome.

$$F^{FA} = \frac{(1 - \tau_n^{FA} \phi_n)}{1 + \rho} [\rho - i(1 - \tau_n^{FA})] dB_n \quad (37)$$

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 claimed depreciation 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 whether the income is positive or negative. Therefore the net present value of the income stream in the bad outcome can be written as

$$R_{BAD}^{FA} = \tau_n^{FA} \phi_n + R_{BAD} - T_n \tau_n^{FA} \quad (38)$$

Regardless the state of the outcome, there is now an additional feedback effect of the investment, as it may alter the applicable tax rate for the existing operations.

¹³For 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.

¹⁴Assuming that interest rates are equal across countries, it is in fact irrelevant where the debt is raised.

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 .

$$\Delta_R = \sum_{m=1}^l (R_m(\tau^{FA}|\lambda > 0) - R_m(\tau^{FA}|\lambda = 0)) \quad (39)$$

This requires an assumption about the income stream of the existing operations. However, as the whole concept of this sort of effective tax rate calculations is based on a hypothetical investment project in the future, we assume that the existing operations take a similar form. We therefore use a assume that the existing operations provide a certain income stream with $p=0.2$. Hence the R_m are given through equation (3).

The effective average tax rate under a formula apportionment system is then, similar to the to the calculation in equation (16), given through the probability weighted average of (36) and (38) plus the additional feedback term as defined in (39)

$$EATR_{FA} = \frac{R^* - [qR_{GOOD}^{FA} + (1-q)R_{BAD}^{FA} + \frac{1-\lambda}{\lambda}\Delta_R]}{p/(1+r)} \quad (40)$$

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

$$\begin{aligned} \tilde{g}_{FA} = & \frac{(r+\delta)(1-A_n^{FA})}{1-\tau_n^{FA}} - \delta \\ & - \frac{1+r}{1-\tau_n^{FA}} \left[F^{FA} + \frac{1-q}{q}(R_{BAD}^{FA} + F^{FA}) + \frac{1-\lambda}{\lambda q}\Delta_R \right] \end{aligned} \quad (41)$$

The *EMTR* for formula apportionment is again calculated using (41) in equations (18) and (8).

2.5 Firm-specific effective tax rates

Usually effective tax rates are calculated for countries, or at most country pairs. However, these hypothetical scenarios fall short to capture all the potential effects of a loss consolidation and a potential formula apportionment system. Therefore we follow the concept of Egger et al. (2008) and use firm-specific information about asset, finance and ownership structure from the ORBIS database.

Define Θ_i^t , Θ_i^i and Θ_i^s as the firm specific share of tangible fixed assets TFA_i , intangible fixed assets IFA_i and stocks STO_i over the sum of them.

$$\begin{aligned} \Theta_i^t &= \frac{TFA_i}{IFA_i + TFA_i + STO_i} \\ \Theta_i^i &= \frac{IFA_i}{IFA_i + TFA_i + STO_i} \\ \Theta_i^s &= \frac{STO_i}{IFA_i + TFA_i + STO_i} \end{aligned} \quad (42)$$

In order to exploit more information from the national tax laws we need to further distinguish between various forms of tangible fixed assets. Therefore we use

information about the industry and size specific structure of capital assets from a Canadian study by McKenzie, Mansour and Brule (1998).¹⁵ Denote the k industry and size specific weights with θ_k^b for buildings, θ_k^m for machinery and θ_k^l for land the firm specific share of tangible fixed assets θ_i^t can be decomposed into

$$\begin{aligned}\Theta_i^b &= \Theta_i^t \theta_k^b \\ \Theta_i^m &= \Theta_i^t \theta_k^m \\ \Theta_i^l &= \Theta_i^t \theta_k^l\end{aligned}\tag{43}$$

Note, that the way we calculate these shares ensures that they add up to 1, i.e. that $\Theta_i^b + \Theta_i^m + \Theta_i^l + \Theta_i^i + \Theta_i^s = 1$ holds. The weights can now 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

$$\phi_i = \phi_n^b \Theta_i^b + \phi_n^m \Theta_i^m + \phi_n^l \Theta_i^l + \phi_n^i \Theta_i^i + \phi_n^s \Theta_i^s\tag{44}$$

$$A_i = A_n^b \Theta_i^b + A_n^m \Theta_i^m + A_n^l \Theta_i^l + A_n^i \Theta_i^i + A_n^s \Theta_i^s\tag{45}$$

Accordingly the parameter for the economic depreciation δ_i needs to be weighted firm specifically.

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

$$dB_n = dB_i = \frac{CL_i + NL_i}{TA_i}\tag{46}$$

It is now possible to calculate all the above introduced measures of the cost of capital and $EATRs$ 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 .

3 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 2005.¹⁶ As we use information at the firm level only for weighting and are not interested in firm behaviour, we average the data across the years and use only the cross-sectional information. 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.

¹⁵See Egger et al. (2008) for the matching of the industry codes and for the used weights.

¹⁶The dataset is very similar to the one in Devereux and Loretz (2007), we therefore only present it very briefly here.

Table 1: Descriptive Statistics: Country coverage and average weights

Country	Observations all firms	parents	(τ_n)	Tax rate (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.

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.¹⁷ We then average the 114,853 companies within corporate groups across the 28,703 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 *EATRs*.

In total our sample includes 4,567 corporate groups that operate in more than one European country. For these corporate 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. Like in Devereux and Loretz (2007) we use an composite apportionment factor with on sixth number of employees, on sixth cost of employees, one third turnover and one third total assets.

The applicable tax rates under the formula apportionment are also depending on the already existing investment in addition to location of the new investment. The latter is only true, if the new investment is large enough to alter the overall distribution for the relevant apportionment factors. As a base case we assume that this is not the case, i.e. we assume that λ is zero. This assumption we be changed in the later on in the paper. Regardless the relative size of the new investment the applicable tax rate under a formula apportionment must 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 and the formula apportionment rates can only be equal or higher in the lowest tax country Cyprus. Equally the rate under a formula apportionment system must be no higher than the statutory rate in Italy, which has the highest statutory tax rate. We therefore expect that companies headquartered in a high tax country would benefit from a lower tax rate under a formula apportionment system, while the firms located in a low tax country would face an increased tax rate. This holds true, as companies in all the high tax countries, Germany, Italy, Spain, France, Belgium would benefit from a lower tax rate. In contrast the tax rates for the firms located in low tax countries as Cyprus, Ireland, Latvia, Lithuania and Hungary would increase. It is noteworthy that the unweighted average is higher under formula apportionment, which reflects that the economic activity within the corporate groups tends to be more within high tax countries.¹⁸

In comparison to the statutory corporate tax rates, the overall distribution of the tax rates is necessarily less dispersed, but the same countries emerge as high tax countries. Despite only looking at multinational companies, the tax rate applicable under a formula apportionment system is very similar to the statutory tax rate in the headquarter country. This mirrors the fact that the domestic activities of a multinational dominate, even more so in large countries as France, Germany, Italy or the United Kingdom.

