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Cross-Border Mergers and Strategic Trade Policy with Two-Part Taxation: Is International Policy Coordination Beneficial?

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ABSTRACT

Cross-Border Mergers and Strategic Trade Policy with Two-Part Taxation: Is International Policy Coordination Beneficial?

by Kjell Erik Lommerud, Trond E. Olsen and Odd Rune Straume

We analyse how national taxation of firms are likely to affect merger incentives in international markets. In particular, we ask whether non-coordinated trade policies stimulate cross-border mergers that are overall inefficient, and if this is then an argument for international coordination of such policies? We address this issue in a setting where policy makers use two-part tariffs to tax exporting firms. The analysis reveals that while non-coordinated policies may induce cross-border mergers (by allowing the firms in question to play national policy makers out against each other), this can nevertheless be overall welfare enhancing compared to market outcomes under coordinated policy making.

ZUSAMMENFASSUNG

Grenzüberschreitende Fusionen und strategische Handelspolitik mit zweiseitiger Besteuerung: Ist eine internationale Koordination sinnvoll?

Das Papier untersucht die möglichen Wirkungen der nationalen Besteuerung auf Anreize für Fusionen in internationalen Märkten. Dabei wird vor allem gefragt, ob unkoordinierte Handelspolitik zu grenzüberschreitenden Fusionen führt, die insgesamt ineffizient sind und ob das für die internationale Koordination der Handelspolitik spricht. Im vorgestellten Modellrahmen nutzen Politikentscheider zweiseitige Zölle um Exportfirmen zu besteuern. Die Untersuchung zeigt, dass zwar nichtkoordinierte Politik grenzüberschreitende Fusionen hervorbringt, indem die beteiligten Firmen ihre nationalen Gesetzgeber gegeneinander ausspielen können; allerdings ist das Ergebnis durchaus wohlfahrtssteigernd im Vergleich zu dem Marktergebnis, das sich aus koordinierter Handelspolitik ergibt.

1 Introduction

Governments regulate and tax private firms in many ways. If the total burden of taxation and regulation is too large, firms have an incentive to move their business elsewhere. Tax competition among countries may be the result, and many fear a race to the bottom in corporate taxation and think that international policy cooperation is called for.

This paper concerns itself with one particular way that firms might flee from the jurisdiction of a given government, namely by international merger. When operating in several countries, production can often easily be increased in one country and reduced in another, according to where the regulatory regime is more lax. We present a model where firms in fact have incentives to choose international over domestic merger due to anticipated taxation. We ask whether this warrants international policy cooperation, and identify circumstances under which the perhaps surprising answer is 'no'. The 'national champion' argument – that national governments should try to promote national mergers rather than international ones – seem popular among policy makers in many countries, and there is an upstart theoretical economic literature that seeks to investigate if such national champion policies can be warranted.[1] The punchline here, which is novel relative to this literature, is that there can indeed be forces other than efficiency reasons that steer companies towards international merger solutions – because this gives a strategic advantage as regards national tax authorities – but that international policy coordination that would remove such 'wrong' incentives for international mergers nevertheless may not be the right answer to the problem. However, when choosing whether or not to coordinate policies, authorities do in effect choose between international mergers and a decentralised market structure. This policy option cannot be used in the current setting to pursue a national champion policy of domestic mergers.

A main feature of the model is that governments have access to two-part tariffs when taxing firms: they can both use a uniform tax/subsidy per unit, while at the same time employing a fixed tax element unrelated to output, that in principle also can be positive or negative. In the current context, with a Cournot oligopoly, a government will – at least in the absence of policy coordination – tend to subsidise its national firms on a per unit

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[1]Papers that are related to the cross-country versus international mergers debate include Barros (1994), Bjorvatn (2004), Haufler and Nielsen (2005), Head and Ries (1997), Horn and Levinsohn (2001), Horn and Persson (2001b), Lommerud, Straume and Sørgard (2006), Neary (2003), Norbäck and Persson (2006), Qiou and Zhou (2006), Richardson (1999), Saggi and Yildiz (2006), Straume (2003) and Südekum (2006).

basis, to gain international market shares, while the lump-sum tax element will be used to shift profit from firms to government. The link to the strategic trade literature should be obvious. For concreteness, think of natural gas as an example. In this industry, a handful of companies in two or three countries are the main suppliers to the European market. Governments can tax away profits lump-sum in several ways, for example by selling gas leases lump-sum or by charging large lump-sum fees for the use of the transportation infrastructure that firms need to use in order to reach the market. The temptation to subsidise exports to win national market shares in the 'third country' where customers reside is of course only strengthened by the fact that any profits in the domestic firms can be confiscated through the lump-sum fee.

We believe that governments have many ways to influence firm profits in a lump-sum manner. Take as a further example environmental standards. Firms will first have to invest fixed costs in complying with environmental standards – then production takes place, and can in principle be taxed or subsidised per unit. This is also a two-part tax scheme, and the cost of compliance with the given standard typically can be viewed as a lump-sum tax element. Many other examples can be found where government requirements indeed inflict a lump-sum tax that firms must meet before they can gain a 'license to operate' in a given market. For example, broadcasters and telecom firms find that entry allowances sell at enormous prices, perhaps decided through auctions.

The basic story of the paper can be outlined as follows. At the outset there are two countries each with two domestic firms. Any two-firm merger is allowed, but not mergers involving three or all four firms. A merger will lead to fixed cost synergies, but also influence how firms compete in the (Cournot) market. The merger decision is taken before taxes are set, but firms know whether international policy coordination will take place or not. One attraction of choosing a cross-border merger is that the firm then has the leverage to scale production up or down in the two countries, if the tax regime makes this warranted. At a second stage, governments announce tax variables. At this point in time the merger decision is already undertaken, so the focus of the authorities will be on how taxation affects their domestic firms (or the domestic parts of international firms) in the Cournot market game that takes place subsequent to taxation. However, taxation will be anticipated by firms, so in this way the tax variables can influence the merger decision. With international cooperation on policy the lump-sum tax and the per-unit subsidy will be set so as to maximise the cartel profit. However, this cartel profit will be

fully confiscated by the governments through the lump-sum tax. With cooperative policy no merger will be profitable, which means that the positive fixed cost synergies associated with merger are lost. With non-cooperative regulation, cross-border mergers stand a chance of rescuing some profits, precisely because international firms have some leverage to react to taxation by shifting production elsewhere, which can discipline the confiscation of profits through the lump-sum tax element. We discuss which mergers will be socially preferred by domestic social planners and whether policy coordination will be beneficial seen through the eyes of such planners. Without going in detail, policy coordination can turn out to be unwanted – this depends on how important it is to harvest at least some merger synergies relative to what can be achieved by the two producer countries in cashing in on their market power in the 'third country' where consumers reside.

Many strands of the economics research literature are relevant for the model developed here. The theory of the interaction among tax regimes in various countries basically comes in two variants. The tax competition literature focuses on governments that want to raise money for example by taxing companies, but who fear that capital may flee to low-tax havens. The strategic trade literature, on the other hand, focuses on national governments that want to use tax and regulation instruments to help domestic firms win market shares abroad.

