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Merger Policy and Tax Competition

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Merger Policy and Tax Competition*

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Abstract

In many situations governments have sector-specific tax and regulation policies at their disposal to influence the market outcome after a national or an international merger has taken place. In this paper we study the implications for merger policy when countries non-cooperatively deploy production-based taxes. We find that whether national or international mergers are more likely to be enacted in the presence of nationally optimal tax policies depends crucially on the ownership structure of firms. When all firms are owned domestically in the pre-merger situation, non-cooperative tax policies are more efficient in the national merger case and smaller synergy effects are needed for this type of merger to be proposed and cleared. These results are reversed when there is a high degree of foreign firm ownership prior to the merger.

Keywords: merger regulation, tax competition

JEL Classification: H 21, H 77, L 13, L 50

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1 Introduction

Mergers have played a prominent role over the past decade, and international merger activity has grown particularly fast. During the period 1981-1998 the annual number of mergers and acquisitions (M&A) has increased more than fivefold and the share of cross-border mergers has reached more than one quarter of the total by the end of this period (Gugler, 2003, Figure 1 and Table 2A). This increase in merger activity has led to situations where a national or an international merger have been in direct competition with each other. A recent example has been the bidding race for the leading Spanish electricity provider *Endesa*, where the German-based *E.ON* company initially competed with the Spanish-based rival *Gas Natural*. The Spanish authorities favored the national merger and formulated severe obstacles to an international take-over by *E.ON*, which was one of the reasons why *E.ON* eventually withdrew its bid.

A different approach has been taken by the British government, which has fully liberalized its electricity market in the early 1990s. In this process, foreign electricity providers (among them *E.ON*) took over a large part of the British electricity industry. The British government responded to high profits in this and other privatized industries by imposing a one-time, sector-specific ‘windfall profit tax’ in 1997. Since then, a renewed imposition of this tax has been repeatedly discussed as a complement to the regulation of prices through the regulation authority Ofgem (Office of Gas and Electricity Markets).

The last example shows clearly that national governments dispose over additional policy instruments in an industry where a merger or a foreign acquisition has taken place. Price regulation in privatized ‘network industries’ is one important way to increase domestic consumer surplus at the expense of corporate profits, which often accrue, at least in part, to foreign shareholders. Sector-specific profit taxes have very similar effects, if their proceeds are redistributed to consumers in compensation for higher goods prices. On the other hand, there are also many industries where subsidies are granted in order to improve the competitiveness of domestic products in world markets. One set of examples are direct subsidies to specific sectors, such as mining, shipbuilding, steel production, or airplane construction. Moreover, several of these sectors and several others (e.g. air transportation) also receive indirect subsidies by paying reduced rates

of excise taxes, in particular mineral oil or electricity taxes. To the extent that these ‘eco taxes’ represent Pigouvian taxes that cause firms to internalize the true social cost of their products, such tax rebates also represent subsidies to the involved sectors and, importantly, to the electricity and energy sector itself. In all these cases, sector-specific tax or subsidy policies can be adjusted by national policymakers in response to a change in market structure caused by a merger.

In this paper we argue that the possibility to levy industry-specific taxes or subsidies in a nationally optimal way has important repercussions on the position that national regulation authorities take vis-à-vis a national or an international merger proposal. At the same time, merging firms will incorporate a possible change in policy when deciding about a merger in a particular country. To analyze this interaction between tax and merger policies we set up a model where both firms and merger regulation authorities anticipate that taxes will be optimally adjusted in the host country after a merger has taken place. More specifically, we investigate a setting of Cournot quantity competition between four producing firms where two firms are located in each of two symmetric countries. Importantly, these firms may have foreign shareholders, thus giving an incentive to each government to employ profit taxes that can be partly exported to foreigners.¹ Starting from a market structure of double duopoly, our focus is on the comparison between a national merger in one of the countries and an international merger between a home and a foreign firm.

Our analysis shows that the relative attractiveness of a national versus an international merger depends critically on the degree of foreign firm ownership. When all firms are nationally owned prior to the merger, then a national merger will lead to more efficient tax policies as compared to the international merger. In contrast, when the level of foreign firm ownership is high initially, then non-cooperative tax policies in the host countries will be more efficient under the international merger, as compared to the national one. Extending the model to allow for synergy effects of mergers, we show that these welfare properties translate into the national (international) merger being

¹This *tax exporting effect* is familiar from the tax competition literature (Huizinga and Nielsen, 1997; Fuest 2005). Huizinga and Nicodème (2006) provide empirical evidence for this effect in Europe, showing that countries with a high share of foreign firm ownership will also impose relatively high corporate taxes.

more likely to be proposed and adopted when the degree of foreign firm ownership is low (high). These results imply that a more geographically dispersed ownership structure of firms, in combination with non-cooperatively chosen national tax policies, may offer one explanation for the recent surge in cross-border merger activity.

Our analysis relates to two strands in the literature. First, there is a growing recent literature on merger policies in open economies.² This literature, however, typically regards merger control as an isolated policy problem for national or international regulators. The literature that analyses the interaction of merger control with other policy instruments is scarce, and it almost exclusively focuses on international trade policies as the additional policy variable (Richardson, 1999; Horn and Levinsohn, 2001; Huck and Konrad, 2004; Saggi and Yildiz, 2006). In contrast, the interaction between merger policy and national tax policies has not been addressed in this literature so far. A second literature strand on which our paper builds is the analysis of optimal commodity taxation in oligopolistic markets (see Keen and Lahiri, 1998; Lockwood, 2001; Keen et al., 2002; Haufler et al., 2005; Hashimzade et al., 2005). This literature, however, has focused mainly on issues of commodity tax harmonization and the choice of commodity tax regime under an exogenously given market structure. It has not addressed the implications for tax policy that follow from changes in the underlying market conditions as a result of mergers.³

The plan of the paper is as follows. Section 2 describes the basic framework for our analysis. Section 3 presents the benchmark case of double duopoly, where two firms are located in each country and all four firms compete in both markets. Section 4 analyzes the changes in tax policies and welfare when a national merger occurs in one of the countries. Section 5 carries out the same analysis for an international merger. Section 6 introduces synergy effects associated with a national and an international merger and compares the conditions under which one or the other type of merger is proposed and accepted by merger authorities. Section 7 concludes.

²Contributions to this literature that relate to our analysis include Barros and Cabral (1994), Head and Ries (1997), Horn and Persson (2001), Bjorvatn (2005), Lommerud et al. (2006), Südekum (2006), Haufler and Nielsen (2007), Norbäck and Persson (2007) and Neary (2007).

³A recent paper that analyzes the interaction of tax policies and mergers is Becker and Fuest (2007). The focus of their paper is very different from ours, however, and lies on the implications of *M&A* activity for the desirability of different international tax regimes.

2 The general framework

We consider a concentrated industry in an open economy model of two symmetric countries $i \in \{A, B\}$. In each country i , there are initially two producing firms, indexed with j . Firms 1 and 2 are located in A and firms 3 and 4 are located in B . All firms are engaged in Cournot quantity competition and produce a homogenous good. Each firm's output can be offered in both countries and, for simplicity, there are no trade costs when goods are sold abroad. The sales of firm j in country i are given by x_j^i and the global sales of firm j are denoted x_j . Each firm maximizes its profit independently for each national market. We thus assume that markets are segmented.⁴

Production is modelled in the simplest possible way. Capital (k) is the only input factor and each firm requires one unit of capital to produce one unit of output. Hence $x_j^i = k_j$. Capital is traded internationally at a constant world interest rate r . The cost of capital consists of the interest rate and a unit tax on capital t^i which is levied in the country of production. Given the above production function, and in line with some of the policy examples mentioned in the introduction, this tax can equivalently be interpreted as an origin-based production tax.⁵ The resulting production costs are $c_1 = c_2 = r + t^A$ for the firms producing in country A and $c_3 = c_4 = r + t^B$ for those in country B.

On the demand side we assume that there is one representative consumer in each market who consumes good x and a numeraire good z , which is produced under conditions of perfect competition. The utility function is of the quasi-linear form

$$U^i(x^i, z^i) = u(x^i) + z^i, \quad x^i = \sum_{j=1}^4 x_j^i \quad \forall i \in \{A, B\}, \quad (1)$$

where x^i is total consumption of good x in market i . Denoting the price of good x in

⁴This assumption simplifies the calculations as firms treat the price in each market as an independent variable. While price discrimination by firms is possible, it will not occur in equilibrium as markets are symmetric and trade costs are absent (see Brander, 1995, p. 1426).