¹⁷In 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.

¹⁸This is in line with previous research, e.g. Fuest et al. (2007) and Devereux and Loretz (2007). However compared to this studies we do not relate the apportionment factors to profits and therefore we can not infer from this that profit shifting takes place.

4 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 *EATRs* and a graphical presentation of the results. The results for the cost of capitals are subsequently presented only in graphical form.¹⁹ Finally we also discuss the importance of the existing investment under a formula apportionment system.

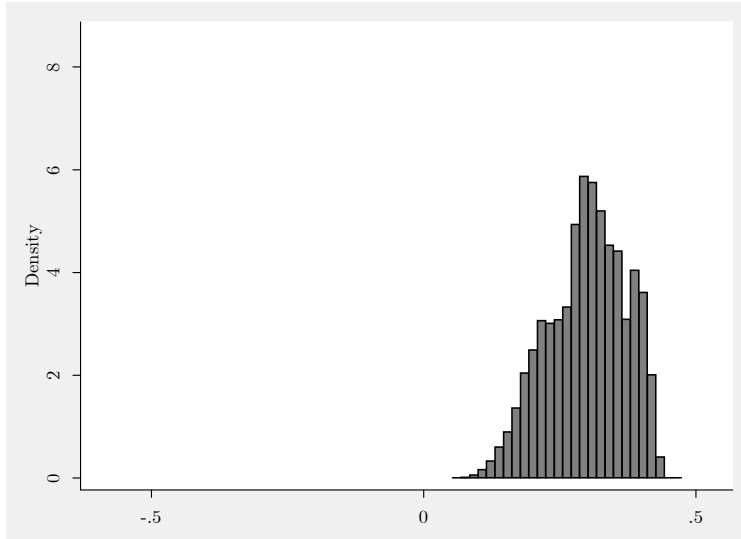
4.1 Effective Average Tax Rates

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 firms. We do so for three different scenarios; for the current system, i.e. without the possibility of international loss offset, for a system of voluntary international loss consolidation without formula apportionment and for a system with international loss consolidation and formula apportionment.

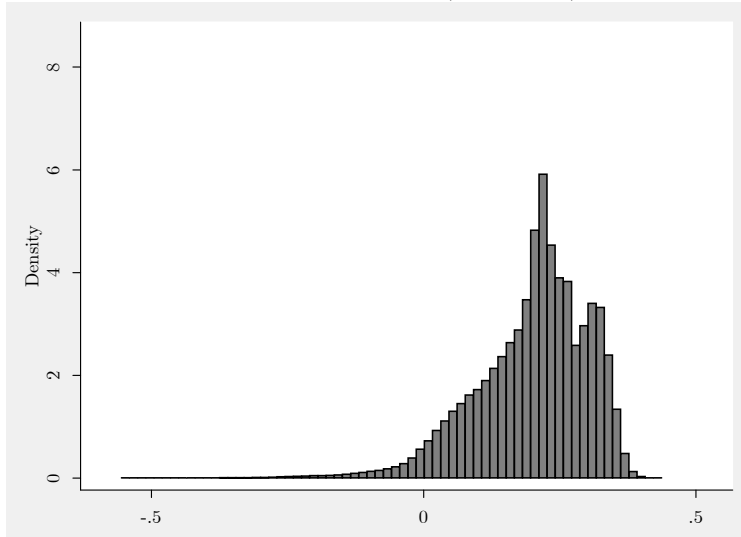
Figure 1 shows histograms of the *EATRs* for these three scenarios. Each histogram shows the dispersion of more than 8.7 million tax rates as we calculate the potential tax burden for 323,442 companies in all 27 European countries. Like in all the figures, the graphs are arranged as follows. The upper 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 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 and its dispersion would be significantly reduced under a formula apportionment system.²⁰

¹⁹More detailed results are available from the authors on request.

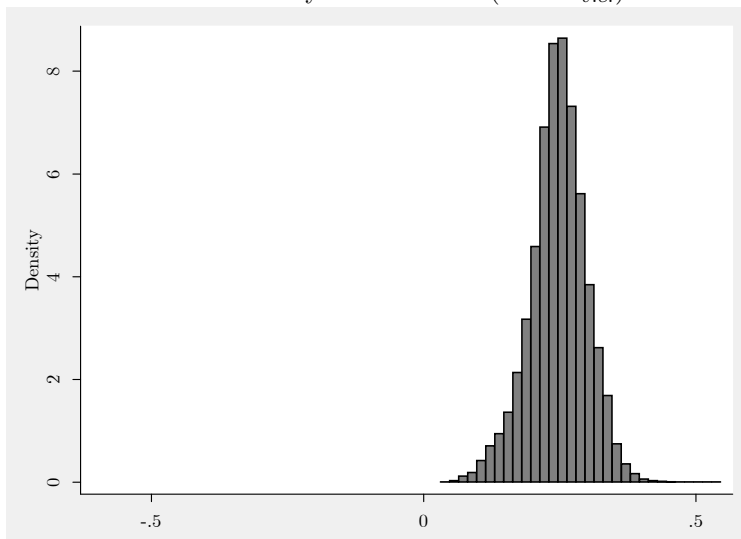
²⁰The few tax rates above 40% are due to the particular system in Estonia, not allowing tax depreciation.



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 *EATRs* for domestic, inbound and outbound investment