In the tax competition literature, Kehoe's well-known 1989-paper was among the first to point out that the lack of international policy coordination can in fact be beneficial because it alleviates hold-up problems associated with taxation.[2] Kehoe uses a model where the consumption/savings decision is undertaken first, then taxes are set, then individuals determine their labor supply and which country to invest their savings in. The fact that taxes are set before investments take place can be interpreted as the governments being able to commit long-term to a level of taxation. Kehoe's contribution is therefore solidly placed in the tax competition literature. The commitment possibility for a government in our analysis is restricted to the choice to enter into policy coordination, which is a less limiting assumption. Moreover, as far as we know, our paper is the first one that points out that an unbeneficial-policy-coordination result can apply also in a strategic trade model. Two-part taxation is essential for this. Lack of policy coordination acts as a quasi-commitment not to be too heavy-handed on the lump-sum tax instrument – which

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[2]Kehoe's article is related to Kydland and Prescott (1980). An example of more recent relevant work is Andersson and Konrad (2003).

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a strategic trade type of policy maker otherwise would tend to use to recoup some of the cost of the export subsidies.[3]

As mentioned, the model used here falls squarely within the strategic trade bracket. Taxes are set before firms compete in a Cournot oligopoly, so the tax instruments can potentially influence the behaviour of domestic firms in a way that wins them a larger international market share.[4] The paper in this tradition that perhaps lies closest to us is Huck and Konrad (2004). These authors find that active strategic trade policy can lead firms to choose national over international mergers because this triggers higher per-unit subsidies of production.[5] There are many differences between this work and our own model. Importantly, we allow governments to use a two-part tax scheme. This takes away the attraction of national mergers for firms: even though they could spur increased strategic per-unit subsidies, this benefit would be confiscated through an increase in the lump-sum tax element. Moreover, a central focus in our paper is how possible merger choices influence the benefits from international policy coordination, something which is not an issue in Huck and Konrad.[6]

Another set of papers in the strategic trade literature are also highly relevant in our context. In a series of papers, Leahy and Neary (1996, 1997, 1999, 2000) have studied how various assumptions on government commitment ability influence results in strategic trade settings.[7] The models are made temporal for example by assuming that R&D investments or learning-by-doing takes place in the first of two periods. In all of this work the policy

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[3]We would like to mention a few further articles from the tax competition literature. Janeba (2000) presents a model where firms first build up capacities in one or more countries, then taxes are set, then outputs are chosen. Excessive production capacity built up in more than one country gives a firm some leverage if taxation should be too high. This has some resemblance to our point that cross-border merger also gives some ex post leverage to firms, but there are numerous differences between the present work and Janeba's model. Olsen and Osmundsen (2001, 2003) discuss national ownership questions in a framework of tax competition. From the large literature on investment and expropriation risk, we mention Eaton and Gersovitz (1983, 1984), Svejnar and Smith (1984), Thomas and Worrall (1994), Schnitzer (1999), Erbenova and Vagstad (1999), Konrad and Lommerud (2001) and Kessing, Konrad and Kotsogiannis (2006).

[4]Pioneering contributions on strategic trade policy were Brander and Spencer (1985) and Eaton and Grossman (1986). See Brander (1995) for an overview.

[5]Dixit (1984) can be seen as a forerunner of some aspects of the Huck-Konrad analysis.

[6]Dick (1993) studies the related theme of cross-ownership in a strategic trade model. Nese and Straume (2006) analyse how national regulators can use tax instruments strategically to shift rents among different parts of a successive international oligopoly, but merger is not an issue.

[7]See also Gruenspecht (1988) and Zigic (2003).

instrument is a uniform subsidy rate – there is no mention of two-part taxation. In our framework it is precisely two-part taxation that can make policy coordination (which can be seen as a commitment instrument) unwanted even though government subsidies can be committed to before merger decisions are taken.

There are close structural similarities between the model presented here and the relatively large literature on mergers in vertical structures. Examples of this line of work include Horn and Wolinsky (1988), Inderst and Wey (2003), Lommerud, Straume and Sørgard (2005, 2006) and O'Brien and Shaffer (2005). The production firms in the model can be seen as 'downstream' firms that supply to a market, while the tax authorities will be 'upstream' input suppliers (supplying 'access' or 'licence to operate'). The present model adds to this literature on several counts. Firstly, the upstream agents are here regulators that have a broader objective function than profit-maximising input suppliers. Secondly, many of the mentioned articles only study the consequences of downstream mergers – while we look at the possibility of different types of downstream mergers and how such mergers can influence upstream cooperation. Thirdly, we allow upstream agents to use two-part tariffs.[8]

The remainder of this paper is organised as follows. The model is presented in Section 2. Section 3 studies the baseline case of merger incentives in the case of international policy cooperation. A corresponding analysis of non-cooperative regulation is found in Section 4. Section 5 uses an endogenous merger model to predict what mergers will take place in the equilibrium market structure under different assumptions about the regulatory regime. Section 6 is devoted to social welfare issues. After asking what types of mergers are socially desirable under cooperative or non-cooperative policies, we turn to the question if international policy cooperation would be beneficial. Section 7 concludes the paper.

2   Model

Consider an industry with initially four single-plant firms located in two countries; firms (plants) 1 and 2 are located in country A, whereas firms (plants) 3 and 4 are located in country B.[9] The firms produce a homogenous good which is exported to a third country.

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[8]Two-part tariffs are considered also in Ziss (1995), Milliou and Petrakis (2005) and Symeonidis (2005), but the link between endogenous downstream mergers and upstream cooperation is not made.

[9]Regarding notation, we use the indices j and i for countries and plants, respectively, while the set of plants located in country j is given by N_j. We will also intermittently use subscript $-j$ to denote the

We assume that the firms compete á la Cournot in the export market.

Third-market demand for the good is given by an inverse demand function

$$p = a - b \sum_{i=1}^{4} q_i, \tag{1}$$

where p is the market-clearing price and q_i is quantity supplied from plant i. The variable cost of production at each plant is given by the convex cost function $C(q_i)$.[10] For simplicity, we let this function take on a simple quadratic form: $C(q_i) = \frac{c}{2}q_i^2$. The firms must also incur a firm-specific fixed cost K. In the decentralised market structure, with no mergers, profits of firm i, located in country j, are then given by

$$\pi_i = (p - w_j) q_i - C(q_i) - K - T_j, \quad i \in N_j, \tag{2}$$

where w_j and T_j denote, respectively, the variable and fixed part of a two-part tariff levied by the policy maker in country j.

National policy makers are concerned about maximising national welfare, which – in the absence of domestic consumers – is assumed to be given by a weighted sum of public revenue and private profits. In the decentralised market structure, national welfare in country j is given by

$$W_j = 2T_j + w_j \sum_{i \in N_j} q_i + \alpha \sum_{i \in N_j} \pi_i, \quad \alpha < 1. \tag{3}$$

The assumption that α is strictly less than one implies that the policy maker will extract all private profits if she is costlessly able to do so.

We consider the following game:

Stage 0: The policy makers in country A and B decide whether or not to set up an institution for coordinated policy making on corporate taxation and trade policy.

Stage 1: The firms decide whether to merge domestically or cross-border, if at all.

Stage 2: The national policy makers set two-part tariffs, w_j and T_j.