⁵Production-based taxation is the relevant scenario in our setting, as we are concerned with taxes and subsidies that are explicitly targeted at producers. This differs from excise taxes, such as taxes on cigarettes or alcohol, that are targeted at consumers and are generally taxed in the country of final consumption. The different allocative effects of production- vs. consumption-based commodity taxes have been an important issue in the literature (see Lockwood, 2001, for an overview).

country i by p^i , the profits of each firm j are given by

$$\pi_j = \begin{cases} p^A x_j^A + p^B x_j^B - (x_j^A + x_j^B)(r + t^A) & \forall j \in \{1, 2\}; \\ p^A x_j^A + p^B x_j^B - (x_j^A + x_j^B)(r + t^B) & \forall j \in \{3, 4\}. \end{cases} \quad (2)$$

The representative consumers in the two countries are also the owners of all firms. Importantly, we assume that the firms producing in country i may not be fully owned by the representative consumer residing in i . More specifically, we denote by α the share of each firm that is initially owned domestically, whereas $(1 - \alpha)$ is the share owned by the representative foreign consumer. We restrict α to be in the range $0.5 \leq \alpha \leq 1$, thus ensuring that foreign owners do not hold a majority in any firm.⁶ To simplify notation, we also assume that the domestic ownership share is the same for all firms, i.e. residents of country A hold the share α in firms 1 and 2, whereas residents of country B hold the same share α in firms 3 and 4. In several parts of our analysis we focus on the polar cases of *full national ownership* ($\alpha = 1$), and of *full international ownership diversification* ($\alpha = 0.5$).

Next, we characterize the behaviour of national governments. Governments simultaneously and non-cooperatively choose the tax rate t^i to maximize the utility of their representative consumer. Tax policy in each country thus follows the national interest only and international tax coordination is ruled out. If positive tax rates are chosen, the resulting revenue is redistributed lump-sum to the representative consumer. Conversely, if subsidies are paid to firms, then the costs of these subsidies are met by a lump-sum tax on the domestic resident. Therefore the income of the representative consumer in each country consists of the profit income derived from all firms and the government balance. Each national government maximizes the indirect utility of its representative consumer. With quasi-linear utility, national welfare in each country equals the sum of consumer surplus, $CS^i = u(x^i) - p^i x^i$, and the consumer's income. Hence the governments of countries A and B solve:

$$\begin{aligned} \max_{t^A} W^A &= CS^A + \alpha \sum_{j=1}^2 \pi_j + (1 - \alpha) \sum_{j=3}^4 \pi_j + t^A \sum_{j=1}^2 x_j, \\ \max_{t^B} W^B &= CS^B + \alpha \sum_{j=3}^4 \pi_j + (1 - \alpha) \sum_{j=1}^2 \pi_j + t^B \sum_{j=3}^4 x_j. \end{aligned} \quad (3)$$

⁶There is substantial empirical evidence for such a 'home bias' in the composition of shareholder's portfolios. See Adler and Dumas (1983) and, more recently, Pinkowitz et al. (2001) for surveys.

Prior to choosing their tax policy, governments decide on an exogenous national or international merger proposal. This sequence of events is motivated by the fact that the setting of sector-specific taxes or subsidies is typically of a more short-term nature than the (usually irrevocable) decision on a firm merger. If a merger proposal is accepted, then governments take into account in their subsequent tax or subsidization policies that the number of firms competing in the two markets is reduced. The timing of the game can thus be summarized as follows. In the first stage, a national or an international merger is proposed by the merging firms. In the second stage, governments reject or clear the proposal, depending on which policy maximizes their national welfare.⁷ In the third stage, both governments non-cooperatively set their tax policies. Finally, in the fourth stage, all firms simultaneously choose their profit maximizing output levels. In the following it proves convenient to first concentrate on the third stage and derive the optimal tax policies in a simplified setting where mergers create no synergy effects. In a second step we then include synergy effects (i.e. cost savings) and ask under which conditions a national and an international merger will be beneficial for both the merging firms and from the perspective of the relevant regulation authority.⁸ Throughout this paper we focus on a single merger, either national or international. Effectively we thus assume that one of the firms in, say, country A is searching for a partner, which could either be the national rival or one of the two firms operating in the other country.

3 Benchmark: Double duopoly

In this section we derive the optimal tax policies and the equilibrium allocation for the benchmark case of double duopoly. Before we solve the model in closed form by imposing additional restrictions on demand, it is useful to derive the optimal tax policy in the more general framework outlined in section 2. This allows us to identify the

⁷We assume that a national merger is decided upon by the country which hosts the merging firms, whereas an international merger is cleared by a common regulation authority of the two countries. These assumptions are not restrictive, however. It will be seen that a national merger in country A is never vetoed by country B so that it is sufficient to concentrate on A's decision. For an international merger the equilibrium is symmetric and hence the interests of the two governments coincide.

⁸As will be shown in Section 6, allowing for synergy effects does not overturn the basic differences in tax policies that are derived in the simplified setting.

different effects that shape tax policy in the third stage of our model. Substituting (2) in (3), differentiating with respect to t^i and employing the symmetry properties yields for the example of country A (see the appendix for the derivation)

$$t^A = \underbrace{\frac{p' x_j^i}{\sum_{i=A}^B \sum_{j=1}^2 (dx_j^i/dt^A)}}_{(+)} \left[\underbrace{\sum_{j=1}^4 \frac{dx_j^A}{dt^A}}_{(I) (-)} + \underbrace{(2\alpha - 1) \left(\sum_{j=1}^2 \frac{dx_j^B}{dt^A} - \sum_{j=3}^4 \frac{dx_j^B}{dt^A} \right)}_{(II) (-,0)} + \underbrace{4(1 - \alpha)}_{(III) (+,0)} \right]. \quad (4)$$

Here $p' < 0$ is the slope of the inverse demand curve, x_j^i is the output of firm j for market i (which is the same for all firms and in both markets) and $dx_1^i/dt^A = dx_2^i/dt^A < 0$ and $dx_3^i/dt^A = dx_4^i/dt^A > 0$ are the equilibrium changes of output for market i produced by a representative firm located in country A and country B, respectively. To sign the effects in (4), note that a rise in t^A reduces equilibrium output of country A's firms and increases that of B's firms. Moreover, the effect of the tax increase will be stronger in absolute terms for the firms in country A so that $|dx_1^i/dt^A| = |dx_2^i/dt^A| > |dx_3^i/dt^A| = |dx_4^i/dt^A|$.⁹

It is then straightforward to infer that the first effect (I) in equation (4) gives the aggregate change in output supplied to country A's consumers. This effect, which we label the *efficiency effect*, is negative, as an increase in t^A reduces output of country A's firms by more than it increases the output of B's firms. Since the consumption of good x in country A is inefficiently low, this effect calls for subsidizing domestic production. The second effect (II) is a *market share effect*. An increase in t^A reduces the output of country A's firms and raises the output of B's firms, thus redistributing profit income towards the latter. This gives a strategic incentive to each country to subsidize domestic firms (cf. Brander, 1995). The effect is strongest with full national ownership of all firms ($\alpha = 1$), and it is absent if the ownership structure of all firms is fully diversified internationally ($\alpha = 0.5$). Finally, the third effect (III) is a positive *tax exporting effect*. It describes the incentive to levy a positive tax on output whenever foreigners hold some share in domestic firms ($\alpha < 1$), as part of the tax burden will be shifted to them.

Having discussed the general effects that shape tax policy in our model we now intro-

⁹These properties will be shown below for the special case of linear demand.

duce the assumption that utility is quadratic and hence $U^i = ax^i - (x^i)^2/2 + z^i$. This utility function gives rise to linear inverse demands in each market:

$$p^i = a - x^i \quad \forall i. \quad (5)$$

This assumption ensures that we can derive closed-form solutions for optimal tax rates and welfare in each of the different scenarios. The latter is critical if we want to compare the discrete equilibria that arise in the double duopoly benchmark and in each of the two different merger scenarios.

Solving the game by backward induction, we start with the solution of the firms' optimization problems. Maximizing profits in (2) with respect to x_j^i , using the inverse demand function (5) and employing the symmetry of the model yields

$$\begin{aligned} x_1^i = x_2^i &= (a - r - 3t^A + 2t^B) / 5 \quad \forall i \in \{A, B\}, \\ x_3^i = x_4^i &= (a - r - 3t^B + 2t^A) / 5 \quad \forall i \in \{A, B\}. \end{aligned} \quad (6)$$

This shows that output levels of each firm depend negatively on the production-based tax rate in the firm's home country, but positively on the tax rate of the foreign country (which hosts some of its rivals).¹⁰ Substituting (6) into (2) yields maximized profits

$$\pi_1 = \pi_2 = \frac{2(a - r - 3t^A + 2t^B)^2}{25}; \quad \pi_3 = \pi_4 = \frac{2(a - r - 3t^B + 2t^A)^2}{25}. \quad (7)$$

Given firms' output decisions, we can now solve for the two governments' simultaneous tax problems in the second stage of the game [eq. (3)]. This yields the non-cooperative tax choices in the Nash equilibrium under double duopoly (subscript DD), which are derived in the appendix

$$t_{(DD)}^A = t_{(DD)}^B = \frac{(a - r)(10\alpha^2 - 27\alpha + 14)}{44 + 10\alpha^2 - 42\alpha}. \quad (8)$$

Substituting equilibrium tax rates in (8) back into (6) and (7) gives:

$$x_{j(DD)}^i = \frac{(6 - 3\alpha)(a - r)}{2(22 + 5\alpha^2 - 21\alpha)} \quad \forall i, j; \quad \pi_{j(DD)} = \frac{(6 - 3\alpha)^2(a - r)^2}{2(22 + 5\alpha^2 - 21\alpha)^2} \quad \forall j. \quad (9)$$

To evaluate the efficiency of this allocation, we substitute the equilibrium values from (9) into the national welfare expressions (3) and get

$$W_{(DD)}^A = W_{(DD)}^B = \frac{(6 - 3\alpha)(a - r)^2(10\alpha^2 - 36\alpha + 32)}{(22 + 5\alpha^2 - 21\alpha)^2}. \quad (10)$$

¹⁰Moreover, eq. (6) shows that $|dx_1/dt^A| > |dx_3/dt^A|$, as postulated above (see footnote 9).

