Industry Concentration and Strategic Trade Policy in Successive Oligopoly

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Abstract We study a policy game between exporting and importing countries in vertically linked industries. In a successive international Cournot oligopoly, we analyse incentives for using tax instruments strategically to shift rents *vertically*, between exporting and importing countries, and *horizontally*, between exporting countries. We show that the equilibrium outcome depends crucially on the relative degree of competitiveness in the upstream and downstream parts of the industry. With respect to national welfare, a more competitive upstream industry may benefit an exporting (upstream) country and harm an importing (downstream) country. On the other hand, a more competitive downstream industry may harm exporting countries.

Keywords successive oligopoly · strategic trade policy · industry concentration

JEL Classifications F12 · F13 · L13

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1 Introduction

Vertical linkages play an important role in international trade, particularly in markets where firms (and ultimately consumers) rely on key intermediate inputs or raw materials that are supplied by dominant exporters in one or a few countries. Trade in natural resources serves as an obvious example. In a policy context, such cross-border vertical linkages naturally lead to a conflict of interest between exporting and importing countries. In the present paper, we develop a successive international oligopoly model,[1] where upstream oligopolist firms in two exporting countries supply a homogenous good to downstream oligopolist firms in an importing country, where the end-user market is located. In this context, we analyse the interaction between *vertical* and *horizontal* rent-shifting. In other words, how the policy makers in the exporting and importing countries may use taxes (or subsidies) strategically in order to shift rents *vertically*, up or down the vertical value-chain, and *horizontally*, between exporting countries. We distinguish the cases where only one or both of the exporting countries engage in strategic trade policy.[2]

We believe that our model structure is sufficiently generic to fit a variety of different industries. However, an interesting—and particularly fitting—example of such an industry structure is the European market for natural gas. The ongoing liberalisation of the market—through the implementation of the so-called Gas Directive[3]—means that the market structure is increasingly taking the shape of a successive oligopoly, with an oligopoly of upstream gas producers and a downstream oligopoly of gas traders.[4] Furthermore, natural gas consumption within the EU relies heavily on supply from a small number of non-EU gas producing countries (Norway, Russia and Algeria).[5]

Although international trade agreements to a certain extent may limit the availability of traditional trade policy instruments, such as export subsidies and import tariffs, there is arguably a wide range of feasible policy instruments that may be used for strategic trade purposes. For example, a country may adopt lax environmental policies—as a substitute for direct subsidies—in order to strengthen the competitive position of domestic firms vis-á-vis their foreign rivals.[6] In our model, we let the

[1] See e.g. Greenhut and Ohta (1979), Salinger (1988) and Ziss (2005) for standard models of successive Cournot oligopoly.

[2] The idea that imperfect competition in international markets may create incentives for strategic trade policy has spurred a rich body of research literature over the last couple of decades. Seminal contributions to the literature on strategic trade policy include Dixit (1984), Brander and Spencer (1985) and Eaton and Grossman (1986).

[3] The original EU Gas Directive from 1998 specified common rules for the trade, distribution, supply and storage of natural gas. In 2003, an amendment to the directive included further measures to be taken in order to liberalise the European gas market. Details can be found at http://europa.eu.int/comm/energy/gas/index_en.htm.

[4] Boots et al. (2004) model the European gas market as a successive Cournot oligopoly. However, strategic policy issues are not looked into.

[5] See e.g. Austvik (1997), Radetzki (1999) and Percebois (1999) for detailed descriptive analyses of the European natural gas market.

[6] Seminal contributions to the literature on 'strategic environmental policy' include Conrad (1993), Barrett (1994) and Kennedy (1994).

policy instrument be a tax (or subsidy) on production in the respective countries, which can be given several different interpretations.[7] In any case, the important feature of the model is that national policy makers can use tax instruments of one or another kind to affect equilibrium market prices, and thus the allocation of industry rents between the countries.[8]

One of the main purposes of our analysis is to discuss how the degree of competition in different parts of the industry is likely to affect the policy equilibrium. This has important implications for competition policy and welfare effects of market liberalisation. Given that policy makers act strategically, which country will gain or lose from increased competition in either the upstream or downstream part of the industry? For example, in the process of liberalising the European natural gas market, there is a stated desire from the European Union not only to increase downstream competition, but also to increase competition in the upstream market by trying to break up the sales monopolies of the exporting countries.[9,10] Although downstream firms may stand to lose, this should—in principle—yield a net benefit to the importing countries through increased supply and lower prices. But will this necessarily be the case if the policy makers in the importing and exporting countries engage in strategic trade policy? And how is the presence of competing exporting countries likely to affect the results? These are some of the key questions analysed in the paper.

Let us now sketch some of our main findings. The strategic aim of policy makers in the exporting countries is to commit their respective countries to the Stackelberg leader level of aggregate output. Whether the optimal policy for pursuing this aim is a tax or a subsidy on domestic production is to a large extent determined by the relative degree of upstream competition in the two exporting countries. In fact, for the special case of linear demand, we show that the nature of the optimal policy is determined only by market structure and is, furthermore, independent of foreign

[7] For example, in our model (with no domestic consumption in the exporting countries), an upstream tax on production is equivalent to an export tax, while a downstream production tax is equivalent to an import tariff levied on the domestic firms. It is also worth noting that a consumption tax would have similar qualitative effects as an import tariff.

[8] In the natural gas example, there is also another policy instrument that may be used strategically in order to extract foreign rents. A key component in the process of liberalising the European gas market is the concept of 'third-party access' (TPA) to gas pipelines and transmission networks, where all players have access to the transportation systems on equal non-discriminatory conditions. Since the exporting and importing countries control different parts of the transmission network, policy makers may have incentives to set the regulated access price strategically, thereby engaging in a regulatory competition game, in order to shift rents up or down the value-chain. In this case, the access price is a de facto tax instrument.

[9] The major gas producer Norway—a non-EU country, but subject to the common competition legislation in the European Economic Area (EEA)—reluctantly accepted to dismantle the Norwegian gas sales monopoly (GFU) after threats of legal actions by the EU Commission.

[10] Golombek et al. (1998) use a numerical model of the Western European natural gas market to analyse supply-side responses to a more liberalised downstream industry, and find that producing countries have an incentive to break up their sales monopolies. However, strategic trade policy, or any form of tax competition between countries, is not an issue.

trade policy. In general, the optimal domestic policy is a tax (subsidy) if the degree of domestic competition is high (low) relative to the foreign exporting country.