Stage 3: The firms choose outputs simultaneously and non-cooperatively.

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other country than j. Finally, where appropriate, we use superscripts d and c for market structures with domestic and cross-border mergers, respectively.

[10] Transportation costs are assumed to be included in the cost function $C(\cdot)$.

Placing the merger decisions before the tax variables are set, reflects the fact that mergers are long-term decisions with a considerable degree of commitment involved. For clarity of analysis, we restrict attention to two-firm mergers. We also assume that there is a private cost $\varepsilon > 0$ of merging, related to the organizational adjustments needed in order to implement the merger. A strictly positive merger cost is sufficient to ensure equilibrium selection in the merger game; however, for simplicity, we assume that ε is infinitesimally small so that it can be dropped from the equilibrium expressions derived in the subsequent sections.

In order to illustrate the main workings of the model, we start out by characterising the equilibria in all symmetrical market structures under different policy regimes. We then proceed to make predictions about the equilibrium market structure of the full game.

3   Cooperative policy making

As a benchmark for comparison, we start out by considering the case where trade policies are harmonised across borders. In the *decentralised market structure*, profit maximising output quantities are given by

$$q_{i \in N_j} = \frac{a(b+c) - (3b+c)w_j + 2bw_{-j}}{(5b+c)(b+c)}.$$ (4)

Maximisation of global welfare implies that the per-unit tariff must satisfy the first-order conditions

$$\frac{\partial (W_A + W_B)}{\partial w_j} = 0,$$ (5)

while the lump-sum tariff must be set so that the participation constraints are satisfied:

$$\pi_i \geq 0.$$ (6)

Solving (5) and (6), assuming that the participation constraints hold with equality, and taking into account that the choice of w_j affects the optimal choice of T_j, we derive the optimal two-part tariff:

$$w_j = \frac{3ab}{8b+c},$$ (7)

$$T_j = \frac{(2b+c)a^2}{2(8b+c)^2} - K.$$ (8)

We observe that optimal taxation involves setting a positive per-unit tariff, $w_j > 0$. This is done to correct for the negative competition externality in the product market. By cooperative policy making, the cartel output – which maximises joint profits – can be implemented. Private profits can then be fully extracted through the fixed tariff T_j, leaving the firms with zero profits in equilibrium.

3.1 Mergers

Focusing on two-firm mergers, we consider the cases where the firms in the industry merge either domestically or cross-border, implying that the number of firms is reduced from 4 to 2. We assume that a merger entails a cost synergy, which takes the form of fixed-cost savings,[11] and we also allow for the possibility that the size of these fixed-cost savings depends on whether the merger is domestic or cross-border. More specifically, we assume that cost savings in a domestic and cross-border merger, respectively, are $\theta_d K$ and $\theta_c K$, where $\theta_d, \theta_c \in (0,1)$.

In the case of *domestic* mergers, profits for the merged firms are given by

$$\pi_{1+2} = (p - w_A)(q_1 + q_2) - C(q_1) - C(q_2) - (2 - \theta_d)K - T_A, \tag{9}$$

$$\pi_{3+4} = (p - w_B)(q_3 + q_4) - C(q_3) - C(q_4) - (2 - \theta_d)K - T_B, \tag{10}$$

from which we can derive optimal outputs in the Cournot game:

$$q_{i \in N_j}^d = \frac{a(2b + c) - w_j(4b + c) + 2bw_{-j}}{(2b + c)(6b + c)}. \tag{11}$$

In the case of *cross-border* mergers, on the other hand, profits in one of the two possible ownership structures are given by

$$\pi_{1+3} = (p - w_A)q_1 + (p - w_B)q_3 - C(q_1) - C(q_3) - (2 - \theta_c)K - T_A - T_B, \tag{12}$$

$$\pi_{2+4} = (p - w_A)q_2 + (p - w_B)q_4 - C(q_2) - C(q_4) - (2 - \theta_c)K - T_A - T_B. \tag{13}$$

Profit-maximising outputs are found to be

$$q_{i \in N_j}^c = \frac{ac - w_j(3b + c) + 3bw_{-j}}{c(6b + c)}. \tag{14}$$

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[11] The main mechanisms of the model, and thus our main results, does not particularly depend on the source of merger synergies. Fixed cost savings are thus chosen for analytical simplicity.

When analysing optimal trade policy we make the assumption that, in the case of cross-border mergers, profits are divided equally between share-holders in the two countries.[12] With cross-border policy harmonisation, the policy makers are always able to implement the full cartel output and extract all profits in equilibrium. Per-unit tariffs are equal regardless of the type of merger, and given by

$$w_j^d = w_j^c = \frac{2ab}{8b + c}.\tag{15}$$

Comparing (7) and (15), we observe that a more concentrated market structure implies a lower per-unit tariff, as we would expect. The fixed tariff, on the other hand, depends on the size of merger synergies:

$$T_j^d = \frac{(4b + c) \, a^2}{(8b + c)^2} - (2 - \theta_d),\tag{16}$$

$$T_j^c = \frac{1}{2} \left\{ \frac{(4b + c) \, a^2}{(8b + c)^2} - (2 - \theta_c) \right\}.\tag{17}$$

4   Non-cooperative policy making

Now we consider the case where national policy makers set tariffs simultaneously and non-cooperatively. We start out by analysing the policy game in the *decentralised* market structure.

Equilibrium tariffs must satisfy

$$\frac{\partial W_j}{\partial w_j} = 0,\tag{18}$$

and

$$\pi_i \geq 0.\tag{19}$$

Using (4), equilibrium tariffs are given by

$$w_j = \frac{ab \, (c - b)}{(c + 7b) \, (2b + c)},\tag{20}$$

$$T_j = \frac{(3b + c)^2 \, a^2}{2 \, (2b + c) \, (c + 7b)^2} - K.\tag{21}$$

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[12] In other words, half of the total profits generated in an internationally merged firm enters the objective function of a domestic policy maker. It should be stressed, though, that the main thrust of the analysis does not depend on a particular sharing rule.

In the absence of international coordination, national policy makers must now balance two opposing incentives when framing the optimal policies. One the one hand, national policy makers have incentives to use per-unit tariffs to correct for a negative externality between domestic competitors, moving the market equilibrium closer to the cartel outcome. One the other hand, there is also an incentive to use the per-unit tariff as a strategic trade policy instrument. By lowering w_j from the cooperative equilibrium level, the policy maker in country j can ensure – all else equal – that a larger share of the export market is served by the firms located in j. Since outputs are strategic substitutes in the product market game, this is a profitable deviation.[13] Consequently, the equilibrium level of w_j is lower when policy making is not internationally coordinated.[14] The relative strengths of these opposing incentives are determined by the degree of convexity in production costs, measured by the parameter c. Strategic trade policy is more effective when c is low. Thus, a lower c increases rent-shifting incentives and leads to a lower equilibrium value of w_j. From (20) we see that the optimal policy entails an export subsidy – i.e., $w_j < 0$ – if $c < b$.

Domestic mergers

Solving (18) and (19) by using (11), equilibrium tariffs when firms merge domestically are given by

$$w_j^d = \frac{-4b^2 a}{10bc + 20b^2 + c^2}, \tag{22}$$

$$T_j^d = \frac{(4b + c)^3 a^2}{(10bc + 20b^2 + c^2)^2} - (2 - \theta_d) K. \tag{23}$$

Policy makers are still able to extract all private profits.