country	domestic investment			outward FDI			inward FDI		
	current system	formula apportionment		current system	voluntary consolidation	formula apportionment	current system	voluntary consolidation	formula apportionment
Austria	18.8%	19.3%		27.6%	21.0%	19.6%	30.0%	21.5%	24.17%
Belgium	24.2%	24.1%		30.2%	19.1%	25.9%	38.0%	30.0%	23.90%
Bulgaria	10.1%	7.6%		27.0%	25.0%	7.8%	22.2%	9.3%	23.12%
Cyprus	8.8%	9.4%		28.0%	26.2%	9.1%	17.7%	7.3%	26.12%
Czech Republic	20.8%	20.3%		31.2%	25.0%	20.0%	29.6%	21.1%	25.04%
Germany	27.3%	26.8%		30.4%	18.1%	27.5%	40.9%	34.0%	23.71%
Denmark	21.3%	20.0%		27.7%	21.3%	20.0%	31.4%	18.0%	25.33%
Spain	27.3%	26.1%		28.4%	18.1%	26.1%	38.1%	30.6%	24.85%
Estonia	22.2%	21.4%		27.8%	22.5%	17.9%	30.3%	23.8%	29.22%
Finland	21.9%	22.0%		27.8%	21.0%	21.3%	32.2%	22.6%	25.78%
France	26.0%	25.9%		29.9%	19.1%	26.2%	38.4%	30.5%	24.17%
United Kingdom	24.1%	24.1%		35.6%	26.4%	23.4%	36.2%	27.5%	25.87%
Greece	21.7%	19.0%		31.9%	25.2%	19.9%	29.5%	20.6%	23.46%
Hungary	13.4%	13.7%		27.7%	24.3%	13.2%	22.9%	13.0%	25.72%
Ireland	10.0%	12.6%		27.1%	24.6%	12.4%	19.6%	9.1%	25.05%
Italy	25.8%	25.7%		31.2%	18.0%	27.3%	40.5%	34.6%	22.62%
Lithuania	14.0%	14.7%		27.8%	23.9%	15.1%	24.6%	3.8%	24.29%
Luxembourg	21.8%	22.3%		28.1%	19.4%	23.2%	34.1%	25.3%	23.62%
Latvia	11.6%	11.8%		27.6%	24.5%	12.2%	21.7%	4.7%	24.06%
Malta	28.3%	28.3%		40.6%	30.0%	28.7%	39.8%	32.6%	24.12%
Netherlands	21.6%	20.4%		27.5%	20.9%	20.8%	30.6%	20.9%	24.89%
Poland	16.0%	16.2%		29.0%	24.7%	15.9%	25.0%	15.6%	24.66%
Portugal	19.8%	19.4%		28.6%	21.3%	20.3%	31.3%	21.5%	23.68%
Romania	12.5%	12.7%		27.8%	24.4%	12.7%	30.3%	10.2%	25.68%
Slovak Republic	15.7%	15.8%		28.1%	23.8%	16.0%	24.9%	14.2%	24.41%
Slovenia	18.1%	18.4%		28.0%	22.1%	18.7%	28.2%	18.8%	24.28%
Sweden	22.5%	22.5%		28.1%	20.4%	22.1%	34.0%	24.3%	25.47%
Europe	24.6%	24.2%		30.2%	19.9%	24.7%	30.2%	19.9%	24.57%

To assess the impact on the *EATR*s in the individual Member States Table 2 compares the average tax burdens for a domestic investment, for inbound and outbound foreign direct investment. We thereby assume that the domestic investment is done through the existing profitable parent company, which allows the losses to be offset. Further we assume that if the international investment takes place in an existing subsidiary that the losses can be offset there. In contrast if the company has no subsidiaries in the country so far, we assume that no loss consolidation is possible under the current system.²¹ 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 tax 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.

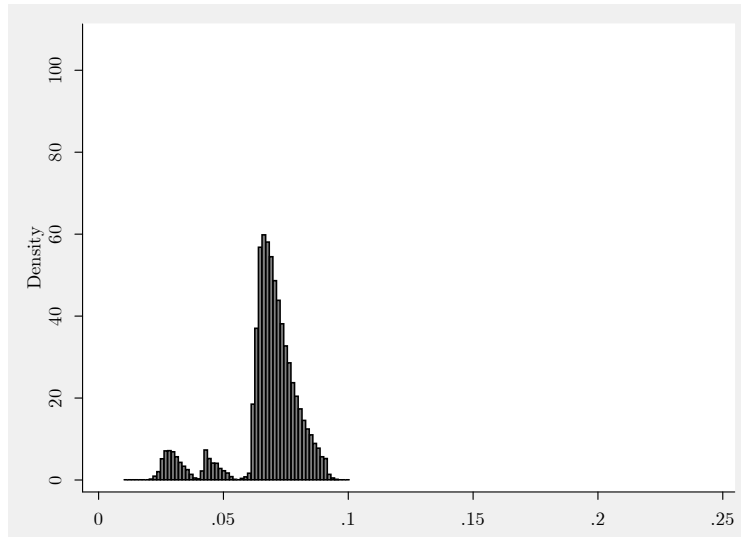
Comparing the domestic *EATR* under the current system with the tax burden for either outbound or inbound investment it is evident that the lack of international loss consolidation increases the *EATR* for international investment. This is at odds with both capital export neutrality and capital import neutrality because domestic investment receives more favourable tax treatment. While the tax burden for domestic investment are 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 to 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 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.

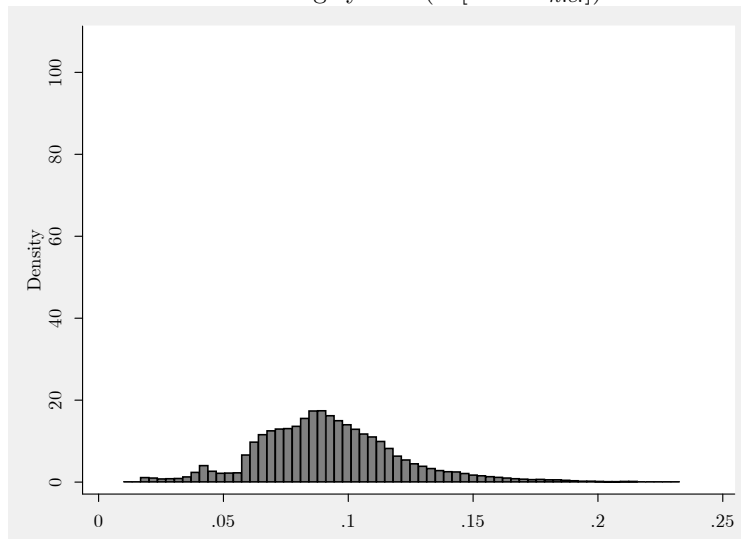
A switch to a formula apportionment system would almost eliminate the differences in the *EATR* for domestic investment and outbound investment. While the tax differential between domestic and outbound investment is reduced, the effective tax burden still do largely vary across the different member states. Country averages range from as little as 7.8 % for outbound investment from Bulgaria to 28.7 % for investment from Malta. However, for the inbound investment the dispersion amongst host countries is significantly reduced, with a lowest average *EATR* of 22.6 % in Italy and a highest average of 29.2 % in Estonia.

²¹For 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.