The equilibrium downstream tax rate, on the other hand, is positive if, roughly speaking, the downstream market is more competitive than the upstream market, and negative otherwise. This illustrates the conflict of interest between the countries: whereas the policy makers in the exporting countries are concerned about maximising upstream revenue net of production costs, the policy maker in the downstream country must balance concerns for rent-extraction from the upstream part of the industry (which requires a positive tax rate) and for stimulating competition in the downstream part of the industry (which requires a negative tax rate).

Perhaps our most interesting results are related to the welfare effects of increased competition in the different parts of the vertically linked industry. While the nature of the policy equilibrium, as mentioned above, is characterised for a general demand function, this part of the analysis relies on the assumption of linear demand. The following main results are derived: if only one of the exporting countries engages in strategic trade policy, increased (upstream) competition in this country will actually benefit *both* exporting countries and harm the importing country in the trade policy equilibrium. This has powerful implications for upstream competition policy. By stimulating upstream competition, and instead use a tax instrument to restrict total supply to the downstream market, rents are shifted up the value-chain, which benefits the exporting countries. A similar result was shown by Cowan (1989) in a structurally simpler model, but under more general demand assumptions.[11] In this respect, we extend Cowan's model by introducing a downstream oligopoly in the importing country and a second exporting (upstream) country, both of which influence policy incentives in non-trivial ways. We show that the result is robust to the introduction of a second exporting country, conditional on non-strategic behaviour by the policy maker in this country. However, if both upstream policy makers act strategically, and non-cooperatively, the result is reversed, although increased competition in *both* exporting countries might benefit these countries in some special cases.

Increased downstream competition, on the other hand, is shown always to benefit the importing country. However, contrary to the case of free trade, *upstream* welfare will be reduced if downstream competition increases beyond a quite concentrated level. Thus, in the context of our natural gas example, even if the major non-EU gas producers like Norway and Russia retain control over their domestic competition policies, liberalisation of the downstream European gas market may affect these exporting countries negatively.

To the best of our knowledge, ours is the only paper that studies policy competition between exporting and importing countries in successive international oligopoly. Our analysis relates closely to several strands of the international trade literature, though. The idea of using some form of domestic taxation to extract rents from foreign exporters with market power was first presented by Katrak (1977), and has

[11] In a model with oligopolist firms in a single exporting country selling directly to consumers in an importing country, and with an export tax and an import tariff as the policy instruments, the equivalent result is shown to hold if demand is not too convex.

since been elaborated on and extended in numerous papers.[12] However, a common feature in these papers is a lack of foreign policy response.[13]

Our paper also relates to a more recent body of contributions that explicitly model a vertical industry structure with trade in intermediates within a context of strategic trade policy.[14] However, these analyses focus either on final-goods competition in a third market—á la Brander and Spencer (1985)—or on domestic trade policy only, which makes them quite different from our study.[15]

Finally, the present paper makes a contribution to the literature on the interplay between competition and trade policy. Much of this research focuses on the substitutability of strategic trade and merger policies, and the question of whether trade liberalisation will induce laxer competition policies.[16] We complement this literature by analysing the interaction of different policy incentives in vertically linked industries. A novel finding is that strategic use of tax policies may increase the conflict of interest, with respect to competition policies, between exporting and importing countries.

2 Model

Consider an industry with two vertically related activities. There are a number of independent upstream producers of a homogenous good located in two exporting countries. We let m_1 and m_2 be the number of upstream firms in countries 1 and 2, respectively. The upstream firms are supplying n independent (and identical) downstream distributors in country D, where the good is consumed.[17] We want to portray a situation where downstream firms are dependent on key inputs from upstream suppliers in one or a few countries, where domestic consumption of inputs

[12] See, e.g., Brander and Spencer (1981, 1984), Bergstrom (1982), Brander and Djajic (1983), Hillman and Templeman (1985) and Lahiri and Ono (1999). Raimondos-Møller and Woodland (2000) derive similar results in a perfectly competitive context, but where the trade policy game is characterised by a sequential structure.

[13] An important exception is Brander and Spencer (1984), who include foreign policy in an analysis of optimal domestic tariff policy for extracting rents from a foreign oligopoly. However, the foreign policy instrument is taken to be the degree of 'cartelisation' only, with the implication that complete cartelisation is the optimal policy when foreign consumption of the good is negligible. However, by equipping the foreign policy maker with the power also to tax, the exact opposite conclusion is reached.

[14] See, e.g., Spencer and Jones (1991, 1992), Ziss (1997), Bernhofen (1997), Ishikawa and Lee (1997), Ishikawa and Spencer (1999), Hokari et al. (2003) and Chang and Sugeta (2004).

[15] Of the aforementioned papers, Ishikawa and Lee (1997) and Ishikawa and Spencer (1999) are perhaps the most closely related, in the sense that they consider a successive Cournot oligopoly similar to ours. However, besides the fact that these papers consider domestic trade policy only, there is a marked difference from the present paper in the types of international market structures that are analysed.

[16] In addition to the aforementioned paper by Cowan, important contributions include Auquier and Caves (1979), Dixit (1984), Richardson (1999), Horn and Levinsohn (2001), Huck and Konrad (2004).

[17] Alternatively, we can think of the upstream activity as the production of a homogenous intermediate good which is transformed into a homogenous final good by downstream firms at constant marginal costs.

in the exporting countries is typically negligible, compared with their export volumes. Thus, to simplify and keep the analysis clearly focused, we assume that there is no consumption of the good in the exporting countries.[18]

The downstream firms acquire the good from the upstream market at a per-unit wholesale price w and supply the final consumers at a per-unit retail price P. Letting q_k denote output by downstream firm k, end demand for the good (in the importing country) is given by the inverse retail demand function $P(Q)$, which is assumed to be strictly decreasing and twice differentiable, where $Q := \sum_{k=1}^{n} q_k$. The upstream firms produce the good at a constant marginal production cost c. Letting x_{ji} denote output by firm j in country i, total output supplied in the upstream industry is given by $X := \sum_{i=1}^{2} \sum_{j=1}^{m_i} x_{ji}$.

The firms compete à la Cournot at both stages of the value-chain. In line with the received literature on successive Cournot oligopoly, we assume that each downstream firm takes the wholesale price (as well as the outputs of other downstream firms) as given when committing to an output quantity. As noted by Salinger (1988) and others, this amounts to giving upstream producers a first-mover advantage.