The previously discussed negative externality on domestic competitors is now fully internalised by the firms themselves through mergers. Thus, when the market structure is characterised by national monopolies, only rent-shifting incentives matter for the choice of per-unit tariffs in the non-cooperative policy game. Consequently, domestic mergers lead to lower equilibrium levels of w_j. Indeed, from (22) we see that the policy makers will always choose to subsidise exports in equilibrium.

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[13]See, e.g., Brander and Spencer (1985).
[14]This is easily confirmed by a comparison of (7) and (20).

Cross-border mergers

Cross-border mergers increase the flexibility of the merging parties, in the sense that a merged firm can choose to serve the export market from both *or either* of the exporting countries. Under non-cooperative policy making, this flexibility serves as a credible threat vis-á-vis national policy makers. The policy maker in country j must now make sure that she offers a tariff that discourages the internationally merged firms to re-locate all export production to the other country.

Let $\widehat{\pi}_m(j)$ denote the profits earned by the merged firm m when serving the export market only from country j (given that the other firm uses both plants for export production). Optimal taxation in the non-cooperative regime must now also satisfy the following *mobility constraint* for each merged firm:

$$\pi_m \geq \widehat{\pi}_m(j). \tag{24}$$

It is straightforward to derive

$$\widehat{\pi}_m(j) = \frac{\left((2b+c)\,a - (c+3b)\,w_j + bw_{-j}\right)^2 (2b+c)}{2\left(6b^2 + c^2 + 6bc\right)^2} - (2 - \theta_c)\,K - T_j. \tag{25}$$

On the other hand, if the merged firms serve the export market from both countries, equilibrium profits are found by inserting (14) into (12) or (13), and given by

$$\pi_m = \frac{2ca\,(4b+c)\,(a - w_A - w_B) + \eta}{2c\,(6b+c)^2} - (2-\theta_c)\,K - T_A - T_B, \tag{26}$$

where

$$\eta := \left(8bc + 18b^2 + c^2\right)\left(w_A^2 + w_B^2\right) - 4bw_Aw_B\,(9b+2c) > 0.$$

Applying the mobility constraints, equilibrium tariffs in the non-cooperative regime with cross-border mergers are given by[15]

$$w_j^c = \frac{abc\left(\alpha\nu + 24b^3\,(3b+2c) - 8c^2b\,(b+c) - c^4\right)}{\alpha cb\nu - (2b+c)\,\varpi}, \tag{27}$$

$$T_j^c = \frac{ca^2\,(c+3b)^2\,\gamma\left(6b^2 + c^2 + 6bc\right)^2}{2\left(\alpha cb\nu - (2b+c)\,\varpi\right)^2}, \tag{28}$$

where

$$\gamma := c^4 + 14bc^3 + 72b^2c^2 + 160b^3c + 120b^4,$$

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[15] Explicit expressions for the mobility constraints are given in Appendix A.

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$$\nu := c^4 + 12bc^3 + 52b^2c^2 + 102b^3c + 72b^4,$$

$$\varpi := 324b^5 + 612b^4c + 444b^3c^2 + 142b^2c^3 + 20bc^4 + c^5.$$

We can now state our first main result:[16]

Proposition 1 *Under non-cooperative policy making, there exists a critical value $\overline{K}$ such that cross-border mergers yield positive profits in equilibrium if $K < \overline{K}$.*

Unless fixed costs are sufficiently high, non-cooperative policy makers are not able to extract all rents from internationally merged firms in equilibrium. This is due to the merged firms' ability to play the national policy makers out against each other. By credibly threatening to shift export production to a foreign plant, an internationally merged firm can induce each national policy maker to offer a tariff that in effect will leave the firm with positive profits in equilibrium.[17]

However, the equilibrium outcome given by (27)-(28) is valid only if fixed costs are not too high. If K is above the critical level $\overline{K}$, the policy makers can extract all profits in the non-cooperative equilibrium without violating the mobility constraint. In this case, the internationally merged firms do not obtain any strategic advantage from the merger. It is easily shown that $\overline{K}$ is increasing in the cost-savings factor θ.[18] Thus, larger merger synergies increase the likelihood of profitable cross-border mergers; not because of the synergies themselves, but because larger synergies make the the threat of production shifting credible for a larger range of K.

When all private profits are not extracted, it also follows that the weight attached to profits in the policy makers' objective functions matters for the equilibrium tariff. From (27) it is easily confirmed that w_j^c is decreasing in α.

5 Equilibrium market structure

What is the equilibrium market structure if we allow for all possible two-firm mergers? In order to make predictions about merger formation, we apply the endogenous merger model

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[16] All formal proofs are presented in Appendix C.

[17] We have assumed that merger synergies and fixed costs are independent of whether the merged firms use both plants (see (25)). If the merged firms could save some fixed costs by using only one plant, the national policy makers would have to leave even more profits to the firms in order to meet the mobility constraints.

[18] See Appendix C.

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introduced by Horn and Persson (2001a), who treat the merger process as a cooperative game of coalition-formation, where the players are free to communicate and write binding contracts.[19]

To introduce some more notation, let an ownership structure M_k be a partition of the set $\{1, 2, 3, 4\}$ of owners (firms) into coalitions. Allowing only for two-firm mergers, there are 5 possible market structures, comprising a total of 10 different ownership structures. For example, the market structure with two cross-border mergers can be realised through two different ownership structures: $\{1 + 3, 2 + 4\}$ and $\{1 + 4, 2 + 3\}$. Without going into details about the theoretical foundations of the merger formation model, the approach involves a comparison of any two possible ownership structures M_k and $M_{k'}$, where M_k is said to *dominate* $M_{k'}$ if the combined profits of the *decisive group* of owners are larger in M_k than in $M_{k'}$. The decisive group of owners are the owners that are expected to be able to influence whether M_k will be formed instead of $M_{k'}$, and vice versa. We do not allow side-payments among coalitions, so owners belonging to *identical coalitions* in the two structures cannot affect whether M_k will be formed instead of $M_{k'}$, but all remaining owners can influence this choice and are thus decisive.[20] Finally, the solution concept is the *core*. Those structures that are in the core (i.e., the structures that are undominated) are defined as equilibrium ownership structures.

Let us now turn to the solution of the full game. Under *cooperative policy making*, private profits are always fully extracted in equilibrium. Due to the private cost of merger ($\varepsilon > 0$), the decentralised market structure strictly dominates all other market structures, and, consequently, no mergers will take place when trade policies are internationally coordinated.

Under *non-cooperative policy making*, on the other hand, we have shown that firms can obtain positive profits by merging cross-border. Thus, if $K < \overline{K}$, the symmetric market structure with two cross-border mergers strictly dominates both the decentralised structure and any market structure involving domestic mergers. However, it is not a priori clear whether a market structure with only a single cross-border merger is dominated by the market structure where all firms merge cross-border. This dominance relation is

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[19]Due to the nature of our model, similar results would be obtained in any plausible model of endogenous mergers. Since the decentralised market structure implies zero profits in equilibrium, a merger can never harm non-participating firms. This implies that there are no incentives for 'pre-emptive mergers' in our model.