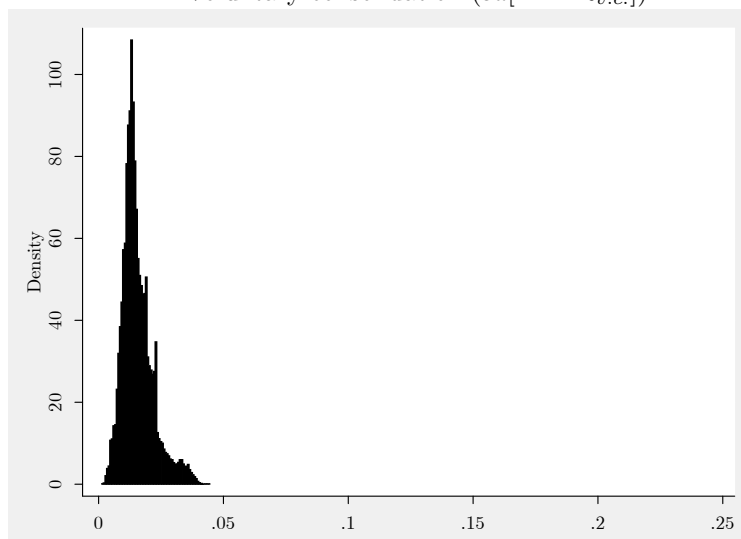
Capital export neutrality: It is, however, not possible to evaluate the efficiency only from country averages of *EATRs*. We therefore fully exploit the firm level information and examine capital export neutrality and capital ownership neutrality for the individual companies. From a company perspective capital export neutrality is given if the investment faces the same tax treatment regardless where it takes place. Technically, this can be measured as the variation between the *EATRs* for a firm in each country, including its home country. The lower this variation is, the better capital export neutrality is fulfilled. The first three columns of Table 3 summarise the standard deviation between the *EATRs* for each of the 323,442 firms under the various tax systems on a country by country basis. Figure 2 further shows histograms 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 *EATRs* for the individual corporations

country	Standard deviation						average <i>EATR</i>						minimum <i>EATR</i>					
	current		voluntary		formula		current		voluntary		formula		current		voluntary		formula	
	system	consolidation	consolidation	apportionment	apportionment	apportionment	system	consolidation	consolidation	apportionment	apportionment	apportionment	system	consolidation	consolidation	apportionment	apportionment	apportionment
Austria	0.081	0.098	0.098	0.012	0.012	0.012	27.3%	20.9%	20.9%	19.6%	19.6%	13.0%	3.3%	3.3%	3.3%	18.1%	18.1%	18.1%
Belgium	0.072	0.100	0.100	0.016	0.016	0.016	29.9%	19.3%	19.3%	25.8%	25.8%	16.2%	-0.5%	-0.5%	-0.5%	23.8%	23.8%	23.8%
Bulgaria	0.080	0.078	0.078	0.005	0.005	0.005	26.3%	24.4%	24.4%	7.8%	7.8%	9.9%	9.1%	9.1%	9.1%	7.2%	7.2%	7.2%
Cyprus	0.083	0.082	0.082	0.005	0.005	0.005	27.3%	25.6%	25.6%	9.1%	9.1%	8.8%	8.8%	8.8%	8.8%	8.3%	8.3%	8.3%
Czech Republic	0.049	0.062	0.062	0.011	0.011	0.011	30.8%	24.9%	24.9%	20.0%	20.0%	20.8%	14.2%	14.2%	14.2%	18.6%	18.6%	18.6%
Germany	0.069	0.099	0.099	0.017	0.017	0.017	30.2%	18.5%	18.5%	27.5%	27.5%	16.5%	-2.1%	-2.1%	-2.1%	25.4%	25.4%	25.4%
Denmark	0.077	0.094	0.094	0.012	0.012	0.012	27.5%	21.3%	21.3%	20.0%	20.0%	12.7%	3.8%	3.8%	3.8%	18.3%	18.3%	18.3%
Spain	0.075	0.103	0.103	0.016	0.016	0.016	28.4%	18.4%	18.4%	26.1%	26.1%	13.7%	-1.9%	-1.9%	-1.9%	24.1%	24.1%	24.1%
Estonia	0.078	0.089	0.089	0.010	0.010	0.010	27.6%	22.5%	22.5%	18.0%	18.0%	12.3%	5.5%	5.5%	5.5%	16.6%	16.6%	16.6%
Finland	0.078	0.098	0.098	0.013	0.013	0.013	27.6%	21.0%	21.0%	21.4%	21.4%	12.6%	3.0%	3.0%	3.0%	19.7%	19.7%	19.7%
France	0.073	0.103	0.103	0.017	0.017	0.017	29.8%	19.4%	19.4%	26.1%	26.1%	15.6%	-1.7%	-1.7%	-1.7%	24.1%	24.1%	24.1%
United Kingdom	0.030	0.049	0.049	0.014	0.014	0.014	35.2%	26.3%	26.3%	23.4%	23.4%	24.1%	14.1%	14.1%	14.1%	21.5%	21.5%	21.5%
Greece	0.044	0.056	0.056	0.011	0.011	0.011	31.6%	25.1%	25.1%	19.8%	19.8%	21.7%	14.9%	14.9%	14.9%	18.4%	18.4%	18.4%
Hungary	0.080	0.082	0.082	0.007	0.007	0.007	27.2%	23.9%	23.9%	13.2%	13.2%	11.7%	7.7%	7.7%	7.7%	12.3%	12.3%	12.3%
Ireland	0.078	0.077	0.077	0.007	0.007	0.007	26.5%	24.1%	24.1%	12.4%	12.4%	10.0%	9.9%	9.9%	9.9%	11.5%	11.5%	11.5%
Italy	0.067	0.096	0.096	0.019	0.019	0.019	31.0%	18.3%	18.3%	27.2%	27.2%	17.7%	-2.4%	-2.4%	-2.4%	25.1%	25.1%	25.1%
Lithuania	0.085	0.089	0.089	0.008	0.008	0.008	27.3%	23.6%	23.6%	15.1%	15.1%	11.4%	5.9%	5.9%	5.9%	14.1%	14.1%	14.1%
Luxembourg	0.075	0.100	0.100	0.015	0.015	0.015	27.9%	19.5%	19.5%	23.2%	23.2%	13.7%	0.9%	0.9%	0.9%	21.3%	21.3%	21.3%
Latvia	0.080	0.081	0.081	0.007	0.007	0.007	27.0%	24.1%	24.1%	12.2%	12.2%	10.8%	8.0%	8.0%	8.0%	11.3%	11.3%	11.3%
Malta	0.026	0.036	0.036	0.015	0.015	0.015	40.1%	29.9%	29.9%	28.7%	28.7%	28.3%	18.0%	18.0%	18.0%	26.6%	26.6%	26.6%
Netherlands	0.076	0.094	0.094	0.013	0.013	0.013	27.3%	20.9%	20.9%	20.7%	20.7%	13.3%	4.3%	4.3%	4.3%	19.1%	19.1%	19.1%
Poland	0.066	0.072	0.072	0.009	0.009	0.009	28.5%	24.3%	24.3%	15.9%	15.9%	16.0%	13.3%	13.3%	13.3%	14.7%	14.7%	14.7%
Portugal	0.076	0.092	0.092	0.012	0.012	0.012	28.3%	21.2%	21.2%	20.2%	20.2%	13.8%	3.8%	3.8%	3.8%	18.7%	18.7%	18.7%
Romania	0.074	0.076	0.076	0.008	0.008	0.008	27.2%	24.0%	24.0%	12.7%	12.7%	12.5%	12.1%	12.1%	12.1%	11.7%	11.7%	11.7%
Slovak Republic	0.081	0.087	0.087	0.008	0.008	0.008	27.6%	23.5%	23.5%	16.0%	16.0%	11.8%	6.6%	6.6%	6.6%	14.9%	14.9%	14.9%
Slovenia	0.081	0.097	0.097	0.011	0.011	0.011	27.6%	21.9%	21.9%	18.7%	18.7%	12.5%	4.6%	4.6%	4.6%	17.3%	17.3%	17.3%
Sweden	0.075	0.095	0.095	0.013	0.013	0.013	27.9%	20.5%	20.5%	22.1%	22.1%	13.2%	2.6%	2.6%	2.6%	20.3%	20.3%	20.3%
Europe	0.068	0.093	0.093	0.016	0.016	0.016	30.0%	20.0%	20.0%	24.7%	24.7%	16.3%	1.2%	1.2%	1.2%	22.8%	22.8%	22.8%