Within this context, a role for strategic trade policy is created by letting the policy makers in both exporting and importing countries use taxes (or subsidies) strategically, in order to shift rents vertically and horizontally. The upstream and downstream per-unit tax rates on production are given by, respectively, t_i^U and t^D, $i = 1, 2$.

We consider the following three-stage game:

Stage 1: The policy makers in exporting and importing countries simultaneously and independently commit to their preferred values of upstream and downstream taxes (subsidies), respectively.

Stage 2: The upstream firms simultaneously and independently commit to the quantities supplied to the downstream market.

Stage 3: The downstream firms simultaneously and independently commit to the quantities supplied to the final consumers.

We look for a subgame perfect Nash equilibrium in pure strategies, and the game is solved by backwards induction.

2.1 Stage 3: Downstream competition

The profit function of a downstream firm k is given by

$$\pi_k^D = \left(P(Q) - w - t^D\right) q_k. \tag{1}$$

Maximising Eq. 1 with respect to q_k yields the first-order condition

$$P'(Q)\, q_k + P(Q) - w - t^D = 0. \tag{2}$$

[18] In the context of the European natural gas market, this is actually a quite accurate assumption for one of the largest gas producers, Norway, where domestic consumption of natural gas is practically non-existent.

From Eq. 2 we can derive the inverse wholesale demand function, $w\left(Q,n,t^D\right)$. Applying symmetry, i.e., $q_k = Q/n$, this function is given by

$$w\left(Q,n,t^D\right) = P'(Q)\frac{Q}{n} + P(Q) - t^D. \tag{3}$$

By differentiation of Eq. 3, the following comparative statics results are straightforwardly obtained:

$$\frac{\partial w(\cdot)}{\partial Q} = \frac{P'(Q)\left[n+1+\beta(Q)\right]}{n} < 0, \tag{4}$$

$$\frac{\partial w(\cdot)}{\partial t^D} = -1, \tag{5}$$

where

$$\beta(Q) := \frac{P''(Q)}{P'(Q)}Q \tag{6}$$

measures the degree of concavity of retail demand. In order to ensure that industry marginal revenue is downward sloping, we assume that $\beta(Q) > -2$. This condition also ensures that the second-order conditions in the retail stage subgame are satisfied.[19] It follows that the wholesale demand curve is downward sloping for any downstream market structure, i.e., $\partial w(\cdot)/\partial Q < 0$ for all n. For the subsequent analysis, the following second-order derivatives of the inverse wholesale demand function will also be useful:

$$\frac{\partial^2 w(\cdot)}{\partial Q^2} = \frac{P''(Q)\left[n+1+\beta(Q)\right] + P'(Q)\beta'(Q)}{n}, \tag{7}$$

$$\frac{\partial^2 w(\cdot)}{\partial t^D \partial Q} = 0. \tag{8}$$

2.2 Stage 2: Upstream competition

The profit function for an upstream firm j in country i is given by

$$\pi_{ji}^U = \left(w\left(Q,n,t^D\right) - c - t_i^U\right)x_{ji}, \quad j = 1,..,m_i, \quad i = 1,2, \tag{9}$$

Differentiating with respect to x_{ji} yields the following first-order condition for upstream profit maximisation:

$$\frac{\partial w(\cdot)}{\partial Q}x_{ji} + w(\cdot) - c - t_i^U = 0. \tag{10}$$

Now let the equilibrium aggregate output by country i be denoted by

$$X_i\left(n,m_1,m_2,t^D,t_1^U.t_2^U\right) := \sum_{j=i}^{m_i} x_{ji}. \tag{11}$$

[19] See also Ziss (2005).

In equilibrium, downstream demand must equal upstream supply, i.e., $Q = \sum_{i=1}^{2} X_i(\cdot)$. Applying symmetry, i.e., $x_{ji} = X_i(\cdot)/m_i$, the equilibrium outputs of the upstream countries are thus given by the solution to the following two-equation system:

$$\frac{\partial w(\cdot)}{\partial Q}\frac{X_i(\cdot)}{m_i} + w(\cdot) - c - t_i^U = 0, \quad i = 1, 2, \tag{12}$$

where

$$Q = \sum_{i=1}^{2} X_i(\cdot).$$

Now let

$$\alpha(Q, n) := \frac{\partial^2 w(\cdot)/\partial Q^2}{\partial w(\cdot)/\partial Q} Q \tag{13}$$

measure the degree of concavity of wholesale demand. We assume that $\alpha(\cdot) > -1$. This ensures that the aggregate reaction functions are downward sloping. Furthermore, let $s_i := X_i/Q$ denote the upstream market share of country i. By total differentiation of Eq. 12, we can use Cramer's Rule to derive the comparative statics effects of taxes on output in the three countries:[20]

$$\frac{\partial X_i}{\partial t_i^U} = \frac{m_i}{\partial w/\partial Q}\left(\frac{m_{-i} + 1 + s_{-i}\alpha}{m_1 + m_2 + 1 + \alpha}\right) < 0, \tag{14}$$

$$\frac{\partial X_{-i}}{\partial t_i^U} = -\frac{m_i}{\partial w/\partial Q}\left(\frac{m_{-i} + s_{-i}\alpha}{m_1 + m_2 + 1 + \alpha}\right) > 0, \tag{15}$$

$$\frac{\partial Q}{\partial t^D} = \sum_{i=1}^{2}\frac{\partial X_i}{\partial t^D} = \frac{1}{\partial w/\partial Q}\left(\frac{m_1 + m_2}{m_1 + m_2 + 1 + \alpha}\right) < 0. \tag{16}$$

Combining Eqs. 14 and 15, we also have that

$$\frac{\partial (X_i + X_{-i})}{\partial t_i^U} = \frac{1}{\partial w/\partial Q}\left(\frac{m_i}{m_1 + m_2 + 1 + \alpha}\right) < 0. \tag{17}$$

Equations 14, 15, 16 and 17 summarise the effects of upstream and downstream taxation on output and, correspondingly, wholesale and retail prices. A higher downstream tax will induce downstream firms to reduce their outputs, which causes an increase in the final price, P. However, such a tax increase also spills over into the upstream part of the industry. A downstream output contraction implies that the demand curve facing the upstream producers shifts inward, causing the equilibrium wholesale price to decrease. Similarly, higher upstream taxes leads to a reduction of upstream output, but part of such a tax increase spills over into the downstream country through a higher wholesale price, causing also the retail price to increase.