[20]See Horn and Persson (2001a) for a formal definition of *decisive owners*.

determined by whether a second cross-border merger is privately profitable. This depends firstly on whether or not taxation is discriminatory. With discriminatory taxation, it is always possible to extract all profits from the non-merged firms. In this case, a second cross-border merger is always privately profitable. Under non-discriminatory taxation, on the other hand, the non-merged firms benefit from the laxer tax regime induced by a single cross-border merger. This free-rider effect may be sufficiently strong to prevent a second merger.

Proposition 2 *(i) Under cooperative policy making, there are no mergers in equilibrium.*

(ii) Under non-cooperative, discriminatory tax polices, the equilibrium market structure is two cross-border mergers if $K < \overline{K}$.

(iii) Under non-cooperative, non-discriminatory tax policies, if $\theta_c > \widetilde{\theta} \in (0,1)$, there exists a critical value $\widetilde{K} < \overline{K}$ such that the equilibrium market structure is two cross-border mergers if $K \in \left(\widetilde{K}, \overline{K} \right)$.

Part (iii) of the Proposition basically states that, with non-discriminatory taxation, private profitability of a second cross-border merger requires a certain amount of merger synergies. Otherwise, the aggressive response of the already merged firm will make a second merger unprofitable, as in a 'standard' Cournot homogenous goods oligopoly.

6   Social welfare

In this section we discuss two interrelated questions regarding social welfare. First, which types of merger, if any at all, are preferred from a welfare point-of-view? Second, assuming that merger decisions are endogenously made, is international harmonisation of trade policies socially desirable? For the first question, we restrict attention to symmetric market structures.

In the *cooperative* policy regime, a social ranking of market structures is straightforward. In any market structure, tariffs are set so that total industry rents are maximised. Then the following result is trivially established:

Proposition 3 *Under cooperative policy making, any mergers are socially desirable if they yield some cost synergies. The socially most preferable market structure is the one in which the largest merger synergies are realised.*

In the *non-cooperative* policy regime, things are far less straightforward. However, by comparing the different equilibrium welfare expressions reported in Appendix B, we can establish the following results:

Proposition 4 *Assume that policy making is non-cooperative.*

(i) Compared with the decentralised structure, domestic mergers are always welfare improving, while cross-border mergers are welfare improving if α or K is sufficiently high.

(ii) Comparing domestic and cross-border mergers, and assuming that cost synergies are identical in both types of merger, cross-border mergers are always socially preferred if α is sufficiently high, while domestic mergers are preferred if α and K are sufficiently low.

Due to the rent-generating effect of a more concentrated market structure, domestic mergers are always welfare improving, even in the absence of cost synergies. On the other hand, if firms merge cross-border, all pure profits cannot be extracted by the policy makers. Consequently, the welfare effect of cross-border mergers depends on how private profits are evaluated. If α is sufficiently high, there is a low social cost of leaving pure profits in the hands of the firms, and cross-border mergers are always welfare improving (relative to no mergers). In general, though, the welfare loss of not being able to extract all rents must be weighed against the merger-induced increase in total rents. Thus, for low levels of α it takes a sufficiently high level of K to make cross-border mergers welfare improving.

Finally, the welfare ranking of *domestic versus cross-border* mergers follows much the same logic. If both types of merger are equal in terms of cost synergies, i.e., $\theta_d = \theta_c$, cross-border mergers are preferred when α is sufficiently high. Consider the limit $\alpha \to 1$. In this case, there is no welfare cost of leaving positive profits in equilibrium and the welfare ranking is fully explained by the effect of different types of merger on national policy makers' rent-shifting incentives. With domestic mergers, rent-shifting incentives cause policy makers to subsidise exports, which reduces total industry rents. With cross-border mergers, on the other hand, the Prisoners' Dilemma characteristics of the non-cooperative equilibrium are less pronounced, since the negative externality between domestic plants (which are owned by different firms) counteracts the national policy makers' rent-shifting incentives. This contributes to higher total industry profits in equilibrium, compared with the case of domestic mergers.

The arguments in this subsection make it clear that the results regarding welfare

comparisons are general, and not dependent on the particular functional forms used in the analysis. The main reason for employing those special functional forms is to facilitate the analysis in the next subsection, where one needs to examine whether it can be the case that cross-border mergers are welfare improving (due to, say, large fixed costs K) and at the same time leave rents to firms (which requires that fixed costs cannot be too large).

6.1   Is international policy coordination beneficial?

Let us now turn to the question of whether or not international harmonisation of trade policies is desirable. The basic idea here is that different policy regimes might imply different market structures in equilibrium. Assume that the countries can commit to a particular policy regime at the outset of the game, before firms make their merger decisions. In this case, we know that no mergers will be undertaken if policy making is transnationally coordinated. If policies are *not* coordinated, however, there may be incentives for cross-border mergers. We consider the case where the equilibrium market structure is two cross-border mergers under non-cooperative policy making. From Proposition 2, we know that this amounts to assuming either that trade policy is discriminatory and $K < \overline{K}$, or that $\widetilde{K} < K < \overline{K}$.

In this case, the question of whether or not to coordinate policies across borders introduces the following trade-off. Non-cooperative policy making implies that national policy makers engage in a Prisoners' Dilemma type of policy game, due to the incentives for strategic trade policy. These incentives are eradicated by international harmonisation. On the other hand, such harmonisation will remove private incentives for potentially welfare improving mergers. An evaluation of this trade-off reduces to a comparison of welfare in the non-cooperative policy regime with cross-border mergers and the cooperative regime without mergers.

Proposition 5 *If $\theta_c > \theta^* \in (0, 1)$, there exists a critical value $K^* < \overline{K}$ such that international policy coordination is not beneficial for $K \in \left(K^*, \overline{K} \right)$.*

In light of the welfare trade-off outlined above, the intuition behind this result is straightforward. If merger synergies – in absolute terms – are sufficiently high, the social benefit of inducing welfare improving mergers outweigh the cost of the negative externalities suffered in a non-harmonised policy regime. On the other hand K cannot be too large,

because then the threat of shifting production between the plants in an internationally merged firm is not effective.

The relative magnitudes of the different regimes can be illustrated by considering a specific numerical example. Assume that $a = 10$, $b = c = 1$, and $\alpha = 0.8$. This yields $\theta^* = 0.38$. Thus, for any $\theta > 0.38$ there is a possibility that international policy coordination is not beneficial. Now assume that $\theta = 0.8$. In this case, we have that $K^* = 2.73$ and $\overline{K} = 5.47$, implying that policy coordination is not beneficial if $K \in (2.73, 5.47)$. In this example and for $K = 5$ policy coordination yields welfare $W_j = 1.11$ while non-coordination yields welfare $W_j^c = 3.47$, implying that the latter alternative allows a significant fraction of potential cost savings ($\theta K = 4$) to be realised and reflected in improved welfare.

7   Concluding remarks

Many policy makers seem to view cross-border mergers with skepticism. We have investigated one possible justification for such views: Cross-border merger allows firms to play national policy makers out against each other, with higher retained profits as result.