In the top part of Figure 2, showing the standard deviation under the current system, a very peculiar distribution of the standard deviation 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 relative low corporate tax rate, which quasi exempts foreign income 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 mostly fulfilled for high tax credit countries, but less so for exemption countries.

The middle part of Figure 2 displays the standard deviation for each firm under a voluntary loss consolidation. Compared to the current system the large increase in the spread of tax rates for each country demonstrates that such a tax reform would represent a move away from capital export neutrality. This large variation of tax rates 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. Nevertheless, in Table 3 the these countries can still be distinguished having a lower average standard deviation.

The lower part of Figure 2 presents the standard deviations under a formula apportionment system. The standard deviations are now significantly reduced and less dispersed. The peak is now at approximately 0.02 which signals the improvement in terms of capital export neutrality because of this tax reform. In the third column in Table 3 it can be now seen that firms located in the countries with the lowest corporate tax rate have the smallest variation in their *EATR*s. This shows that the effective tax burden is largely dominated by the statutory tax rate of the headquarter country.

Capital Ownership Neutrality: To assess the ability of the tax reforms to improve capital ownership neutrality we follow two approaches. First we follow a more conservative approach and stipulate that the requirements for capital ownership neutrality are met if all potential competitors face the on average the same tax burden. This is measured in comparing the average *EATR* for all 27 investment locations - the home country and all the other 26 European countries - for all firms. The results are presented graphically in the upper row of Figure 3 and on a more detailed country by country basis in the middle three columns of Table 3.

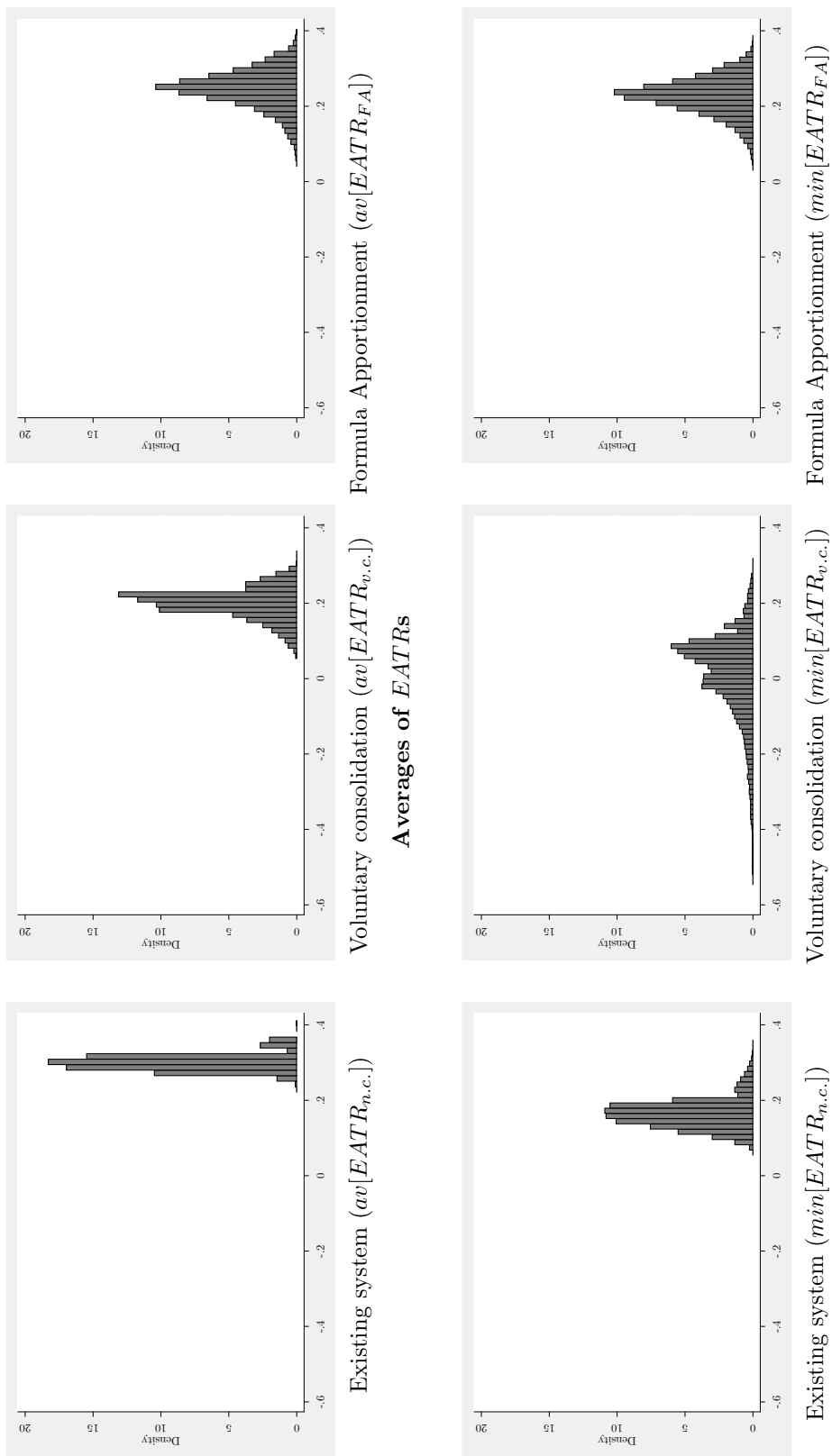


Figure 3: Histograms of average and minimum $EATR$

Additionally we also examine a stronger requirement for capital ownership neutrality. We assume that multinational companies can engage in tax planning or profit shifting. This implies that each corporation would set up the subsidiary in the country with the lowest *EATR*.²² Therefore capital ownership neutrality is only achieved if the tax optimal location decisions lead to an identical tax treatment for all potential competitors. In consequence we measure the degree of capital ownership neutrality through comparing the lowest possible *EATR* for each company. Again, the results are presented both graphically in the lower row of Figure 3 and on a country per country basis 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 capital ownership neutrality. The country averages in Table 3 strengthen this impression, as the only moderately vary between 26.3 % in Bulgaria and 40.1 % in Malta.