[20] We use subscript $-i$ to denote the other exporting country than i. We will also, occasionally, refer to countries i and $-i$ as the 'domestic' and 'foreign' country, respectively.

In effect, downstream taxes are partly paid by upstream firms, whereas upstream taxes are partly paid by downstream firms and consumers. Conversely, a downstream *subsidy* will partly benefit upstream firms, while an upstream subsidy partly benefits downstream firms and consumers.

Equations 14 and 15 also indicate the scope for horizontal rent-shifting between the exporting countries. By lowering the upstream tax rate t_i^U, the policy maker in country i can induce the domestic firms to act more aggressively in the Cournot game, as seen from Eq. 14. This induces a contraction of output from the foreign exporting country, as seen from Eq. 15, the result being that some industry rents are shifted from country $-i$ to country i. Thus, for an exogenous downstream tax rate, the model mirrors a 'standard' third-market model of strategic trade policy, along the lines of Brander and Spencer (1985). From Eqs. 14 and 15, we can define a measure of this horizontal rent-shifting effect as

$$g_i := \frac{\partial X_{-i}/\partial t_i^U}{\partial X_i/\partial t_i^U} = -\frac{m_{-i} + s_{-i}\alpha}{m_{-i} + 1 + s_{-i}\alpha} < 0. \tag{18}$$

Since t_i^U only shifts the aggregate reaction function in country i , g_i reflects the slope of the reaction function in country $-i$. Note also that g_i is less than one in absolute value.

2.3 Stage 1: Optimal tax policies

We make the standard assumption that national policy makers maximise national welfare, defined as the total surplus accruing to all agents situated in a given country.

2.3.1 Upstream tax policy

The policy makers in the exporting countries maximise the sum of post-tax upstream profits plus tax revenue, which is equivalent to maximising pre-tax upstream profits.[21] In country i, these are given by

$$W_i^U = \left(w\left(Q, n, t^D\right) - c\right) X_i(\cdot), \tag{19}$$

where

$$Q = \sum_{i=1}^{2} X_i(\cdot)$$

The first-order condition for optimal tax policy in country i is found by differentiating Eq. 19 with respect to t_i^U, yielding

$$\left(\frac{\partial w(\cdot)}{\partial Q} X_i(\cdot) + w(\cdot) - c\right) \frac{\partial X_i(\cdot)}{\partial t_i^U} + \frac{\partial w(\cdot)}{\partial Q} \frac{\partial X_{-i}(\cdot)}{\partial t_i^U} X_i(\cdot) = 0. \tag{20}$$

[21] Since we allow for negative tax rates, this definition of welfare relies on an implicit assumption that the policy makers are able to raise funds for subsidy payments in a non-distortionary manner.

Using the definition of g_i from Eq. 18, we can rewrite Eq. 20 as

$$w(\cdot) + X_i w_Q (1 + g_i) - c = 0 \tag{21}$$

We can then substitute for $w(\cdot)$ from Eq. 3, and let $X_i = m_i x_{ji}$, to get

$$t_i^U = \underset{(+)}{\left(-\frac{\partial w}{\partial Q}\right)} \underset{(+)}{x_{ji}} \underset{(0/+)}{[(m_i - 1)} + \underset{(+)(-)}{m_i g_i}]. \tag{22}$$

Equations 21 and 22 provide a neat illustration of the policy incentives dictating the optimal upstream tax policy.[22] Since the policy makers in the exporting countries maximise pre-tax upstream profits, the strategic aim of the policy maker in country i is to commit its country to the Stackelberg leader level of aggregate output, as can deduced from Eq. 21. In principle, since aggregate output in country i is monotonically increasing in m_i, this can be accomplished by an appropriate degree of intra-country competition, without using the tax instrument. However, when the domestic market structure (m_i) is not a policy variable, the policy maker can correct a suboptimal market structure by using the tax instrument. The nature of the optimal policy—whether a subsidy or a tax is used—depends then on the degree of industry concentration in the domestic country. In the extreme case of no intra-country competition ($m_i = 1$), the domestic monopoly firm has no incentive, absent taxation, to commit to the Stackelberg level of output. Consequently, the government must offer a subsidy ($t_i^U < 0$) to increase the level of output. This is reflected by the first term in the square brackets of Eq. 22 being zero, leaving the expression unambiguously negative.

However, we see (when applying Eq. 18) that the expression in the square brackets of Eq. 22 is increasing in m_i and there is a cut-off value of m_i where the expression turns positive. In other words, if domestic industry concentration is low (m_i is high), aggregate output may exceed the Stackelberg level. In this case, the policy maker can correct for the excessive degree of intra-country competition by taxing production in order to move aggregate output down towards the desired Stackelberg level.[23] With respect to Eq. 22, this corresponds to a situation where, in the square brackets, the first term is larger (in absolute value) than the second.

More exact results regarding the effect of market structure on upstream taxation can be obtained by substituting for g_i from Eq. 18 into Eq. 22, yielding

$$t_i^U = \underset{(+)}{\left(-\frac{\partial w}{\partial Q}\right)} \underset{(+)}{\left(\frac{x_{ji}}{m_{-i} + 1 + s_{-i}\alpha}\right)} \left[m_i - (m_{-i} + 1 + s_{-i}\alpha)\right]. \tag{23}$$

The sign of the optimal tax rate is given by the sign of the expression in the square brackets. Thus, from Eq. 23 we can summarise the above discussion by stating

[22] We are indebted to an anonymous referee for suggesting this line of reasoning.

[23] This is also related to the so-called terms-of-trade motive for taxation as discussed by, e.g., Dixit (1984) and Eaton and Grossman (1986).

the following results regarding the relationship between market structure and the upstream tax policy:

Proposition 1 *Given that $m_{-i} \geq 1$, the optimal upstream tax rate in country i is*

(a) *Negative if the degree of competition in country i is sufficiently low,*
(b) *Positive if the degree of competition in country i is sufficiently high, relative to the degree of competition in country −i.*

In addition to the above discussion, Proposition 1 also highlights the role of the relative degree of industry concentration in the two exporting countries as a determinant of the sign of the optimal tax rate. Increased competition in the foreign country will reduce the market share of domestic firms, thus increasing the likelihood of a subsidy being the optimal domestic policy.