Equations (8) and (10) summarize tax policy and welfare in each country for different ownership structures, as captured by the parameter α . In the following, we first consider the case of full domestic ownership ($\alpha = 1$) and then turn to an internationally diversified ownership structure.

National ownership of firms: With $\alpha = 1$, the Nash equilibrium taxes in (8) simplify to $t_{(DD)}^i = -(a - r)/4 \forall i$. Governments offer a production or capital subsidy to firms in order to raise output to its efficient level.¹¹ Hence the resulting allocation represents a global Pareto optimum (subscript *PO*). From (10), national and global welfare are

$$W_{(DD)}^A = W_{(DD)}^B = \frac{1}{2}(a - r)^2; \quad W_{(DD)}^A + W_{(DD)}^B = (a - r)^2 \equiv W_{PO}^{A+B}. \quad (11)$$

The result that non-cooperative tax policy yields an efficient outcome when firms are fully owned by the domestic resident is not obvious in our open economy setting. It is, however, easily explained from (4). National governments do not fully internalize the benefits to consumers induced by a production subsidy because, with costless international trade, some part of domestic production will be consumed by foreigners. Therefore the *efficiency effect* (I) is reduced, relative to the case of a closed economy. However, this incomplete incentive is offset by the *market share effect* (II), which gives an incentive to subsidize domestic firms in order to increase their profits at the expense of foreigners. In the special case of symmetric countries and zero trade costs, the market share effect exactly compensates for the reduced efficiency incentive. Finally, for $\alpha = 1$ the *tax exporting effect* (III) is absent. Hence in this case each country sets its non-cooperative tax rate at the globally efficient level.¹²

¹¹This is seen from substituting $\alpha = 1$ in the output equation in (9). Noting that there is a total of four firms and substituting the resulting aggregate output in the demand equation (5) shows that the subsidy ensures $p_{(DD)}^i = r \forall i$. Therefore prices in both countries equal marginal costs.

¹²Recall that the quantities supplied to each market are well defined in our segmented markets model (see footnote 4). The result that non-cooperative commodity taxation under the origin principle yields a first-best outcome when markets are integrated is due to Keen and Lahiri (1998, Proposition 6). Haufler et al. (2005) show that the result also holds when markets are segmented, but trade costs are absent. Neither of these analyses includes foreign firm ownership, however.

International ownership of firms: With foreign firm ownership ($\alpha < 1$), two changes occur in equation (4). First, the incentive to subsidize domestic firms through the *market share effect* (II) is reduced. Second, via the *tax exporting effect* (III), each country has an incentive to tax the profits of its domestic firms, which partly accrue to foreigners (Huizinga and Nielsen, 1997; Fuest, 2005). In the non-cooperative tax equilibrium, these changes will lead to inefficiently low subsidies, or even positive taxes.¹³ Evaluating (10) shows that welfare continuously falls in each country if the foreign ownership share is increased (if α falls). Summarizing our results in this section gives:

Proposition 1 *Under a market structure of double duopoly, non-cooperative tax policies by national governments achieve the first best if all firms are fully owned by domestic residents. An increase in the share of foreign firm ownership raises tax rates in both countries above their Pareto efficient levels and reduces welfare in each country.*

4 National merger

In this section we develop the implications of an exogenous national merger proposal in country A. If the proposal were accepted, firms 1 and 2 would merge to the new entity 12. The merged firm behaves as a single player so that there are now three identical firms engaged in Cournot quantity competition.¹⁴ The two governments' problems in the case of a national merger in country A are

$$\begin{aligned} \max_{t^A} W^A &= CS^A + \alpha\pi_{12} + (1 - \alpha)\sum_{j=3}^4 \pi_j + t^A x_{12}, \\ \max_{t^B} W^B &= CS^B + \alpha\sum_{j=3}^4 \pi_j + (1 - \alpha)\pi_{12} + t^B \sum_{j=3}^4 x_j. \end{aligned} \quad (12)$$

Solving these problems simultaneously leads to the following Nash equilibrium tax rates in the national merger (NM) case, which are derived in the appendix:

$$t_{(NM)}^A = \frac{(a - r)(19 - 40\alpha + 16\alpha^2)}{2(27 - 30\alpha + 8\alpha^2)}, \quad t_{(NM)}^B = \frac{(a - r)(39 - 76\alpha + 32\alpha^2)}{4(27 - 30\alpha + 8\alpha^2)}. \quad (13)$$

¹³It is easily inferred from (8) that Nash equilibrium taxes turn positive when the domestic ownership share falls below $\alpha = 0.7$.

¹⁴In Section 6 we will introduce asymmetries between firms by incorporating synergy effects (cost savings) associated with the merger.

It is inferred from (13) that $t_{(NM)}^A < t_{(NM)}^B$ must hold throughout the relevant parameter range $0.5 \leq \alpha \leq 1$. Hence country A offers a lower tax, or a higher subsidy, to its merged firm 12, as compared to country B's tax treatment of its local duopolists (firms 3 and 4). This result will be further discussed below.

These tax rates lead to equilibrium levels of outputs and profits given by

$$\begin{aligned} x_{12(NM)}^i &= \frac{(a-r)(9-4\alpha)}{2(27-30\alpha+8\alpha^2)} \quad \forall i, & x_{j(NM)}^i &= \frac{(a-r)(17-12\alpha)}{4(27-30\alpha+8\alpha^2)} \quad \forall i, j \in \{3, 4\}, \\ \pi_{12(NM)} &= \frac{(a-r)^2(9-4\alpha)^2}{2(27-30\alpha+8\alpha^2)^2}, & \pi_{j(NM)} &= \frac{(a-r)^2(17-12\alpha)^2}{8(27-30\alpha+8\alpha^2)^2} \quad \forall j \in \{3, 4\}. \end{aligned} \quad (14)$$

Substituting the results from (14) into (12) yields national welfare in each country:

$$\begin{aligned} W_{(NM)}^A &= \frac{(a-r)^2(969-1823\alpha+1144\alpha^2-240\alpha^3)}{4(27-30\alpha+8\alpha^2)^2}, \\ W_{(NM)}^B &= \frac{(a-r)^2(1163-2193\alpha+1352\alpha^2-272\alpha^3)}{4(27-30\alpha+8\alpha^2)^2}. \end{aligned} \quad (15)$$

Again, we first consider the case of full national ownership and then turn to an internationally diversified ownership structure.

National ownership of firms: For $\alpha = 1$ the Nash equilibrium tax rates in (13) reduce to $t_{NM}^A = -(a-r)/2$ and $t_{NM}^B = -(a-r)/4$. Hence country A increases the subsidy to the single remaining firm within its borders, whereas the tax policy of country B is unchanged from the double duopoly benchmark. Furthermore, inserting $\alpha = 1$ in (15) shows that national and global welfare are also unchanged from the benchmark case. Hence, when firms are fully owned by domestic residents, non-cooperative tax policies will again be globally Pareto efficient:

$$W_{(NM)}^A = W_{(NM)}^B = \frac{1}{2}(a-r)^2; \quad W_{(NM)}^A + W_{(NM)}^B = (a-r)^2 = W_{PO}^{A+B}. \quad (16)$$

At first sight it is surprising that the asymmetric scenario of a national merger in country A causes neither global efficiency losses nor redistributive effects, even though equilibrium subsidy rates differ between the two countries. To explain this result, note first from (14) that, for $\alpha = 1$, the merged firm 12 located in country A produces just as much output as the two firms located in country B produce together. This is due to the higher subsidy enjoyed by the merged firm in country A, compared to a situation

of double duopoly. The reason for the change in country A's tax policy is that both the *efficiency* and the *market share effect* increase from the perspective of this country. This in turn is explained as follows. In the double duopoly case, if country A grants a subsidy to one of its firms, then not only the foreign firm in B but also the second firm in A will react with a reduction of output under Cournot conjectures. This reduces the effectiveness of subsidies when a country hosts two (or more) firms. Hence, when the two firms merge, the incentive to use subsidies is increased both in the home market (by the efficiency effect) and in the foreign market (by the market share effect).¹⁵

This reasoning also explains why country B's optimal tax policy remains unchanged after the national merger in country A. The total number of firms in the market has been reduced but, due to the higher subsidy, the production of the merged firm 12 will equal the sum of outputs of the two independent firms 1 and 2 in the double duopoly case [see eq. (14)]. Since the *efficiency effect* and the *market share effect* are fundamentally unaffected in country B, this country will thus choose the same tax policy as under the double duopoly. This in turn implies that total production will also be unchanged from the benchmark and a Pareto optimum is again attained. Finally, no redistributive effects between countries arise because the higher subsidies paid by country A are fully matched by higher profits of the merged firm [see (14)], which are in turn redistributed entirely to domestic residents.