In comparison, the lower left part of Figure 3 depicts the distribution of the lowest possible *EATR* 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 tax rates with the tax burdens 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 tax burdens and simultaneously increase their dispersion. Already from the upper middle part of Figure 3, showing the averages of the *EATR* it becomes evident that most of the increased variation 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, which is at odds with capital ownership neutrality. 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 are now the countries with the lowest averages, all below 20 %. At the other end of the spectrum are still 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 less tax 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 can not benefit from the loss consolidation and therefore face relatively large tax burdens.

The lower middle part of Figure 3 displays the minimum of the *EATR*s under a voluntary loss consolidation system and even more highlights the tax planning opportunities under this system. More than half of the firms can direct the invest-

²²Even if the tax optimal location is not realistic for actual economic activity, it is still feasible to assume that a small subsidiary is set up there in order to shift profits or losses there.

ment to a country where it faces a negative effective tax burden. On the other hand some firms can not benefit to that extent from the loss consolidation and face positive *EATR*s of more than 30 %. This is obviously inconsistent with capital ownership 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 do profit most, while credit countries, like Malta, United Kingdom, Greece or the Czech Republic can benefit less from the new tax incentives and face on average a higher tax burden.

Under the assumption that an obligatory formula apportionment would be introduced, the distribution of the averages of the *EATR* would substantially increase, as can be seen in the upper right part of Figure 3. Comparing the distribution with the current system shows a decrease in the average tax burden in combination with increased tails on both sides. Hence the introduction of formula apportionment would lead to a move away from capital ownership neutrality. This is also apparent in Table 3 where the country averages now vary from 9.45 % in Cyprus to 28.60 % in Malta. In fact, the country averages very closely resemble the averages for domestic investment as presented in the first two columns of Table 2, which in turn are largely dominated by the existing differences in the statutory tax rates across the Member states.

However, looking at the distribution of the minimum of the *EATR*s as depicted in the lower right of Figure 3, the histogram looks very similar to the one for the average *EATR*s. This is due to the fact, that in contrast to a system of voluntary loss consolidation without formula apportionment no large tax benefits of loss consolidation exist. Therefore no negative *EATR*s occur and the distribution in the lower right part of Figure 3 is even less dispersed than for the current system. Interestingly, the peak of the distribution is also further on the right, than under the current system implying that firms face on average a higher minimum *EATR*. In the last column in Table 3 it can again be observed that the country averages of the lowest *EATR* under a formula apportionment system are very similar to the averages and the *EATR*s for the domestic investment in Table 2. This is in line with the small standard deviation between the *EATR*s in different locations for each individual company. The persisting difference between the companies in different locations stems from the statutory corporate tax rate in the parent country. These in turn dominate the *EATR* under the formula apportionment because most of the economic activity is concentrated in the headquarter country and we further assume that the investment is sufficiently small not to influence the overall distribution of the apportionment factors. In consequence, the feature of the formula apportionment system, which is responsible for the improvement in capital export neutrality, is also responsible for lack of performance in terms of capital ownership neutrality.

4.2 Cost of Capital

The methodology described in section 2 also allows to calculate the cost of capital and the *EMTR*.²³ These measures inform about the tax burden for a marginal investment, or, in our case for an investment with an expected return of the alternative investment (the real interest rate r). Based on the same tax law information and on the same firm sample, the results are similar for most of the measure. We therefore present the results very briefly and highlight where additional insight can be

²³The *EMTR* as defined in equation (8) 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.

gained from analysing the cost of capital.

Capital Export Neutrality: We follow the same logic as in the previous chapter to measure the extent to which the various tax systems fulfill capital export neutrality. We look at the standard deviation between the cost of capitals for the all 27 possible investment locations for each of the individual firms. Figure 4.2 again displays the histograms for the three scenarios. Comparing the left hand side part of Figure 4.2 to the upper part of Figure 2 is can be seen that the current system fulfills capital export neutrality substantially better for marginal investments than for profitable investment projects. This is due to the fact that the cost of capital depending relatively more on the tax base and less on the tax rates than the *EATR*. This narrower distribution reflects the fact that with Europe tax base definitions are less varying than the tax rates.²⁴

Further the three distinct peaks in the distribution under the current system are now longer visible. This mirrors that the double taxation system does not matter for a marginal investment as no dividends will be repatriated. Moving right in Figure 4.2 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 would violate capital export neutrality while the formula apportionment system would largely achieve it. The fact that the tax rate is less important for the cost of capital even leads to a standard deviation of zero for some of the companies, i.e. capital export neutrality would be achieved.

Capital Ownership Neutrality: In line with the previous analysis we measure Capital Ownership Neutrality looking at the distribution of the smallest possible tax burden for each individual company. Generally the results for the cost of capital as presented in Figure 4 are in line with the findings for the *EATR*. The increase in the dispersion of tax burdens because of the 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 4, displaying the minimum cost of capitals under a system with voluntary loss consolidation, 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.

In contrast under the formula apportionment system the dispersion of the distribution of the minimum cost of capitals is in-between the current system and the voluntary consolidation system but located more to the right. This illustrates two main aspects of the introduction of such a system. On the one hand the introduction of a formula apportionment system would violate capital ownership neutrality because the existing differences in tax rates and bases would create some variation in the potential minimum tax burden. On the other hand the formula apportionment system seems to be the only system able to avoid excessive tax saving through cross-border investment.

²⁴The one notable exception to this finding is Estonia with its distribution tax and no tax depreciation.