Merger issues are typically studied in oligopoly models, and we have used a standard Cournot setting with two firms in each of two countries, with consumers residing in a third country. In this type of model, governments can gain from strategic trade type of policies, to help national firms gaining market shares in the international market. We introduce the possibility of two-part taxation. Output can be subsidised per unit, while profits at the same time can be confiscated through a lump-sum tax element. This introduces a hold-up problem of taxation also in a strategic trade framework. The particular problem at hand is that heavy-handed use of the lump-sum tax element will scare off any up-front sunk investment, such as mergers. Policy makers may want to commit not to use such confiscatory taxation. The only commitment option offered in this model is the possibility to enter – or not to enter – into an agreement with the other country to coordinate tax decisions. The absence of policy coordination means that some externalities in the strategic trade game are left uninternalised – but on the upside at least some merger synergies can be salvaged. Uncoordinated policy gives international firms, but only them, the option to play tax authorities out against each other, due to the credible threat to move production from one country to another.

In tax theory, studies of non-linear taxation abound, but not so in strategic trade theory. We have argued that two-part taxation is realistic in many oligopolistic markets. Oil companies pay for exploration rights, gas producers sometimes pay for the use of publicly owned transportation networks, broadcasters and telecoms pay for the right to operate. Also, environmental and safety standards come close to lump-sum taxation. We have assumed that it is possible to remove all pure profits through the lump-sum tax. Assume to the contrary that there are some limits to how much lump-sum taxation can be used. The necessary assumption is that lump-sum tax costs increase after a merger – the firm will then weigh retained profits against mergers costs (that can be substantial). The broad point remains valid – that lump-sum taxation reduces merger activity, and that uncoordinated policy partly can correct for this while encouraging cross-border merger.

Results about unbeneficial policy cooperation typically arise in second-best settings. Key ingredients here are that policy makers cannot influence merger decisions, but they can choose whether or not to cooperate on policy. Naturally, it then becomes relevant how the cooperation decision feeds back on private merger decisions. As a concluding remark, assume the opposite: that international policy cooperation is not an option, but policy makers can influence merger decisions, for example by subsidising domestic mergers (presumably in some half-hidden way). A government could then correct for the lack of merger incentives directly – and would perhaps want to encourage domestic mergers in particular, for example because domestic mergers have larger synergies than international ones. The national champion argument would then not be as irrational as it sometimes is made out to be. However, we have described a second-best world where the national authorities in reality have to chose between international mergers or none at all.

A Mobility constraints under non-cooperative policy making

Consider the case of two cross-border mergers. Using (25) and (26) from Section 4, the mobility constraints for national policy makers can be expressed as

$$T_A \leq \frac{(ac - (c + 3b)\, w_A + 3bw_B)\,(\gamma ac - \beta w_A + \phi bw_B)}{2c\,(6b + c)^2\,(6b^2 + c^2 + 6bc)^2}, \tag{A.1}$$

$$T_B \leq \frac{(ac - (c + 3b)\, w_B + 3bw_A)\,(\gamma ac - \beta w_B + \phi bw_A)}{2c\,(6b + c)^2\,(6b^2 + c^2 + 6bc)^2}, \tag{A.2}$$

where

$$\beta := c^5 + 17bc^4 + 110b^2c^3 + 328b^3c^2 + 432b^4c + 216b^5,$$

$$\phi := 3c^4 + 38bc^3 + 168b^2c^2 + 312b^3c + 216b^4,$$

and γ is defined in Section 4. By using (A.1)-(A.2) in the policy makers' maximisation problems, we derive (27) and (28), given in Section 4.

B Social welfare in the symmetric market structure equilibria

Using the equilibrium tariffs derived in the main body of the paper, equilibrium expressions for social welfare in the symmetric market structures, under the two different policy regimes, are given as follows.

B.1 Coordinated policy making

No mergers:

$$W_j = \frac{a^2}{8b + c} - 2K. \tag{B.1}$$

Domestic mergers:

$$W_j^d = \frac{a^2}{8b + c} - (2 - \theta_d)\, K. \tag{B.2}$$

Cross-border mergers:

$$W_j^c = \frac{a^2}{8b + c} - (2 - \theta_c)\, K. \tag{B.3}$$

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B.2 Non-cooperative policy making

No mergers:

$$W_j = \frac{\left(7bc + 4b^2 + c^2\right)\left(3b + c\right)a^2}{\left(7b + c\right)^2\left(2b + c\right)^2} - 2K. \tag{B.4}$$

Domestic mergers:

$$W_j^d = \frac{\left(8bc + 8b^2 + c^2\right)\left(4b + c\right)a^2}{\left(10bc + 20b^2 + c^2\right)^2} - \left(2 - \theta_d\right)K. \tag{B.5}$$

Cross-border mergers:

$$W_j^c = \frac{a^2\left(c + 3b\right)\left(6b^2 + c^2 + 6bc\right)^2\left(c\chi + 12\alpha b^3\left(4b + 3c\right)\left(9b^2 + 6bc + 2c^2\right)\right)}{\left(\alpha cb\nu - \left(2b + c\right)\varpi\right)^2} \tag{B.6}$$
$$-\alpha\left(2 - \theta_c\right)K,$$

where

$$\chi := c^5 + 19bc^4 + 6c^3\alpha b^2 + 130b^2c^3 + 392b^3c^2 + 504b^4c + 216b^5$$

and ν and ϖ have been defined in Section 4.

C   Proofs

All proofs require only quite straightforward algebra. However, some of the algebra is extremely detailed and thus omitted. In these cases, we only provide a main sketch of the proof.[21]

C.1   Proof of Proposition 1

Inserting the equilibrium two-part tariff, (27)-(28), into (26), equilibrium profits for an internationally merged firm m, under non-cooperative policy making, is given by

$$\pi_m^c = \frac{2a^2b\nu\left(c + 3b\right)^2\left(6b^2 + c^2 + 6bc\right)^2}{\left(\alpha cb\nu - \left(2b + c\right)\varpi\right)^2} - \left(2 - \theta_c\right)K, \tag{C.1}$$

where ν and ϖ are defined in Section 4. It follows straightforwardly that $\pi_m^c > 0$ if $K < \overline{K}$, where

$$\overline{K} := \frac{2a^2b\nu\left(c + 3b\right)^2\left(6b^2 + c^2 + 6bc\right)^2}{\left(2 - \theta_c\right)\left(\alpha cb\nu - \left(2b + c\right)\varpi\right)^2}. \tag{C.2}$$

For $K > \overline{K}$, all profits are extracted through the lump-sum tax in equilibrium. *Q.E.D.*

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[21] The 'nitty gritty' of the calculations are available from the authors upon request.