We conclude from this case that both national governments will just be indifferent with respect to a national merger proposal in country A when the merger has no synergy effects. However, the involved firms 1 and 2 clearly have an incentive to pursue such a merger proposal.¹⁶ This result is in sharp contrast to the well known analysis of Salant et al. (1983) who show that the formation of a merger is not privately profitable for the merging firms in a standard Cournot game with linear demands, unless the merged firm realizes a market share of at least 80 per cent. Here the merger *is* privately profitable,

¹⁵A similar effect is known from the analysis of Huck and Konrad (2004) who consider the competition between two countries for market shares in a third market. In their analysis the reduced effectiveness of domestic subsidies due to the output reduction of rivalling home firms is labelled a 'cannibalization effect'.

¹⁶This is seen by comparing the profits of the merged firm in eq. (14) with the joint profits of both firms prior to the merger [eq. (9)]. This comparison shows that $\pi_{12(NM)} = (a - r)^2/2 > \pi_{1(DD)} + \pi_{2(DD)} = (a - r)^2/4$.

even though the merged firm controls a market share of only 50%. Of course this is due to the increased output subsidy paid by country A in response to the change in market structure caused by the national merger.

International ownership of firms: We now turn to the welfare comparison of the national merger scenario with the double duopoly benchmark when the ownership of firms is internationally diversified ($\alpha < 1$). From (10) and (15) we get

$$\begin{aligned} W_{(NM)}^A &< W_{(DD)}^A, & W_{(NM)}^B &> W_{(DD)}^B & \forall \alpha < 1; \\ W_{(NM)}^A + W_{(NM)}^B &< (a - r)^2 \equiv W_{PO}^{A+B} & \forall \alpha < 1. \end{aligned}$$

Hence in this case country A loses from the national merger within its borders, whereas country B gains. Moreover, as in the double duopoly benchmark, the global first best optimum can no longer be achieved by non-cooperative tax policies when firms are partly owned by foreigners.

These results are again explained by the tax exporting motive that is present when the tax is partly borne by foreign firm owners. The basic trade-off for each country is that the efficiency and market share effects call for a domestic production subsidy, but this in turn causes an income transfer from domestic taxpayers to the foreign owners of local firms. With a national merger in country A, the trade-off becomes more severe for this country for any given value of α because the incentive to subsidize the merged firm is increased. In the Nash equilibrium, this leads to country A choosing a lower tax, or a higher subsidy, than country B for all levels of α [see eq. (13)].¹⁷ This implies that a redistribution of income occurs from country A to country B, which is strongest when the domestic ownership share of firms reaches the minimum ($\alpha = 0.5$).

Our results imply that country A's government should reject a national merger proposal whenever foreigners own a positive share in the merged firm. However, the merger would be beneficial for the merging firms and also for their non-merging rivals. Comparing

¹⁷It is seen from (13) that country A chooses a positive tax rate when the domestic ownership share α is smaller than 0.63, whereas country B's tax rate turns positive for all $\alpha < 0.75$. Hence country A will always choose a lower tax than country B, no matter whether tax rates are negative or positive.

(14) with (9) gives

$$\begin{aligned}\pi_{12(NM)} &> \pi_{1(DD)} + \pi_{2(DD)} \quad \forall \alpha \in [0.5; 1], \\ \pi_{j(NM)} &> \pi_{j(DD)} \quad \text{if } j \in \{3, 4\} \quad \forall \alpha \in [0.5; 1[.\end{aligned}$$

As in the case of national ownership, the merging firms benefit from the higher subsidy (or lower tax) in country A after the merger. The non-merging firms 3 and 4 also benefit from the merger for all levels of $\alpha < 1$. The reason is that country A is then constrained in its subsidization policy and hence the output of the merged firm 12 will fall below the joint output of firms 1 and 2 in the double duopoly benchmark. Our main results for the case of a national merger are summarized in the following proposition:

Proposition 2 *A national merger in one of the countries (country A) leads to a higher subsidy, or a lower tax, being levied in this country as compared to the other country (country B). If firms are partly owned by foreigners ($\alpha < 1$), welfare falls in the country where the merger takes place, whereas welfare in the other country rises.*

5 International merger

In this section we consider an exogenous international merger proposal between firm 1 in country A and firm 3 in country B. Due to the symmetric distribution of ownership shares, the merged entity 13 will be owned equally by the representative consumer of each state for all levels of α . This firm has two basic options of how to divide its production between the two countries. It can either produce its entire output in one country or it can maintain production in both countries. We analyze both scenarios in turn, starting with the case where the merged firm divides its production equally between the two countries (this will turn out to be the more attractive option).

Taxes continue to be paid in the country of production. Hence the right to tax (or subsidize) the merged firm 13 is divided in this case between the two countries, according to the output levels produced in each jurisdiction. Finally, it remains to specify which customers are served from each plant. Here it is plausible to assume that the merged firm serves each market by production in the respective country. We can motivate this

assumption by thinking of very small costs for shipping goods abroad, which break the indifference of firms as to which customers to serve from each production unit.

The maximization problems of the three firms $j \in \{13, 2, 4\}$ in the last stage of the game are similar in structure to eq. (2), but the problem of firm 13 must account for the fact that different parts of its output are taxed in different countries. The resulting equilibrium profits and quantities as well as induced consumer surplus, as functions of the tax rates, can be found in the appendix.

The maximization problems of the governments in the international merger case are

$$\begin{aligned} \max_{t^A} W^A &= 0.5(x^A)^2 + 0.5\pi_{13} + \alpha\pi_2 + (1 - \alpha)\pi_4 + t^A(x_2^A + x_2^B + x_{13}^A) \\ \max_{t^B} W^B &= 0.5(x^B)^2 + 0.5\pi_{13} + \alpha\pi_4 + (1 - \alpha)\pi_2 + t^B(x_4^A + x_4^B + x_{13}^B). \end{aligned} \quad (17)$$

Note that the profits of the merged firm 13 are always shared equally between the residents of countries A and B, regardless of the ownership structure of firms 1 and 3 prior to the merger. Hence, an international merger necessarily increases the international diversification of ownership whenever $\alpha > 0.5$ holds in the pre-merger situation.

In the appendix, we derive the symmetric Nash equilibrium tax rates after an international merger. These are

$$t_{(IM)}^A = t_{(IM)}^B = \frac{(a - r)(385 - 736\alpha + 256\alpha^2)}{(1365 - 1184\alpha + 256\alpha^2)}. \quad (18)$$

These tax rates lead to the following equilibrium outputs and profits for each firm:

$$\begin{aligned} x_{j(IM)}^i &= \frac{(a - r)(980 - 448\alpha)}{4(1365 - 1184\alpha + 256\alpha^2)} \quad \forall i, j \\ \pi_{j(IM)} &= \frac{(a - r)^2(980 - 448\alpha)^2}{8(1365 - 1184\alpha + 256\alpha^2)^2} \quad \forall j \in \{13, 2, 4\}. \end{aligned} \quad (19)$$

Using (18) and (19) in (17) we get the equilibrium welfare levels in both countries:

$$W_{(IM)}^A = W_{(IM)}^B = \frac{3(a - r)^2}{32} (5 - 2\beta - 3\beta^2), \quad \beta \equiv \frac{385 - 736\alpha + 256\alpha^2}{1365 - 1184\alpha + 256\alpha^2}. \quad (20)$$

National firm ownership prior to merger: If there is full national ownership of firms prior to the merger ($\alpha = 1$), the Nash equilibrium tax rates with an international merger [eq. (18)] reduce to

$$t_{(IM)}^i = -\frac{5}{23}(a - r) > -\frac{1}{4}(a - r) = t_{DD}^i \quad \forall i \in \{A, B\}.$$

Hence both countries grant an inefficiently low subsidy, relative to the double duopoly benchmark.¹⁸ The main reason for this finding is that a *tax exporting effect* is now also present for $\alpha = 1$. Whereas all firms were domestically owned prior to the merger, the ownership of the merged firm is shared by residents of countries A and B. This creates an incentive in both countries to levy production-based taxes in excess of their Pareto efficient level.