2.3.2 Downstream tax policy

The policy maker in the importing country maximises the sum of consumers' and producers' surplus, plus tax revenues. This is equivalent to the area underneath the retail demand curve minus the costs of buying the consumed quantity of the good at wholesale prices, and is thus given by

$$W^D = \int_0^{Q(t^D)} P(Q)\, dQ - w\left(Q\left(t^D\right), t^D\right) Q\left(t^D\right), \tag{24}$$

where

$$Q\left(t^D\right) = \sum_{i=1}^{2} X_i(\cdot).$$

The first-order condition for the optimal downstream tax rate is found by differentiating Eq. 24 with respect to t^D, yielding

$$\left[P\left(Q\left(t^D\right)\right) - w(\cdot)\right] \frac{\partial Q}{\partial t^D} - Q\left[\frac{\partial w}{\partial Q}\frac{\partial Q}{\partial t^D} + \frac{\partial w}{\partial t^D}\right] = 0. \tag{25}$$

We can substitute out for $P(\cdot) - w(\cdot)$ in Eq. 25 by using Eq. 2, and rearrange, to get

$$t^D = Q\left[\frac{\overbrace{(\partial w/\partial Q)\left(\partial Q/\partial t^D\right) + \left(\partial w/\partial t^D\right)}^{(-)}}{\underset{(-)}{\partial Q/\partial t^D}}\right] + \underset{(+)}{q_k} \underset{(-)}{P'(Q)}. \tag{26}$$

Equation 26 illustrates the different policy incentives dictating the optimal downstream tax policy. Two different considerations must be balanced. On the one hand, the policy maker can extract some upstream rents by imposing a positive downstream tax rate: an increase in t^D will lower demand for the good and subsequently cause a reduction in the wholesale price. This policy incentive is reflected by the first term on

the right-hand side of Eq. 26, which is positive.[24] On the other hand, considerations for product market efficiency dictate that the policy maker should use a subsidy to stimulate downstream competition, thereby increasing consumers' surplus. This policy incentive is reflected by the second term on the right-hand side of Eq. 26, which is negative.

In order to say something more about the relative magnitudes of these two offsetting effects, we can substitute from Eqs. 4, 5 and 16, and apply symmetry by letting $Q = nq_k$, to get

$$t^D = -\frac{\overset{(+)}{q_k}\overset{(-)}{P'(Q)}}{\underset{(+)}{m_1 + m_2}} \left[(1+\alpha)(n+1+\beta) - (m_1+m_2)\right]. \tag{27}$$

The sign of the optimal tax rate is given by the sign of the expression in the square brackets in Eq. 27. We can thus summarise the relationship between market structure and the optimal downstream policy as follows:

Proposition 2 *The optimal downstream tax rate is positive (negative) if the degree of competition in the downstream part of the industry is sufficiently high (low), relative to the degree of upstream competition.*

The intuition is relatively straightforward. The incentive to extract upstream rents depends on the ability of the downstream policy maker to affect the wholesale price, which, in turn, requires a certain degree of upstream market power. Increased competition in the upstream part of the industry makes the wholesale price less sensitive to changes in the downstream tax rate, which weakens the rent-extraction motive for downstream tax policy.[25] The incentive for stimulating an efficient supply of the good in the downstream market, on the other hand, is determined by the degree of *downstream* competition. The lower the number of firms operating in the downstream market, the stronger the incentives to reduce taxes (or increase subsidies) in order to stimulate competition. Thus, the optimal balancing of the two policy incentives depends on the relative number of upstream and downstream firms.

2.4 Linear demand

For the remainder of the analysis, we will consider the special case of linear demand, which enables us to derive more results regarding the relationship between industry concentration, optimal tax policies and welfare. Before deriving the explicit

[24] Using Eqs. 4, 5 and 16, and remembering that $\alpha > -1$, it is straightforward to show that the numerator in the square brackets in Eq. 26 is negative, making the sign of the first term in Eq. 26 positive.

[25] It is straightforward to show that

$$\frac{dw}{dt^D} = \frac{\partial w}{\partial Q}\frac{\partial Q}{\partial t^D} + \frac{\partial w}{\partial t^D} = \frac{-(1+\alpha)}{m_1 + m_2 + 1 + \alpha},$$

implying that the effect of a downstream tax change on the wholesale price is stronger when upstream competition is weaker.

expressions for the equilibrium outcome, let us first pursue an interesting implication of the linear demand assumption for the nature of the optimal trade policies. Setting $\alpha = \beta = 0$ in Eqs. 23 and 27, we obtain the following result:

Proposition 3 *With linear demand, the sign of the optimal trade policy in either of the countries depends only on market structure and is independent of foreign trade policy.*

From Eqs. 23 and 27 we clearly see that, with linear demand, the sign of the optimal tax rate—upstream or downstream—depends only on the market structure parameters n, m_1 and m_2, and not on any level of output. This implies that the decision of whether to tax or subsidise domestic production is independent of whether or not foreign countries engage in strategic trade policy.[26] Foreign trade policy will affect the *magnitude* of the domestic policy—whether production should be taxed (subsidised) with a 'high' or 'low' rate—but not the *sign* of the optimal policy (i.e., whether production should be taxed or subsidised).[27]

Let us now derive the explicit expressions for the equilibrium outcome under the linear demand assumption. We will distinguish between two different cases, where either one or both of the exporting countries engage in strategic trade policy. This distinction has not played any role for the results derived in the above analysis, but, as we will see, it plays an important role in the analysis of the next section, where we discuss the relationship between industry concentration and welfare.

Assume that the inverse demand function is given by $P(Q) = a - Q$. This implies, of course, that $\beta(Q) = \alpha(Q) = 0$, and explicit expression for output and prices in the Cournot–Nash equilibrium are then easily derived. Equilibrium outputs of upstream firms are given by

$$x_{ji} = \frac{n\left[a - c - t^D - t_i^U + m_{-i}\left(t_{-i}^U - t_i^U\right)\right]}{(m_1 + m_2 + 1)(n+1)}, \tag{28}$$

yielding an equilibrium total supply of

$$\sum_{i=1}^{2} X_i = Q = \frac{n\left[(m_1 + m_2)\left(a - c - t^D\right) - m_1 t_1^U - m_2 t_2^U\right]}{(m_1 + m_2 + 1)(n+1)}, \tag{29}$$

with corresponding wholesale and retail equilibrium prices given by

$$w = \frac{a - t^D + (m_1 + m_2)c + m_1 t_1^U + m_2 t_2^U}{(m_1 + m_2 + 1)} \tag{30}$$

and

$$P = \frac{(n+1)a + (m_1 + m_2)\left[a + n\left(c + t^D\right)\right] + n\left(m_1 t_1^U + m_2 t_2^U\right)}{(m_1 + m_2 + 1)(n+1)}. \tag{31}$$

Here we see more clearly that the structural richness of the model allows for different standard assumptions to appear as special cases. For example, $m_i \to \infty$

[26] An implicit assumption needed is that foreign trade policy does not affect market structure.