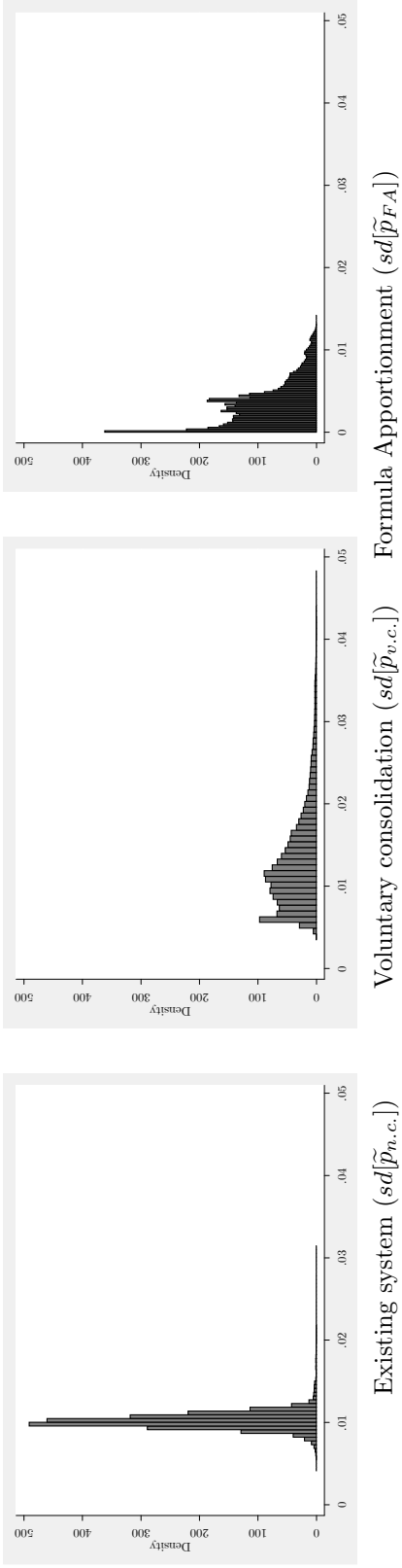


Figure 4: Histograms of standard deviation of cost of capital

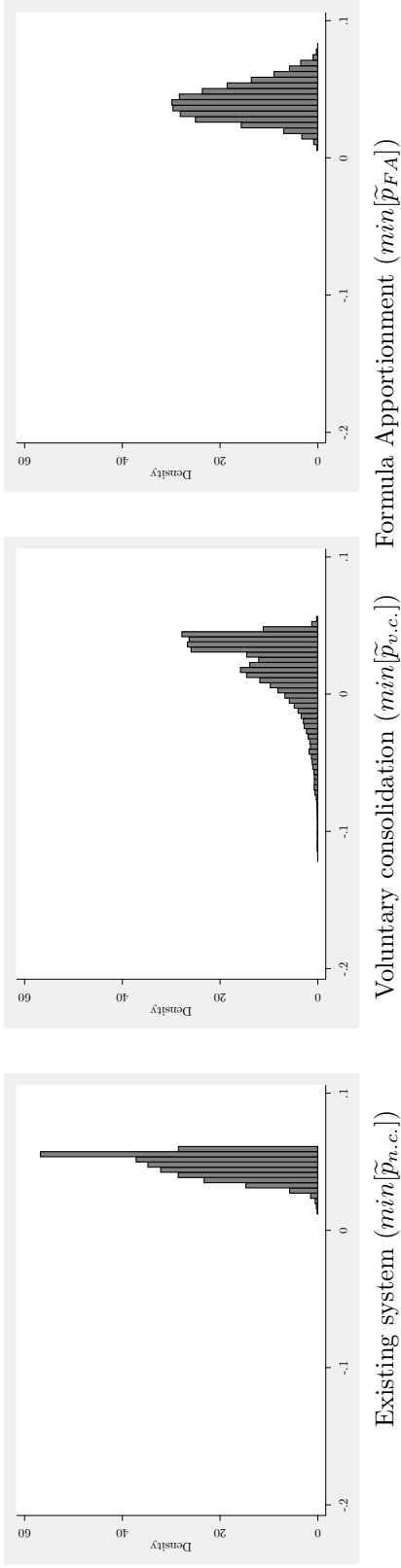


Figure 5: Histograms of minimum cost of capital

4.3 The importance of the size of the new investment

So far we assumed that the investment in the new subsidiary is sufficiently small not to alter the overall distribution of the factors used for the apportionment of the profits. While this assumption is consistent with the model and somewhat realistic for large companies, it may also be too restrictive. There is an additional incentive for companies to invest in low tax countries as the increase use of factors there would reduce the tax that is applicable for the rest of the corporate group. However, the larger the share of investment in the host country and therefore the bigger the feedback effect on the corporate group's tax rate, the smaller is the share of profits that is affected by the changed applicable tax rate. Or, in more technical terms, δR is increasing in λ while the scaling factor $(1 - \lambda)/\lambda$ is decreasing. Hence we expect a non-linear impact of the size of the new investment.

For reasons of space we do not present the full set of results for different sizes of the new investment, but rather summarized graphs to highlight the underlying mechanisms affecting the distributions of the tax burden.

Capital Export Neutrality: So far the formula apportionment system proved to be superior in terms of capital export neutrality with a significantly reduced standard deviation. Figure 6 highlights that part of this result was due to the assumption of the small size of the new investment. The bold and solid line represents the average of the standard deviations for all firms under different assumptions about the size of the new investment. Starting from the left the average standard deviation is minimal under the assumption of λ equal to zero. Increasing the relative size of the investment the average standard deviation first jumps up to then gradually drops until a λ of roughly 50 percent. If the size of the investment is bigger than that the host country tax rate starts to dominate and therefore the average standard deviation increases again. To put these results into perspective, Figure 6 also includes the averages of the standard deviations for the current system and the voluntary consolidation system. These are represented by the horizontal dashed lines, indicating that these numbers are independent of the size of the new investment.

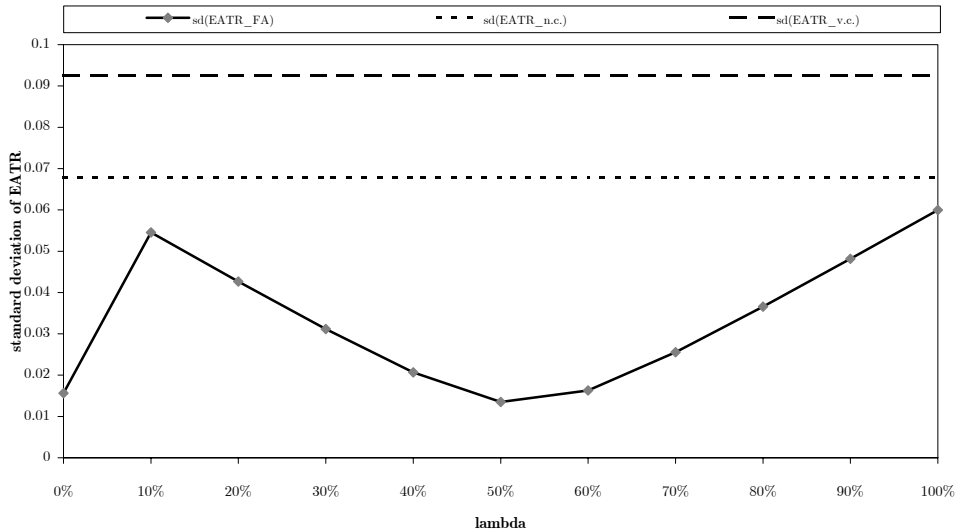


Figure 6: Averages of the standard deviation of the *EATR* for different values of λ

Regardless the size of the new investment, the average standard deviation of the *EATR*s under formula apportionment never reaches the level of the average standard deviation under the current system. This highlights once more that the switch to formula apportionment would improve capital export neutrality.