C.2 Proof of Proposition 2

Given our assumptions about merger formation, parts (i) and (ii) of the Proposition follow immediately from the analysis of Sections 3 and 4. To prove part (iii) of the Proposition, we need to derive the equilibrium with a single cross-border merger. Assume that firms 1 and 3 merge. If the merged firms supply the good from both countries, profits are given by

$$\pi_{1+3} = \frac{2ac\left(4b+c\right)\left(c+b\right)^2\left(a-w_A-w_B\right) + \left(c+2b\right)\delta\left(w_A^2+w_B^2\right) - 4b\xi w_A w_B}{2c\left(c^2+7cb+8b^2\right)^2} \tag{C.3}$$
$$- \left(2-\theta_c\right)K - T_A - T_B,$$

where

$$\delta := c^3 + 8bc^2 + 21b^2c + 16b^3,$$

$$\xi := 14bc^2 + 27b^2c + 2c^3 + 16b^3,$$

Profits of the non-participating firms are given by

$$\pi_2 = \frac{\left(c+2b\right)\left(a\left(c+b\right)\left(c+2b\right) - w_A\left(c^2+5b\left(c+b\right)\right) + bw_B\left(2c+3b\right)\right)^2}{2\left(c+b\right)^2\left(c^2+7cb+8b^2\right)^2} \tag{C.4}$$
$$-K - T_A,$$

$$\pi_4 = \frac{\left(c+2b\right)\left(a\left(c+b\right)\left(c+2b\right) - w_B\left(c^2+5b\left(c+b\right)\right) + bw_A\left(2c+3b\right)\right)^2}{2\left(c+b\right)^2\left(c^2+7cb+8b^2\right)^2} \tag{C.5}$$
$$-K - T_B.$$

On the other hand, if the merged firm chooses to supply the good only from country j, it will realise a profit of

$$\widehat{\pi}_{1+3}\left(j\right) = \frac{\left(2b+c\right)\left(a\left(c+b\right) - w_j\left(c+2b\right) + w_{-j}b\right)^2}{2\left(c+b\right)^2\left(c+4b\right)^2} - \left(2-\theta_c\right)K - T_j. \tag{C.6}$$

Imposing the mobility conditions $\pi_{1+3} \geq \widehat{\pi}_{1+3}\left(j\right)$, equilibrium trade policy is characterised by

$$w_j = \frac{abc\rho}{\psi}, \tag{C.7}$$

$$T_j = \frac{\vartheta^2\left(64b^4+102b^3c+53c^2b^2+12c^3b+c^4\right)\left(4b+c\right)^2a^2c}{2\psi^2}, \tag{C.8}$$

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where

$$\psi \quad : \quad = 2c^6\alpha b + 25c^5\alpha b^2 + 123c^4\alpha b^3 + 305c^3\alpha b^4 + 360c^2\alpha b^5 + 160c\alpha b^6 - 2c^7$$
$$-43c^6 b - 355c^5 b^2 - 1472c^4 b^3 - 3312b^4 c^3 - 4000b^5 c^2 - 2368b^6 c - 512b^7,$$

$$\rho \quad : \quad = 2c^5\alpha + 25\alpha bc^4 + 123\alpha b^2 c^3 + 305\alpha b^3 c^2 + 360\alpha b^4 c$$
$$+160b^5\alpha - 3c^5 - 32bc^4 - 121b^2 c^3 - 196b^3 c^2 - 112b^4 c,$$

$$\vartheta := 2c^3 + 10bc^2 + 13b^2 c + 4b^3.$$

Equilibrium profits are given by

$$\pi_{1+3} = \frac{(c+2b)(c+4b)^2 \left(c^2 + 7cb + 8b^2\right)^2 \vartheta^2 a^2}{2\psi^2} - (2 - \theta_c) K, \tag{C.9}$$

$$\pi_2 = \pi_4 = \frac{(c+4b)^2 \vartheta^2 b \left(2c^4 + 23c^3 b + 98c^2 b^2 + 192cb^3 + 128b^4\right) a^2}{2\psi^2} - K. \tag{C.10}$$

The profitability of a second cross-border merger, i.e., a merger between firms 2 and 4, are determined by a comparison of (C.1) and (C.10). It turns out that a second merger is profitable if $K > \widetilde{K}$, where

$$\widetilde{K} := \frac{2F}{\theta_c}, \tag{C.11}$$

where

$$F := \frac{a^2 b^2 A}{2\Lambda^2 \Upsilon^2},$$

$$\Lambda \quad : \quad = -\alpha c^5 b - 12\alpha c^4 b^2 - 52\alpha c^3 b^3 - 102\alpha c^2 b^4 - 72\alpha cb^5 + 648b^6 + 1548b^5 c$$
$$+1500b^4 c^2 + 728b^3 c^3 + 182b^2 c^4 + 22bc^5 + c^6,$$

$$\Upsilon \quad : \quad = -2c^6\alpha b - 25c^5\alpha b^2 - 123c^4\alpha b^3 - 305c^3\alpha b^4 - 360c^2\alpha b^5 - 160c\alpha b^6 + 2c^7$$
$$+43bc^6 + 355b^2 c^5 + 1472b^3 c^4 + 3312b^4 c^3 + 4000b^5 c^2 + 2368b^6 c + 512b^7,$$

and $A > 0$ is a function of the parameters c, b and α.[22]

It follows that the market structure with two cross-border mergers dominates all other market structures if $K \in \left(\widetilde{K}, \overline{K}\right)$. It remains to establish when $\widetilde{K} < \overline{K}$, if at all. We

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[22] We omit the explicit expression of A, which is extremely detailed. It is, however, straightforward to determined the positive sign of A. Details are available upon request.

see that $\partial \widetilde{K}/\partial \theta_c < 0$ while $\partial \overline{K}/\partial \theta_c > 0$, implying that $\partial \left(\overline{K} - \widetilde{K} \right)/\partial \theta_c > 0$. From (C.2) and (C.11), it is immediately clear that $\lim_{\theta_c \to 0} \left(\overline{K} - \widetilde{K} \right) < 0$. It is also relatively straightforward to show that $\lim_{\theta_c \to 1} \left(\overline{K} - \widetilde{K} \right) > 0$.[23] Thus, there exists a critical value $\widetilde{\theta} \in (0,1)$, such that $\overline{K} > \widetilde{K}$ if $\theta_c > \widetilde{\theta}$. *Q.E.D.*

C.3 Proof of Proposition 4

(i) Comparing (B.4) and (B.5), the market structure with two *domestic* mergers yields higher welfare than the decentralised structure if

$$\frac{16b^4 \left(92b^3 + c^3 + 69b^2 c + 15bc^2 \right) a^2}{(7b + c)^2 \left(10bc + 20b^2 + c^2 \right)^2 (2b + c)^2} + \theta_d K > 0. \tag{C.12}$$