In the light of this analysis it is obvious that welfare in each country will fall below the first best. Indeed, substituting $\alpha = 1$ in (20) yields

$$W_{(IM)}^i = \frac{525(a-r)^2}{1058} < \frac{(a-r)^2}{2} = W_{(NM)}^i = W_{(DD)}^i \quad \forall i \quad \text{if } \alpha = 1.$$

If there is full domestic ownership, we have seen that the global Pareto optimum can be achieved in the national merger and the double duopoly cases. The same does not hold for the international merger. Hence from a global, but also from a national welfare perspective, the international merger is inferior to a national merger when all firms are domestically owned prior to the merger and synergy effects are absent.

International firm ownership prior to merger: When firms are partly foreign-owned prior to the merger, it is obvious that the *tax exporting effect* will still be at work and taxes will be above their Pareto optimal level. The relevant comparison is, however, whether the overtaxation of output is more or less severe in the international merger case, as compared to the national merger scenario.

To carry out this comparison it is helpful to investigate the special case where the ownership of all firms is completely diversified prior to the merger ($\alpha = 0.5$). Explicitly comparing the tax rates for $\alpha = 0.5$ in the two scenarios using (13) and (18) yields

$$\begin{aligned} t_{(IM)}^A &= \frac{9}{93}(a-r) < t_{(NM)}^A = \frac{3}{28}(a-r) \quad \text{if } \alpha = 0.5 \\ t_{(IM)}^B &= \frac{9}{93}(a-r) < t_{(NM)}^B = \frac{9}{56}(a-r) \quad \text{if } \alpha = 0.5. \end{aligned} \quad (21)$$

Hence, evaluated at $\alpha = 0.5$, the tax rates in *both* countries are lower in the international merger case, as compared to the national merger. Since we know that tax rates are

¹⁸Note that the efficient post-merger subsidy would even be higher than in the double duopoly benchmark, due to increased market concentration.

above their Pareto efficient levels in the presence of foreign firm ownership this implies that global welfare must also be higher for the international merger.¹⁹

To explain this result, observe first that the profits of all firms are equally shared between residents from country A and country B. Hence the *tax exporting effect* is equally strong in the national and international merger scenarios when $\alpha = 0.5$. Moreover, when the ownership of all firms is equally shared between the two countries, the *market share effect* is absent [see equation (4)]. Hence any tax differences in the two scenarios must be driven by the *efficiency effect*. In general this effect will be the stronger the larger is the part of domestic consumption that is produced domestically (as governments ultimately aim at increasing domestic consumption, but can only subsidize production), and the smaller is the number of firms that produce domestic output (because of the negative effect that an output increase of one firm has on the output of others under Cournot competition). In country B both of these determinants work in the direction of a stronger efficiency effect, as compared to the national merger case. In country A there are counteracting effects but the dominant change is that a larger part of domestic consumption is also produced domestically under the international merger. Hence the negative efficiency effect is strengthened in both countries, and tax rates are accordingly lower, as compared to the national merger.

The above discussion shows that the global welfare comparison between the national and the international merger depends crucially on the ownership structure of firms. For $\alpha = 1$ the national merger yields a global Pareto optimum and dominates the international merger. For $\alpha = 0.5$ the global welfare comparison is reversed, however, as the efficiency effect is stronger in the international merger case and counteracts the incentive to overtax foreign owners of the domestic firm.

Turning to national welfare, we have seen above that country A unambiguously prefers the national merger over the international merger when $\alpha = 1$. Evaluating the equilibrium welfare levels in the other boundary case of $\alpha = 0.5$ gives [using eq.(20)]:

$$W_{(IM)}^A > W_{(NM)}^A, \quad W_{(IM)}^B < W_{(NM)}^B \quad \text{if } \alpha = 0.5. \quad (22)$$

The explanation for these results is implicit in the previous discussion. If the ownership

¹⁹This is easily confirmed by substituting $\alpha = 0.5$ in (15) and (20) and adding up the welfare levels in the two countries.

of all firms is completely diversified initially, tax rates in both countries are lower, and hence more efficient, in the international merger case [see eq. (21)]. Moreover, the redistribution of income from country A to country B that occurs in the national merger case is not present here. Country A gains from both of these changes and is thus clearly better off with the international merger. For country B the loss of its redistributive advantage in the national merger case is instead the dominant effect.

Let us now briefly consider the alternative setting where the internationally merged firm 13 produces only in one of the two countries. For concreteness let us assume that this is country B. It is shown in the appendix that the merged firm will face a higher tax in this case, and hence has lower after-tax profits as compared to the case where it divides its production evenly among the two countries. This result holds for any level of the foreign ownership share α . Intuitively, by producing in only one of the two countries, the merged firm forgoes the advantage to produce locally for the majority of its customers. Due to the efficiency effect, host governments will levy lower production-based taxes if a larger share of domestic production also serves domestic consumers. In our model it is thus the endogenous response of tax policy that makes it attractive for an internationally merged firm to maintain a production base in each country.²⁰

Finally, note that even in the preferred case where the merged firm maintains production in both countries, an international merger that produces no synergy effects is not in the interest of the merging firms. This can be seen from comparing the profit expressions in the international merger scenario [eq. (19)] with those in the double duopoly benchmark [eq. (9)]. For this reason an international merger will not be proposed to regulation authorities, unless it is accompanied by sufficiently large cost reductions. We will take up this issue in the following section. Our results are summarized in:

Proposition 3 *In comparison to a national merger, an international merger with production in both countries (i) leads to higher taxes in both countries and lower global welfare when there is full national ownership in the pre-merger equilibrium ($\alpha = 1$); (ii) leads to lower taxes in both countries and higher global welfare when the pre-merger equilibrium is characterized by full international ownership diversification ($\alpha = 0.5$).*

²⁰The previous literature has instead stressed the role of international mergers in reducing aggregate transport costs (e.g. Horn and Persson, 2001 and Südekum, 2006).

6 Synergy effects of mergers

In the analysis of the previous sections, mergers were typically either against the interest of the merging firms themselves, or against the interests of the host countries (or both). Hence, considering the full merger game described in Section 2, mergers would either not be proposed by the firms at all (in stage 1), or they would not be cleared by the regulation authorities (stage 2). In practice a core motivation for firms to undertake mergers, and an important reason for regulation authorities to permit them, is that mergers can create synergy effects. In the following we thus extend the previous analysis by allowing for a reduction in the variable production costs of the merging firms.²¹

In this setting we analyze how large the cost savings must be for a national or an international merger in order to be in the interest of both the merging firms *and* the regulation authority of the host country. We deal again with different ownership structures of firms. Due to the complexity of the resulting expressions, we confine the discussion in the main text to the polar cases of full national ownership ($\alpha = 1$) and complete international ownership diversification ($\alpha = 0.5$).

6.1 National Merger

We assume that a national merger between firms 1 and 2 reduces the unit production costs by $\Delta \geq 0$. The merged firm takes these lower costs into account when solving its maximization problem (2). The optimal output decision of all firms is again anticipated by the two governments, who decide on tax policies so as to maximize national welfare as given in (12).²² The resulting Nash equilibrium tax rates (derived in the appendix) are evaluated at different values of α .

With full domestic ownership ($\alpha = 1$) we get

$$t_{(NM)}^A = -\frac{1}{2}(a - r) - \frac{11}{10}\Delta; \quad t_{(NM)}^B = -\frac{1}{4}(a - r) - \frac{3}{20}\Delta \quad \text{if } \alpha = 1. \quad (23)$$

²¹Röller et al. (2000) distinguish between different sources of efficiency gains following a merger such as rationalization, economies of scale, technological progress, purchasing economies, and reduction of slack. They also provide some empirical evidence of savings in variable cost associated with mergers.

²²Note that market size must be sufficiently large in order to keep all firms in the market. In the benchmark case of full national ownership, for example, we must assume that $a > (9/5)\Delta + r$.

Note first that these tax rates reduce to the values in (13) if $\Delta = 0$ and $\alpha = 1$. With positive cost savings, tax rates fall further in both countries (i.e. subsidies rise), and this effect is more pronounced in country A. This can be explained by the fact that the merged firm 12 can achieve a higher market share due to its cost advantage, benefiting the representative consumer by generating larger total output and higher profits. Hence the incentive for country A's government to subsidize the output of its merged firm rises from both the *market share* and the *efficiency effects* (cf. the discussion in Section 4). The higher subsidy granted by country A will in turn trigger a higher subsidy paid by country B to its local firms.

Note that with lower unit production costs incurred by the merged firm, the first best allocation would imply that only firm 12 stays in the market, producing output levels for each market such that price equals marginal costs. In contrast to the scenario without synergy effects the global Pareto optimum cannot be achieved with non-cooperatively set production taxes, however. The reason is that with an asymmetric cost structure the *efficiency effect* and the *market share effect*, which are governing nationally optimal tax policy in country A, no longer sum to the globally efficient subsidy. Nevertheless, it is straightforward to show that each country is better off with a national merger that yields a strictly positive level of cost savings, as compared to the initial double duopoly [compare eq. (10) with (A.11) in the appendix].