Capital Ownership Neutrality: To evaluate the impact of the size of the new investment on capital ownership neutrality proceed as follows. We first calculate the average and the minimum *EATR* for each company and then take the standard deviation of these measures. To fulfill capital ownership neutrality the standard deviation should be zero. Relating this to the previous analysis, zero standard deviation would imply that the histograms in Figure 3 would collapse to single pike. Following a the logic of the previous graph we also include the values for the current system and for a system of voluntary consolidation as dashed lines while the values for the formula apportionment system are represented through the solid lines.

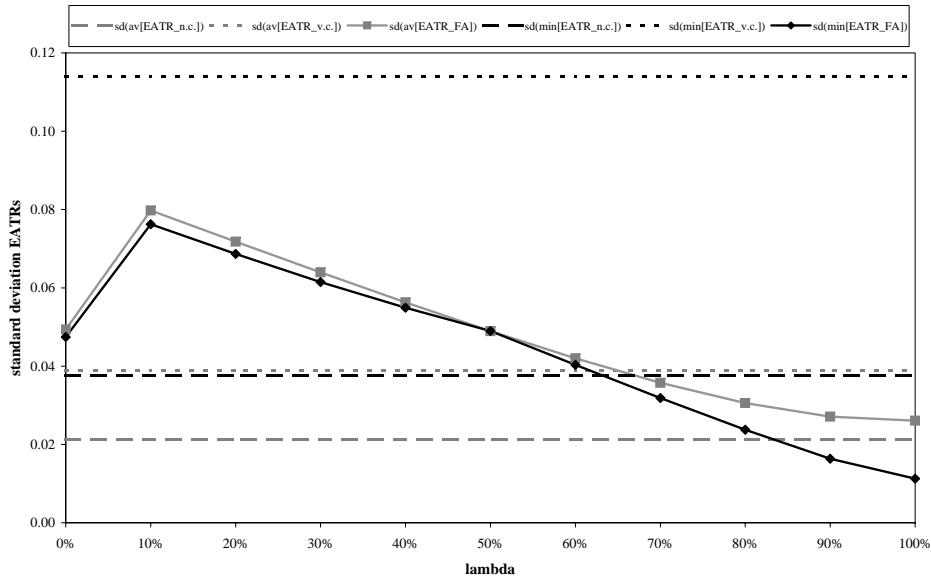


Figure 7: Standard deviation of the averages and minimums of *EATR* for different values of λ

The grey lines in Figure 7 display the results for the standard deviation of the averages of the *EATR* while the black lines describe the standard deviation of the minimum *EATR*. It can be seen that the values for the minimum rates are substantially higher for the current and even more so for the voluntary consolidation case. Only for the formula apportionment the values for the minimum *EATR* are lower and very close to the ones for the average *EATR*. These two fact together illustrate the fact that tax planning is somewhat reduced under formula apportionment and were tax saving opportunities are left, they are more evenly distributed across companies and countries. However, the fact the both solid lines lie above the dashed lines for a large part of the spectrum of λ reinforces the point earlier made, that formula apportionment would imply a further deviation from capital ownership neutrality. And in fact, unless the new investment is not bigger than the existing one, i.e. λ bigger than 50 percent, the spread of both the average and minimum *EATR*s is even bigger than in our analysis above with the assumption of λ equal to zero.

Only for very big new investments formula apportionment would perform best in terms of capital ownership neutrality measured in the standard deviation of the minimum *EATR*. There is a relatively simple explanation behind this. For a new investment which shifts all apportionment factors to the new subsidiary, i.e. λ equals a 100 percent, the same tax law apply to all firms. The remaining spread is solely due to the differences in firm characteristics like the assets structure and the leverage.

5 Conclusion

This paper aims to investigate whether the international loss consolidation and a formula apportionment would increase the efficiency of the tax system in Europe. To evaluate the impact of such reforms it further develops the effective average tax rate concept of Devereux and Griffith (1999) to allow for a potential loss. With the use of the largest available data set of firm level data, we calculate the effective tax rates under the existing system without loss consolidation. We then calculate the potential effective tax rates under two comprehensive tax reforms; a voluntary international loss consolidation under the current system and a obligatory system of international consolidation and formula apportionment.

We can show that the current system provides beneficial tax treatment for domestic investment because of the lack of international loss consolidation. Therefore the current system fulfills the requirements for neither capital export neutrality nor capital ownership neutrality. Changing to a system of voluntary consolidation would largely change the investment incentives and partly correct the distortion between domestic and international investment. However, such a tax reform would introduce more distortions and tax planning opportunities, which overall would imply a move away from both capital export neutrality and capital ownership neutrality.

In contrast, the change to a formula apportionment system would in fact have some desirable efficiency effects. First the overall distribution of the *EATR* would be less dispersed. More importantly the tax differential between domestic and international investment would be mitigated, and capital export neutrality would be achieved to a large extent. On the other hand, the fact that the effective tax burden would be dominated by the host country tax rate, would imply that such a tax reform would worsen the capital ownership neutrality. The extent of this change, however, somewhat depends on the assumptions about firm behaviour. If firms take full advantage of all tax saving opportunities, the move to a formula apportionment system would only moderately worsen capital ownership neutrality and outperform a voluntary consolidation system. This is due to the fact, that firms can - despite the lack of international loss consolidation - pursue some tax saving strategies under the current system, which would no longer be available under a formula apportionment system.

Taking into account that firms are to some extent able to alter the applicable tax rate for the corporate group as a whole via a substantially large investment, the efficiency gains of the introduction are significantly reduced. While the position in terms of capital export neutrality would still be improved, the increased deviation from capital ownership neutrality could be substantial. This is mainly due to the existing differences in statutory tax rates, which would imply a sizable feedback effect to the corporate groups applicable tax rate.

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