[27] From Eq. 27 we also see that, if demand is non-linear but with constant concavity (i.e., $\beta(Q) = \beta$, which implies $\alpha(Q) = \alpha$), the sign of the optimal *downstream* policy is unaffected by foreign trade policy. However, as can be seen from Eq. 23, this does not hold for the optimal upstream policy.

implies that downstream firms source their inputs from a perfectly competitive upstream market in country i. In this case, the wholesale price is simply given by $w = c + t_i^U$. On the other hand, $n \to \infty$ implies that $P = w + t^D$. In this case, our model is equivalent to a standard trade model with foreign exporters selling directly to consumers in the importing country, where t^D corresponds to an import tariff.

Explicit expressions for the optimal trade policies in the two different versions of the policy game are given below. For simplicity, we set $t_{-i}^U = 0$ in the case where the foreign exporting country does not engage in strategic trade policy.

Case 1 Non-strategic behaviour by the policy maker in country -i:

$$t_i^U = \frac{(m_1 + m_2)(m_i - m_{-i} - 1)(n+1)(a-c)}{m_i\left(m_i + n + 3m_{-i} + 2m_i n + 4m_{-i} n + 2m_i m_{-i} n + 2m_{-i}^2 n + 1\right)}, \quad (32)$$

$$t^D = \frac{(2m_{-i} + 1)[n + 1 - (m_1 + m_2)](a-c)}{m_i + n + 3m_{-i} + 2m_i n + 4m_{-i} n + 2m_i m_{-i} n + 2m_{-i}^2 n + 1}. \quad (33)$$

Case 2 Strategic behaviour by all policy makers:

$$t_i^U = \frac{(m_1 + m_2)(m_i - m_{-i} - 1)(n+1)(a-c)}{m_i\left(2(n+1) + (m_1 + m_2)[2(2n+1) + (m_1 + m_2)n]\right)}, \quad (34)$$

$$t^D = \frac{(m_1 + m_2 + 2)[1 + n - (m_1 + m_2)](a-c)}{2(n+1) + (m_1 + m_2)[2(2n+1) + (m_1 + m_2)n]}. \quad (35)$$

2.4.1 Comparative statics results

From Eqs. 32, 33, 34 and 35 we can derive the following comparative statics results regarding the effect of market structure on the *magnitude* of optimal trade policy:

Proposition 4

1. *In both Case 1 and Case 2,*
   (a) $\partial t^D / \partial n > 0$,
   (b) $\partial t_i^U / \partial n < (>) 0$ if $m_i > (<) m_{-i} + 1$,
   (c) $\partial t_i^U / \partial m_{-i} < 0$,
   (d) $\partial t^D / \partial m_i < 0$.
2. *In Case 1,* $\partial t_i^U / \partial m_i > 0$, *while in Case 2,* $\partial t_i^U / \partial m_i > (<) 0$ *if* $m_i < (>) \overline{m}$, *where* $\overline{m} > m_{-i} + 1$.

We see that the comparative statics results are, in qualitative terms, mostly unaffected by whether one or both of the exporting countries engage in strategic trade policy, and the intuition for the results follow quite straightforwardly from the discussion of the different policy incentives in the more general analysis above.

Consider first an increase in downstream competition. This leads, unsurprisingly, to an increase in downstream taxes, due to the reduced need to keep taxes low in order to stimulate downstream competition. However, the effect on the upstream tax rate in the domestic country is ambiguous. In fact, t_i^U will increase if $m_i < m_{-i} + 1$, which implies that the equilibrium upstream tax rate is negative. This is

a strategic response to changes in the downstream tax rate. When $t_i^U < 0$, export market rivalry is the dominant force in determining domestic upstream tax policy. An increase in downstream competition implies an increase of the downstream tax rate, which reduces the wholesale price, and thereby the profitability of supplying the export market. This reduces the incentives for using upstream subsidies to capture downstream market shares, and the optimal upstream subsidy in country i is correspondingly reduced.

Now consider an increase in upstream competition. Increased *domestic* competition (i.e., an increase in m_i) has potentially different effects on the optimal policy in country i, depending on whether or not country $-i$ engages in strategic trade policy. In Case 1, where the government in country $-i$ does not act strategically, an increase in m_i will always lead to an increase in t_i^U. The reason is that increased competition in country i leads to an aggregate output expansion in this country, which the policy maker wants to counteract by increasing the upstream tax rate, bringing aggregate output back towards the Stackelberg leader level of output. In Case 2, though, where all policy makers act strategically, increased domestic competition leads to a reduction in the optimal tax rate, t_i^U, if the degree of competition is sufficiently high to begin with. This is due to the strategic policy response from country $-i$. Starting from a monopoly situation in country i (i.e., $m_i = 1$), increased competition will induce the policy maker in this country to increase taxes, as before. However, increased competition in country i also triggers a tax reduction (or increased subsidy) from the competing exporting country, which implies a loss of market share for country i. If m_i gets sufficiently large, the policy maker in country i is eventually forced to reduce taxes in order to prevent the domestic firms being outcompeted by foreign suppliers. The effect of increased domestic competition on *downstream* taxes, however, is qualitatively similar in all cases. As previously explained, an increase in m_i reduces the effectiveness of using downstream taxes to shift rents down the value chain; consequently, the downstream tax rate will decrease in equilibrium.

Finally, increased *foreign* competition to serve the export market (i.e., an increase in m_{-i}) will always provoke a tax reduction from the domestic upstream country. The reduction in the market share of domestic firms, resulting from stronger foreign competition, are counteracted by a lower domestic tax rate, bringing the aggregate output back up towards the Stackelberg level.

3 Industry concentration and national welfare

How does increased competition in the upstream or downstream part of the industry affect national welfare when national policy makers act strategically? Before looking more closely into this question, let us first consider the laissez-faire (LF) policy as a benchmark case. In order to facilitate the analysis, we retain the assumption of linear demand.