With full international ownership diversification ($\alpha = 0.5$), equilibrium tax rates are

$$t_{(NM)}^A = \frac{3}{28}(a - r) + \frac{1}{28}\Delta, \quad t_{(NM)}^B = \frac{9}{56}(a - r) + \frac{3}{56}\Delta \quad \text{if } \alpha = 0.5. \quad (24)$$

Recall from our previous discussion that taxes turn positive for low levels of α due to the tax exporting motive. Moreover, the increased tax base in A, which results from the cost-induced output expansion, raises the incentive for the government of country A to tax the corresponding profits accruing to foreigners. Further recall that the *market share effect* disappears when profits are shared equally between the residents of both countries. This explains the different impact that positive cost savings Δ have on tax policy in country A when the share of foreign firm ownership rises.

We are now prepared to discuss the conditions under which a national merger in country A will be cleared by this country's regulation authorities. Recall first from our discussion in Section 4 that the merger is privately profitable for the merging firms for

any level of α , even if there are no cost savings. This private interest of the merging firms is maintained (and indeed strengthened) when the merger also causes positive synergy effects. In the absence of cost savings, the merger reduces national welfare in country A, however, whenever foreigners own some positive share in the merged firm (see Proposition 2). Cost reductions caused by the merger will increase both output and profits and thus unambiguously benefit the representative consumer in country A. The optimal adjustment of country A's tax policy will further increase these benefits, relative to the case where national tax policy is exogenous. Hence there must be a critical value of cost savings above which the national merger is in the national interest of country A. This critical value depends on the level of foreign firm ownership and ranges from zero for $\alpha = 1$ to $0.1015(a - r)$ for $\alpha = 0.5$ [compare eq. (10) with eqs. (A.11)–(A.12) in the appendix]. When these threshold levels are surpassed, the proposed merger will be cleared by country A's regulation authority.

6.2 International Merger

Consider now a unit cost reduction of $s \geq 0$ for the international merger of firms 1 and 3. The Nash equilibrium tax rates and the resulting welfare levels are calculated in the appendix. For full domestic ownership of all non-merged firms ($\alpha = 1$) we get:

$$t_{(IM)}^A = t_{(IM)}^B = -\frac{5}{23} + \frac{9}{23}s . \quad (25)$$

For an international merger, equilibrium tax rates are too high from a global efficiency perspective as governments try to tax the profits of the merged firm that partly accrue to foreigners. The exporting motive is even strengthened when the internationally merged firm commands of cost advantages relative to its national competitors and hence captures a larger share of both markets.

With full international ownership diversification ($\alpha = 0.5$), Nash equilibrium taxes are

$$t_{(IM)}^A = t_{(IM)}^B = \frac{3}{31}(a - r) + \frac{1}{31}s . \quad (26)$$

In this case we still observe a positive impact of s on the non-cooperative tax rates, but the effect is quantitatively weaker as before. The reason is that the profits of all firms are now shared equally between the residents of the two countries. Hence the rising

market share of the low-cost firms matters less in determining nationally optimal tax policy.

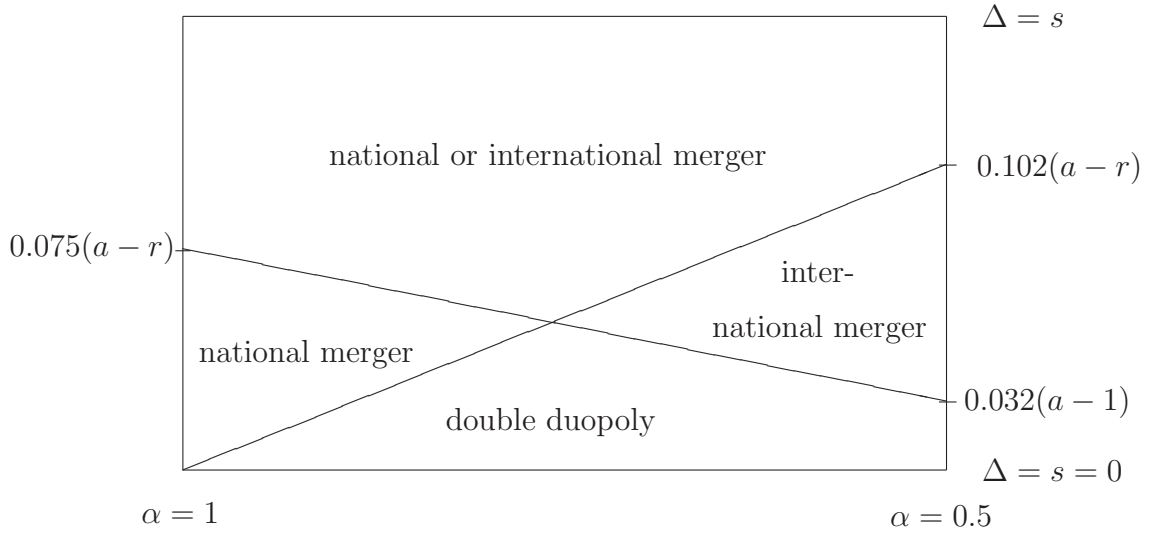
While the cost savings increase the incentives for strategic tax setting, they also have a direct positive effect on both countries. Hence we can again compute critical values of cost savings such that national welfare in each country is identical before and after an international merger. From eqs. (10) and (A.15)–(A.16) in the appendix these critical values are $s \approx 0.0123(a - r)$ for $\alpha = 1$ and $s \approx 0.0273(a - r)$ for $\alpha = 0.5$. Finally the international merger will also be privately profitable if there are sufficiently large synergies. Comparing the pre-merger profits in eq. (9) with the profits of the merged firm yields critical levels of $s \approx 0.0754(a - r)$ for $\alpha = 1$ and $s \approx 0.0320(a - r)$ for $\alpha = 0.5$ [see eq. (A.17) in the appendix]. Since these critical values are higher, for all levels of α , than those required by regulation authorities, they represent the binding constraint for an international merger to be enacted.

6.3 When does each type of merger occur?

Having described the national and international merger scenarios in isolation, it is straightforward to infer under which conditions one or the other type of merger is more likely to be proposed and cleared by the regulation authorities. For this comparison we make the critical assumption that cost savings are the same in the two scenarios, i.e. $\Delta = s$. For full domestic ownership of firms ($\alpha = 1$) the national merger is then the preferred alternative, as *any* positive level of cost savings will ensure that the merger benefits all the parties involved. In contrast the international merger will cause overtaxation of profits due to a *tax exporting effect*. The resulting efficiency losses imply that positive, but small synergy effects will not be sufficient to make the international merger profitable for firms and governments alike.

In the case of full international ownership diversification ($\alpha = 0.5$) this result is reversed, however. The critical value of cost savings at which the national merger will be proposed and cleared is now higher than under the international merger. There are two reasons for this result. First, the *tax exporting effect* is now equally strong in the two merger scenarios and no longer constitutes a disadvantage for the international merger. Second, the *efficiency effect* is stronger in the international merger case,

Figure 1: Equilibrium market structure with at most one merger



because a higher share of consumption in each country is also produced locally and subsidies can be targeted more effectively. As a result taxes in both countries will be lower, and hence more efficient, in the international merger scenario when $\alpha = 0.5$.

Figure 1 summarizes these results. The figure shows that if cost savings are small (and α is substantially less than 1), neither a national nor an international merger will simultaneously benefit the merging firms and the host country. Hence a double duopoly situation is the equilibrium outcome in this case.²³ Conversely, for very high levels of $\Delta = s$, either the national or the international merger will be proposed and cleared, irrespective of the degree of foreign firm ownership. The interesting cases lie in between. For high levels of α there is a range of cost savings for which the national merger, but not the international merger, is simultaneously profitable for the merging firms and for country A's government. For low levels of α there is instead a range of cost savings where the international merger is proposed and cleared, whereas the national merger is blocked by the host country's regulation authority. These results are summarized in our final proposition:

Proposition 4 *In comparison to a national merger, an international merger is pro-*

²³Note, however, that 'equilibrium' has a narrow meaning in our analysis, as at most one merger is permitted to occur.

posed and cleared (i) for a smaller range of cost savings when the pre-merger equilibrium is characterized by full domestic ownership of firms ($\alpha = 1$); (ii) for a larger range of cost savings when the pre-merger equilibrium is characterized by a fully diversified ownership structure of firms ($\alpha = 0.5$).

One implication of Proposition 4 is that we should observe a positive and systematic relationship between the foreign ownership share and the share of cross-border mergers in a particular industry. There is indeed some first, suggestive evidence in favour of this proposition. In the OECD countries the share of cross-border mergers in the total number of *M&A* cases differs widely across different economic sectors and is highest in manufacturing (about 35%; see Focarelli and Pozzolo, 2001, Table 1). At the same time, manufacturing is also one of the most internationalized sectors with respect to foreign ownership, at least in European countries (about 25%; see Denis et al., 2005, Figure 4.2). Similarly, there are sectors with a low share of foreign firm ownership, such as construction, where the share of cross-border mergers in the total number of *M&A* cases is also low. A detailed empirical study would be needed to rigorously test whether this positive relationship between foreign ownership and the share of cross-border mergers holds more generally, and whether it can be linked to the interaction of nationally optimal tax policies and merger control.