We see that this is always true. Comparing (B.4) and (B.6), the market structure with two *cross-border* mergers yield higher welfare than the decentralised structure if

$$-a^2 \left(c + 3b \right) b \left(\frac{\Psi \left(2b + c \right)^2 + \alpha \nu \left(\alpha c^2 b \left(7bc + 4b^2 + c^2 \right) \nu - 2 \left(2b + c \right) \vartheta \right)}{(\alpha cb\nu - (2b + c)\varpi)^2 (7b + c)^2 (2b + c)^2} \right)$$
$$+ \left(2 \left(1 - \alpha \right) + \alpha \theta_c \right) K > 0, \tag{C.13}$$

where

$$\begin{aligned} \Psi \quad : \quad &= 2c^{11} + 79c^{10}b + 1377c^9 b^2 + 14\,010 c^8 b^3 + 92\,616 c^7 b^4 \\ &\quad + 417\,892 c^6 b^5 + 1310\,220 c^5 b^6 + 2837\,016 c^4 b^7 \\ &\quad + 4117\,104 c^3 b^8 + 3770\,064 c^2 b^9 + 1940\,112 cb^{10} + 419\,904 b^{11}, \end{aligned}$$

$$\begin{aligned} \vartheta \quad : \quad &= 10\,584 b^8 + 30\,780 b^7 c + 37\,188 b^6 c^2 + 24\,564 b^5 c^3 \\ &\quad + 9874 b^4 c^4 + 2469 b^3 c^5 + 370 b^2 c^6 + 30 bc^7 + c^8, \end{aligned}$$

and ν and ϖ are defined before. It is easily shown that the first term in (C.13) is monotonically increasing in α, and positive (negative) for $\alpha = 1$ ($\alpha = 0$). Thus, since the second term is non-negative, the inequality in (C.13) holds if α is sufficiently high. If α is sufficiently low, so that the first term is negative, K must be sufficiently high to make the inequality hold. The highest value K is allowed to take in this expression is $\overline{K}$. It is easily verified that the inequality holds for $\alpha = 0$ and $K = \overline{K}$. It follows that a sufficiently high

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[23] The details of the calculations, which requires some very meticulous, but straightforward, algebra, are available from the authors upon request.

value of K (within the relevant range) is always enough to make the inequality in (C.13) hold.

(ii) Comparing (B.5) and (B.6), domestic mergers are preferred to cross-border mergers, from a welfare-point-of-view, if

$$a^2b\frac{\Phi + \alpha\nu\left(\alpha c^2 b\left(4b + c\right)\left(8bc + 8b^2 + c^2\right)\nu - \Omega\right)}{\left(10bc + 20b^2 + c^2\right)^2\left(\alpha cb\nu - \left(2b + c\right)\varpi\right)^2} - K\left(2 - \theta_d - \alpha\left(2 - \theta_c\right)\right) > 0, \quad \text{(C.14)}$$

where

$$\begin{aligned}
\Omega \quad : \quad &= 2c^{10} + 74bc^9 + 1182b^2c^8 + 1180\,032b^7c^3 + 1364\,832b^8c^2 + 905\,472b^9c \\
&\quad + 259\,200b^{10} + 10\,792b^3c^7 + 62\,816b^4c^6 + 245\,376b^5c^5 + 654\,968b^6c^4,
\end{aligned}$$

$$\begin{aligned}
\Phi \quad : \quad &= 28\,452c^{11}b^3 + 28\,301\,024b^7c^7 + 231\,221\,376b^{10}c^4 + 256\,016b^4c^{10} \\
&\quad + 171\,300\,096b^{12}c^2 + 7883\,368b^6c^8 + 155\,414\,640b^9c^5 + 2138b^2c^{12} \\
&\quad + 1651\,276b^5c^9 + 97bc^{13} + 71\,663\,616b^{13}c + 243\,694\,656b^{11}c^3 \\
&\quad + 76\,655\,168b^8c^6 + 13\,436\,928b^{14} + 2c^{14}.
\end{aligned}$$

Setting $\theta_d = \theta_c$, the second term in (C.14) is always non-negative. The first term in (C.14) is monotonically decreasing in α, and positive (negative) for $\alpha = 0$ ($\alpha = 1$). Thus, the inequality never holds when α is sufficiently high. When α is sufficiently low, the sign of the expression is a priori ambiguous. A higher value of K will reduce the likelihood that the inequality holds. Inserting the extreme value in the upper limit of the relevant range, $K = \overline{K}$, it is easily shown that the expression in (C.14) is negative. Thus, even for $\alpha = 0$, the inequality holds only if K is sufficiently low. $Q.E.D.$

C.4   Proof of Proposition 5

Comparing (B.1) and (B.6), we find that harmonisation is not preferred if $K > K^*$, where

$$K^* := \frac{a^2b\left(\Theta + \alpha\nu\left(\alpha c^2 b\nu - \sigma\right)\right)}{\left(2\left(1 - \alpha\right) + \alpha\theta_c\right)\left(8b + c\right)\left(\alpha cb\nu - \left(2b + c\right)\varpi\right)^2}, \quad \text{(C.15)}$$

where

$$\begin{aligned}
\sigma \quad : \quad &= 2c^7 + 50bc^6 + 502b^2c^5 + 2680b^3c^4 + 8328b^4c^3 \\
&\quad + 14\,976b^5c^2 + 14\,040b^6c + 5184b^7,
\end{aligned}$$

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$$\Theta \quad : \quad = 77c^{10}b + 2605\,104c^4b^7 + 3750\,624c^3b^8 + 419\,904b^{11} + 2c^{11}$$
$$+1819\,584cb^{10} + 3446\,064c^2b^9 + 13\,264c^8b^3 + 87\,128c^7b^4$$
$$+1215\,672c^5b^6 + 1318c^9b^2 + 390\,892c^6b^5.$$

This case is only relevant if $K^* < \overline{K}$. From (C.2) and (C.15) we have that

$$\overline{K} - K^* = a^2 b \frac{-2by^2 + \theta_c \left(u + \alpha cb\nu\tau\right)}{(2 - \theta_c)\, z^2 \left(2\left(1 - \alpha\right) + \alpha\theta_c\right)(8b + c)}, \tag{C.16}$$

where

$$y \quad : \quad = c^5\alpha + 12c^4\alpha b + 52c^3\alpha b^2 + 102c^2\alpha b^3 + 72c\alpha b^4 + c^5$$
$$+22bc^4 + 160b^2c^3 + 480b^3c^2 + 576b^4c + 216b^5,$$

$$u \quad : \quad = 77c^{10}b + 2605\,104c^4b^7 + 3750\,624c^3b^8 + 419\,904b^{11}$$
$$+2c^{11} + 1819\,584cb^{10} + 3446\,064c^2b^9 + 13\,264c^8b^3$$
$$+87\,128c^7b^4 + 1215\,672c^5b^6 + 1318c^9b^2 + 390\,892c^6b^5,$$

$$\tau \quad : \quad = 2c^5 + c^5\alpha + 12c^4\alpha b + 44bc^4 + 52c^3\alpha b^2 + 320b^2c^3$$
$$+102c^2\alpha b^3 + 960b^3c^2 + 72c\alpha b^4 + 1152b^4c + 432b^5,$$

$$z \quad : \quad = -\alpha c^5b - 12\alpha c^4b^2 - 52\alpha c^3b^3 - 102\alpha c^2b^4 - 72\alpha cb^5 + 648b^6$$
$$+1548b^5c + 1500b^4c^2 + 728b^3c^3 + 182b^2c^4 + 22bc^5 + c^6.$$

It can be shown that $\left(\overline{K} - K^*\right)$ is monotonically increasing in θ, and $\overline{K} - K^* < 0$ if $\theta = 0$. It is also easily confirmed that $\lim_{\theta \to 1} \left(\overline{K} - K^*\right) > 0$. This implies that $K^* < \overline{K}$ if θ is above a critical level $\theta^* < 1$. From (C.16) we derive

$$\theta^* = \frac{2by^2}{u + \alpha cb\nu\tau}. \tag{C.17}$$

It can also be shown that $\widetilde{K} < K^* < \overline{K}$ for $\theta > \theta^*$. Q.E.D.

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