With $t_i^U = t^D = 0$, equilibrium expressions for national welfare are given by

$$W_i^U(LF) = \frac{(m_1 + m_2)\, n\, (a-c)^2}{(m_1 + m_2 + 1)^2\, (n+1)} \tag{36}$$

and

$$W^D(LF) = \frac{(m_1+m_2)^2\, n\,(n+2)\,(a-c)^2}{2\,(m_1+m_2+1)^2\,(n+1)^2}, \tag{37}$$

from which it follows that

$$\frac{\partial W_i^U(LF)}{\partial m_i} < 0, \quad \frac{\partial W^D(LF)}{\partial m_i} > 0, \quad \frac{\partial W_i^U(LF)}{\partial n} > 0, \quad \frac{\partial W^D(LF)}{\partial n} > 0.$$

Increased *upstream* competition reduces upstream profits and benefits downstream firms (through a lower wholesale price) and consumers (through a lower retail price). Increased *downstream* competition, on the other hand, benefits both countries, in terms of national welfare. Upstream firms benefit due to increased demand from the downstream market. Downstream profits suffer, but this is outweighed by an increase in consumers' surplus.

These effects change, though, if national policy makers use tax instruments strategically. As in the previous section, we will consider both the cases of strategic and non-strategic behaviour by the foreign upstream policy maker.

3.1 Case 1: Non-strategic behaviour by policy maker in country $-i$

Using Eqs. 32 and 33, equilibrium expressions for social welfare in the exporting and importing countries are given by

$$W_i^U = \frac{(m_1+m_2)^2\,(m_{-i}+1)\,(n+1)\,n\,(a-c)^2}{\left(m_i+n+3m_{-i}+2m_in+4m_{-i}n+2m_im_{-i}n+2m_{-i}^2n+1\right)^2}, \tag{38}$$

$$W_{-i}^U = \frac{(m_1+m_2)^2\,m_{-i}\,(n+1)\,n\,(a-c)^2}{\left(m_i+n+3m_{-i}+2m_in+4m_{-i}n+2m_im_{-i}n+2m_{-i}^2n+1\right)^2}, \tag{39}$$

$$W^D = \frac{(m_1+m_2)\,(2m_{-i}+1)^2\,[2\,(n+1)+(m_1+m_2)\,n]\,n\,(a-c)^2}{2\left(m_i+n+3m_{-i}+2m_in+4m_{-i}n+2m_im_{-i}n+2m_{-i}^2n+1\right)^2}. \tag{40}$$

From Eqs. 38, 39 and 40 we derive the welfare effects of increased competition:

Proposition 5 *With non-strategic behaviour by the policy maker in country $-i$,*

(a) $\partial W_i^U/\partial m_i > 0$,
(b) $\partial W_{-i}^U/\partial m_i > 0$,
(c) $\partial W^D/\partial m_i < 0$,
(d) $\partial W_i^U/\partial n > 0$ *if* $m_{-i} = 0$ *or* $n < \overline{n}$,
$\partial W_i^U/\partial n < 0$ *if* $m_{-i} > 0$ *and* $n > \overline{n}$, *where*

$$\overline{n} := \frac{m_i+3m_{-i}+1}{2m_{-i}\,(m_1+m_2-1)-1}$$

(e) $\partial W^D/\partial n > 0$.

The introduction of strategic trade policy leads to a surprising result with respect to industry concentration in the upstream part of the industry. Contrary to the benchmark case, increased upstream competition in the domestic country actually benefits the domestic country (and the competing foreign country), while harming the downstream country, in terms of social welfare. If we decompose the effect of an increase in m_i, we find that domestic upstream firms lose, while downstream firms and consumers benefit, as in the benchmark case. What happens, though, is that *tax revenues are shifted upstream*.

The intuition is related to the optimal tax responses to an increase in upstream competition. For clarity of discussion, consider first the special case of $m_{-i} = 0$, which corresponds to either a single exporting country or international coordination of tax policies across exporting countries.[28] From Proposition 4 we know that an increase in the number of upstream suppliers leads to increased upstream taxes, while downstream taxes are reduced. As previously argued, stronger upstream competition reduces the rent-extraction incentive for the downstream policy maker, leading to a lower downstream tax rate. Although total output increases, the possibility of shifting rents downstream is reduced, and downstream welfare drops as a consequence. Upstream welfare increases for the same reason. Increased upstream competition means that less rents are shifted downwards in the value-chain, while the domestic upstream policy maker optimally increases the tax rate to correct for the negative competition externality.

Perhaps surprisingly, these results are not qualitatively affected by the presence of foreign upstream competition (i.e., $m_{-i} > 0$), which, all else equal, puts a downward pressure on upstream taxes. If $m_{-i} > 0$, a higher upstream tax rate in the domestic country implies a loss of market shares to foreign firms. Thus, increased competition in country i clearly benefits country $-i$, as can be verified from Eq. 39. Even so, this horizontal rent-shifting from the domestic to the foreign upstream country is not outweighed by the vertical rent-shifting from the importing country, implying that both exporting countries benefit from increased upstream competition.

This result is in sharp contrast to the notion that complete cartelisation is always beneficiary for an exporting country with no domestic consumption of the good.[29] The reason is simply that cartelisation has two opposing effects on upstream welfare. On the one hand, it reduces (or eliminates) the negative competition externality, which is the intended effect. On the other hand, though, it increases the amount of rents available for extraction by downstream policy makers. To the extent that m_i is a choice variable for the domestic upstream policy maker, it is better to increase m_i—thereby reducing the scope for rent-extraction—and instead use the tax instrument indirectly to regulate the upstream oligopoly. An increase in m_i is optimally accompanied by an increase in t_i^U, which triggers a reduction in t^D. We can think of this as the domestic, rather than a foreign, policy maker taxing away the domestic rents.

What about the welfare effects of increased *downstream* competition? As in the laissez-faire benchmark, increased downstream competition benefits the importing country. However, in contrast to the benchmark, the domestic exporting country

[28] As mentioned in the Introduction, Cowan (1989) considers a tax policy game in a model that is equivalent to $m_{-i} = 0$ and $n \to \infty$ in our model.