7 Conclusion

In many industries governments have sector-specific tax and regulation policies at their disposal to influence the market outcome after a change in market structure has occurred. In this paper we have set up a simple model to analyze how nationally optimal tax rates will be adjusted in response to a national merger on the one hand and an international merger on the other. Extending the analysis to incorporate synergy effects of mergers, we have then studied how these changes in tax policy feed back on the incentives for firms to propose one or the other kind of merger, and for the merger regulation authorities to accept it.

Our analysis shows that a national and an international merger lead to different incentives for national tax policy. On the one hand an international merger increases the

incentives for non-cooperative tax policy to tax foreign firm owners in excess of the efficient levels. On the other hand, an international merger leads to a larger share of consumption in each country being served by local producers and thus increases the incentive for each country to grant Pareto efficient subsidies. Which of these two effects dominates depends crucially on the share of foreign firm ownership in the pre-merger situation. If all firms are locally owned initially, then the national merger is the dominant alternative, in the sense that it requires fewer cost savings in order to be proposed by the merging firms and to be cleared by the regulation authority. In contrast, if the share of foreign firm ownership is large, then the international merger will be proposed and cleared for a wider range of cost savings.

One implication of our model is that a rise in international portfolio diversification will favour cross-border mergers, other things being equal. When, as it is often argued, a rise in foreign asset holdings is one of the consequences of economic integration, then our analysis provides an explanation for the rising share of cross-border mergers. In principle our argument is complementary to other reasons for cross-border mergers found in the literature, in particular the argument that they allow firms to save aggregate transport costs. It is interesting to note, however, that this alternative argument cannot explain a rising share of cross-border mergers over time, as it becomes less important when economic integration proceeds and transport costs accordingly fall.

Our analysis could be extended in several directions. One possibility would be to endogenize the share of foreign firm ownership, and relate this share explicitly to the forces of economic integration. In such a setting international portfolio diversification would lead to gains in the form of higher returns or lower aggregate risk, but it would also cause higher information or transaction costs. If economic integration reduces the latter, the link between globalization and the rise of cross-border mergers could be explicitly modelled. We do not expect, however, that our conclusions would be fundamentally altered by this extension. Another model extension would be to consider consecutive mergers, or ‘merger waves’. In such a setting it would be possible to derive equilibrium market structures for any given set of exogenous model parameters (as in Horn and Persson, 2001). In principle this extension could be incorporated into our model, but the analysis must account for both the change in market structure and for the change in tax policies following each merger. We leave this task for future research.

Appendix

Section 3: Double duopoly

To derive equation (4), we first differentiate the profit expressions in (2). For the firms located in country A this yields, using the first-order condition of the firms' optimal output choices $(p^i - r - t^A) = (p^i)'x_j^i \forall i$

$$\frac{d\pi_j}{dt^A} = x_j^A (p^A)' \left(\frac{dx^A}{dt^A} - \frac{dx_j^A}{dt^A} \right) + x_j^B (p^B)' \left(\frac{dx^B}{dt^B} - \frac{dx_j^B}{dt^A} \right) - x_j^A - x_j^B \quad \forall j = 1, 2$$

The firms located in country B face no direct effect of the tax increase so that

$$\frac{d\pi_j}{dt^A} = x_j^A (p^A)' \left(\frac{dx^A}{dt^A} - \frac{dx_j^A}{dt^A} \right) + x_j^B (p^B)' \left(\frac{dx^B}{dt^B} - \frac{dx_j^B}{dt^A} \right) \quad \forall j = 3, 4$$

Differentiating (3) with respect to t^A , using the above results and employing the symmetry conditions $(p^A)' = (p^B)' = p'$ and $x_j^i = x \forall i, j$; gives

$$-p'x_j^i \left[\alpha \sum_{i=A}^B \sum_{j=1}^2 \frac{dx_j^i}{dt^A} + (1-\alpha) \sum_{i=A}^B \sum_{j=3}^4 \frac{dx_j^i}{dt^A} + 4(1-\alpha) \right] = t^A \sum_{i=A}^B \sum_{j=1}^2 \frac{dx_j^i}{dt^A}.$$

Adding and subtracting $(1-\alpha) \sum_{j=1}^2 (dx_j^A/dt^A)$ and $\alpha \sum_{j=3}^4 (dx_j^A/dt^A)$ in the square bracket and using $(dx_j^A/dt^A) = (dx_j^B/dt^A) \forall j$ gives equation (4).

With the demand function (5), the consumer surplus in (3) is $u(x^i) - px^i = (x^i)^2/2 \forall i$. Country A's maximization problem is obtained by substituting the firms' output and profit levels (6) and (7) into (3):

$$\begin{aligned} \max_{t^A} W^A &= \frac{2}{25} [2(a-r) - t^A - t^B]^2 + \frac{4}{25} \alpha [a-r - 3t^A + 2t^B]^2 \\ &\quad + \frac{4}{25} (1-\alpha) [a-r - 3t^B + 2t^A]^2 + t^A \frac{4}{5} [a-r - 3t^A + 2t^B] \end{aligned}$$

The maximization problem of country B is analogous. The resulting reaction functions of the two governments are

$$t^A = \frac{(a-r)(7-10\alpha) - t^B}{21-10\alpha}; \quad t^B = \frac{(a-r)(7-10\alpha) - t^A}{21-10\alpha},$$

generating the Nash equilibrium tax rates in equation (8).

Section 4: National merger

The firms' maximization problem in the last stage of the game is

$$\begin{aligned}\max_{x_{12}^A, x_{12}^B} \pi_{12} &= (a - x^A)x_{12}^A + (a - x^B)x_{12}^B - (x_{12}^A + x_{12}^B)(r + t^A); \\ \max_{x_j^A, x_j^B} \pi_j &= (a - x^A)x_j^A + (a - x^B)x_j^B - (x_j^A + x_j^B)(r + t^B) \quad \text{if } j \in \{3, 4\}.\end{aligned}$$

The resulting equilibrium quantities are

$$\begin{aligned}x_{12}^A &= x_{12}^B = \frac{a - r - 3t^A + 2t^B}{4} \\ x_3^A &= x_4^A = x_3^B = x_4^B = \frac{a - r - 2t^B + t^A}{4}.\end{aligned}\tag{A.1}$$

This leads to profits $\pi_j(t^A, t^B)$ and consumer surplus $CS^i(t^A, t^B)$

$$\pi_{12} = \frac{1}{8}(a - r - 3t^A + 2t^B)^2; \quad \pi_3 = \pi_4 = \frac{1}{8}(a - r - 2t^B + t^A)^2.\tag{A.2}$$

$$CS^A = CS^B = \frac{1}{32}[3(a - r) - 2t^B - t^A]^2.\tag{A.3}$$

Using (A.2) and (A.3) in (12) leads to the best response functions

$$t^A = \frac{(13 - 20\alpha)(a - r) - t^B(8\alpha - 2)}{39 - 28\alpha}; \quad t^B = \frac{(9 - 12\alpha)(a - r) + t^A(4\alpha - 3)}{22 - 8\alpha},\tag{A.4}$$

which generate the Nash equilibrium tax rates in (13).

Section 5: International merger

The problem solved by each of the three firms in the international merger scenario is

$$\begin{aligned}\max_{x_{13}^A, x_{13}^B} \pi_{13} &= (a - x^A)x_{13}^A + (a - x^B)x_{13}^B - x_{13}^A(r + t_A) - x_{13}^B(r + t_B) \\ \max_{x_2^A, x_2^B} \pi_2 &= (a - x^A)x_2^A + (a - x^B)x_2^B - (x_2^A + x_2^B)(r + t_A) \\ \max_{x_4^A, x_4^B} \pi_4 &= (a - x^A)x_4^A + (a - x^B)x_4^B - (x_4^A + x_4^B)(r + t_B).\end{aligned}$$

Taking price discrimination and the symmetry of markets into account, the equilibrium quantities supplied by each firm are

$$\begin{aligned}x_{13}^A &= x_2^A = \frac{a - r - 2t^A + t^B}{4}; & x_4^A &= \frac{a - r + 2t^A - 3t^B}{4}; \\ x_{13}^B &= x_4^B = \frac{a - r - 2t^B + t^A}{4}; & x_2^B &= \frac{a - r + 2t^B - 3t^A}{4}.\end{aligned}$$

This yields profits $\pi_j(t^A, t^B)$ and consumer surplus $CS^i(t^A, t^B)$

$$\begin{aligned}\pi_{13} &= \pi_{13}^A + \pi_{13}^B = \frac{1}{16}(a - r - 2t^A + t^B)^2 + \frac{1}{16}(a - r - 2t^B + t^A)^2; \\ \pi_2 &= \pi_2^A + \pi_2^B = \frac{1}{16}(a - r + t^B - 2t^A)^2 + \frac{1}{16}(a - r - 3t^A + 2t^B)^2; \\ \pi_4 &= \frac{1}{16}(a - r - 3t^B + 2t^A)^2 + \frac{1}{16}(a - r - 2t^B + t^A)^2;\end{aligned}\quad (\text{A.5})$$

$$CS^A = \frac{1}{32} [3(a - r) - 2t^A - t^B]^2; \quad CS^B = \frac{1}{32} [3(a - r) - 2t^B - t^A]^2. \quad (\text{A.6})$$

Using (A.5) and (A.6) in (17) gives the reaction functions

$$t^i = \frac{(a - r)(11 - 16\alpha) - 2t^j}{37 - 16\alpha} \quad \forall i, j, i \neq j. \quad (\text{A.7})$$

These yield the equilibrium tax rates in (18).

International merger with exclusive production in B:

In the case where the internationally merged firm 13 produces exclusively in country B, there are two firms in country B and one in country A. Hence firm interaction is the same as in the national merger case and the output quantities and profits of the single firm in country A (firm 2) and the two firms in country B (firm 13 and firm 4) are equivalent to (A.1) and (A.2). Moreover, consumer surplus is as given in (A.3) However, the ownership of firm 13 is equally shared between residents of the two countries, irrespective of the value of α . Hence national welfare in each country is

$$\begin{aligned}\max_{t^A} W^A &= CS^A + \alpha\pi_2 + (1 - \alpha)\pi_4 + 0.5\pi_{13} + t^A x_2; \\ \max_{t^B} W^B &= CS^B + (1 - \alpha)\pi_2 + \alpha\pi_4 + 0.5\pi_{13} + t^A(x_{13} + x_4).\end{aligned}\quad (\text{A.8})$$

Substituting (A.1)–(A.3) in (A.8) gives Nash equilibrium tax rates

$$t_{(IM^*)}^A = \frac{(a - r)(28\alpha - 8\alpha^2 - 15)}{(44\alpha - 8\alpha^2 - 48)}, \quad t_{(IM^*)}^B = \frac{(a - r)(48\alpha - 16\alpha^2 - 29)}{2(44\alpha - 8\alpha^2 - 48)}. \quad (\text{A.9})$$

Substituting these tax rates into the merged firm's profit expression $\pi_{13} = (a - r - 2t^B + t^A)^2/8$ gives

$$\pi_{13(IM^*)} = \frac{(12\alpha - 17)^2}{128\alpha^4 - 1408\alpha^3 + 5408\alpha^2 - 8448\alpha - 4608}.$$

Comparing this value with the equilibrium profits of the merged firm when it splits production [eq. (19)] shows that $\pi_{13(IM^*)} < \pi_{13(IM)} \forall \alpha \in [0.5, 1]$.

Section 6: Synergy effects of mergers

6.1 National merger

The firms' maximization problem is given by

$$\begin{aligned}\max_{x_{12}^A, x_{12}^B} \pi_{12} &= (a - x^A)x_{12}^A + (a - x^B)x_{12}^B - (x_{12}^A + x_{12}^B)(r - \Delta + t^A) \\ \max_{x_j^A, x_j^B} \pi_j &= (a - x^A)x_j^A + (a - x^B)x_j^B - (x_j^A + x_j^B)(r + t^B) \quad \text{if } j \in \{3, 4\}\end{aligned}$$

leading to the following equilibrium quantities

$$\begin{aligned}x_{12}^A &= x_{12}^B = \frac{a - r + 3\Delta + 2t^B - 3t^A}{4} \\ x_3^A &= x_4^A = x_3^B = x_4^B = \frac{a - r - \Delta - 2t^B + t^A}{4}.\end{aligned}$$

Together with profits $\pi_j(t^A, t^B)$ and consumer surplus $CS^i(t^A, t^B)$ this implies the following maximization problem for national governments:

$$\begin{aligned}\max_{t^A} W^A &= \frac{1}{32} [3(a - r) + \Delta - t^A - 2t^B]^2 + \frac{\alpha}{8} (a - r + 3\Delta - 3t^A + 2t^B)^2 \\ &\quad + \frac{(1 - \alpha)}{4} (a - r - \Delta - 2t^B + t^A)^2 + \frac{1}{2} t^A (a - r + 3\Delta + 2t^B - 3t^A) \\ \max_{t^B} W^B &= \frac{1}{32} [3(a - r) + \Delta - t^A - 2t^B]^2 + \frac{\alpha}{4} (a - r - \Delta - 2t^B + t^A)^2 \\ &\quad + \frac{(1 - \alpha)}{8} (a - r + 3\Delta - 3t^A + 2t^B)^2 + t^B (a - r - \Delta - 2t^B + t^A)\end{aligned}$$

This leads to Nash equilibrium tax rates:

$$\begin{aligned}t_{(NM)}^A &= \frac{(a - r)(19 - 40\alpha + 16\alpha^2) + \Delta(21 - 48\alpha + 16\alpha^2)}{2(27 - 30\alpha + 8\alpha^2)} \\ t_{(NM)}^B &= \frac{(a - r)(39 - 76\alpha + 32\alpha^2) + \Delta(9 - 12\alpha)}{2(54 - 60\alpha + 16\alpha^2)}.\end{aligned}\tag{A.10}$$

The resulting welfare levels in the case of full domestic ownership ($\alpha = 1$) are

$$\begin{aligned}W_{(NM)}^A|_{\alpha=1} &= \frac{1}{50} [25(a - r)^2 + 50(a - r)\Delta + 69\Delta^2] \\ W_{(NM)}^B|_{\alpha=1} &= \frac{1}{50} [25(a - r)^2 + 63\Delta^2].\end{aligned}\tag{A.11}$$

With full international ownership diversification ($\alpha = 0.5$) welfare is

$$\begin{aligned}W_{(NM)}^A|_{\alpha=0.5} &= \frac{1}{1568} [627(a - r)^2 + 754(a - r)\Delta + 1227\Delta^2] \\ W_{(NM)}^B|_{\alpha=0.5} &= \frac{1}{1568} [741(a - r)^2 + 270(a - r)\Delta + 1053\Delta^2].\end{aligned}\tag{A.12}$$

Finally, the profits of the merged firm 12 in the polar cases $\alpha = 1$ and $\alpha = 0.5$ are

$$\pi_{12}|_{\alpha=1} = \frac{1}{2} (a - r + 2\Delta)^2 \quad \pi_{12}|_{\alpha=0.5} = \frac{1}{8} (a - r + 3\Delta)^2. \quad (\text{A.13})$$

6.2 International merger

The maximization problem of the merged firm 13 in eq. (2) changes to:

$$\max_{x_{13}^A, x_{13}^B} \pi_{13} = (a - x^A) x_{13}^A + (a - x^B) x_{13}^B - x_{13}^A (r - s + t_A) - x_{13}^B (r - s + t_B),$$

leading to equilibrium quantities, consumer surplus and profits as functions of the two tax rates. The final welfare maximization problem for country A is given by:

$$\begin{aligned} \max_{t^A} W^A &= \frac{1}{32} [3(a - r) + s - 2t^A - t^B]^2 + \frac{t^A}{4} [3(a - r) + s - 7t^A + 4t^B] \\ &+ \frac{1}{32} (a - r + 3s - 2t^A + t^B)^2 + \frac{1}{32} (a - r + 3s - 2t^B + t^A)^2 \\ &+ \frac{\alpha}{16} (a - r - s - 2t^A + t^B)^2 + \frac{\alpha}{16} (a - r - s - 3t^A + 2t^B)^2 \\ &+ \frac{(1 - \alpha)}{16} (a - r - s + 2t^A - 3t^B)^2 + \frac{(1 - \alpha)}{16} (a - r - s - 2t^B + t^A)^2, \end{aligned}$$

and an analogous problem is solved by country B. This generates the following Nash equilibrium tax rates

$$t_{(IM)}^A = t_{(IM)}^B = \frac{(a - r)(385 - 736\alpha + 256\alpha^2) + s(-245 + 672\alpha - 256\alpha^2)}{(1365 - 1184\alpha + 256\alpha^2)}. \quad (\text{A.14})$$

This yields welfare levels for full domestic ownership

$$W_{(IM)}^A = W_{(IM)}^B|_{\alpha=1} = \frac{1}{1058} [525(a - r)^2 + 318(a - r)s + 689s^2] \quad (\text{A.15})$$

and for complete international ownership diversification

$$W_{(IM)}^A = W_{(IM)}^B|_{\alpha=0.5} = \frac{1}{1922} [861(a - r)^2 + 574(a - r)s + 1377s^2] : . \quad (\text{A.16})$$

Finally, the profits of the merged firm 13 for the two benchmark values of α are

$$\pi_{13}|_{\alpha=1} = \frac{1}{8} \left[\frac{532(a - r) + 1140s}{437} \right]^2; \quad \pi_{13}|_{\alpha=0.5} = \frac{1}{8} \left[\frac{756(a - r) + 2484s}{837} \right]^2. \quad (\text{A.17})$$

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