[29] See, e.g., Brander and Spencer (1984).

might suffer. From part (d) of Proposition 5, we see that this is the case if there is foreign upstream competition ($m_{-i} > 0$) and the number of downstream firms is above a critical level $\overline{n} \leq 5$.[30] This is due to the policy response of the importing country.[31] Higher downstream competition has two opposing effects on upstream welfare: it increases demand from the downstream market, which benefits upstream firms, but it also induces a downstream tax increase, which has the opposite effect. The total effect on upstream welfare depends thus on the relative strength of these two effects. If the domestic exporting country is the single supplier of the good to the downstream market, the first effect always dominates. However, competition from a second exporting country puts a downward pressure on upstream taxes, which increases upstream rents and thus the incentive for rent-extracting taxation in the importing country. Consequently, the downstream tax response to increased competition in the downstream market is *stronger* when the good is supplied from two exporting countries. If n gets sufficiently large, this is enough to make the overall effect on upstream welfare negative.

3.2 Case 2: Strategic behaviour by all policy makers

To what extent is the relationship between national welfare and industry concentration dependent on a (lack of) policy response from the foreign exporting country? If the policy makers in both exporting countries act strategically, explicit expressions for social welfare in the policy equilibrium are given by

$$W_i^U = \frac{(m_1 + m_2)^2 (m_{-i} + 1) (n + 1) n (a - c)^2}{(2 (n + 1) + (m_1 + m_2) [2 (2n + 1) + (m_1 + m_2) n])^2}, \tag{41}$$

$$W^D = \frac{(m_1 + m_2 + 2)^2 (m_1 + m_2) [2 (n + 1) + (m_1 + m_2) n] n (a - c)^2}{2 (2 (n + 1) + (m_1 + m_2) [2 (2n + 1) + (m_1 + m_2) n])^2}. \tag{42}$$

The relationship between industry concentration and welfare in the different parts of the vertical industry is outlined in the final proposition of the paper:

Proposition 6 *With strategic behaviour by all policy makers,*

(a) $\partial W_i^U / \partial m_i < 0$,
(b) $\partial W_i^U / \partial m_{-i} > (<) 0$ *if* $m_{-i} < (>) \widehat{m}$, *where* $\widehat{m} > m_i$.
(c) $\partial W^D / \partial m_i > 0$,
(d) $\partial W_i^U / \partial n > (<) 0$ *if* $n < (>) \widehat{n}$, *where*

$$\widehat{n} := \frac{2 (m_1 + m_2 + 1)}{(m_1 + m_2)^2 - 2}.$$

(e) $\partial W^D / \partial n > 0$.

[30] Since $\overline{n}$ is monotonically decreasing in m_1 and m_2, it follows that $\overline{n} \leq 5$ for all permissible values of m_1 and m_2.

[31] It can easily be shown that, with non-strategic behaviour by the downstream policy maker, increased downstream competition will always benefit the exporting countries.

From part (a) of the proposition we see that the previous relationship between competition and welfare in the upstream market is now reversed. This is due to the policy competition between the exporting countries. When the policy makers in both exporting countries act strategically, increased upstream competition in country i triggers a tax reduction in the competing upstream country (cf. Proposition 4), with a subsequent reduction in export market shares, and thus welfare, in country i.

However, increased competition in one exporting country might increase welfare in the *other* exporting country, as part (b) of Proposition 6 suggests.[32] This raises the question of whether the previously derived positive relationship between upstream competition and welfare might be restored—even in the case of policy competition between rivaling exporting countries—if we consider a *simultaneous liberalisation of both upstream markets*. From Eq. 41, we derive

$$\frac{\partial W_i^U}{\partial m_i} + \frac{\partial W_i^U}{\partial m_{-i}} = \frac{\Phi_i \left(m_1 + m_2\right) (n+1)\, n \left(a-c\right)^2}{\left(2\left(n+1\right) + \left(m_1 + m_2\right)\left[2\left(2n+1\right) + n\left(m_1 + m_2\right)\right]\right)^3},$$

where

$$\Phi_i = 2\left(4 + m_i + 5m_{-i}\right)(n+1) + \left(m_1 + m_2\right)^2\left[2 + n\left(m_i - 3m_{-i}\right)\right].$$

An exporting country will lose from increased competition in its own country, but gain from increased competition in the rivaling upstream country. The net gain is determined by the sign of Φ_i, which is ambiguous. In general, we see that country i will always benefit from increased competition in both upstream markets if m_i is, and remains, sufficiently larger than m_{-i}, which suggests that only one country—if any at all—will stand to gain. This is also generally the case, although numerical simulations suggest that both countries might benefit if the degree of concentration is, and remains, at a very high level.[33]

Finally, we can observe—from part (d) of Proposition 6—that the potential for exporting countries being adversely affected by a more competitive downstream market is reinforced, compared with the analysis in the previous sub-section. Now, increased downstream competition will hurt exporting countries if the number of downstream firms is larger than $\widehat{n} \leq 3$. Strategic trade policy by both exporting countries puts an additional downward pressure on upstream taxes, which reinforces the incentive for rent-extracting taxation in the importing country, implying that the downstream tax response to increased downstream competition is even stronger than in the previous case. This consequently increases the likelihood that a more competitive downstream market will hurt the exporting countries.

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[32] From Eq. 41 we have that

$$\frac{\partial W_i^U}{\partial m_{-i}} = \frac{\left(a-c\right)^2 (n+1)\, n \left(m_1 + m_2\right)\left[\Psi_i + n\left(m_i - m_{-i}\right)\left(m_1 + m_2\right)^2\right]}{\left(2\left(n+1\right) + \left(m_1 + m_2\right)\left(2\left(2n+1\right) + n\left(m_1 + m_2\right)\right)\right)^3},$$

where

$$\Psi_i := 2\left(2 + m_i + 3m_{-i} + \left(m_1 + m_2\right)^2\right)(n+1) > 0.$$

We see that $m_i \geq m_{-i}$ is a sufficient (but not necessary) condition for $\partial W_i^U / \partial m_{-i} > 0$.

[33] For the special case of $m_1 = m_2$, numerical simulations seem to confirm that going from one to two firms in each exporting country increases welfare in both, whereas an increase from two to three is only beneficial if there is a downstream monopoly ($n = 1$). An increase in the number of firms beyond three in each country is not beneficial for any of the exporting countries.

Table 1 Welfare effects of increased competition.

	$m_i \uparrow$			$n \uparrow$		
	LF	Case 1	Case 2	LF	Case 1	Case 2
W_i^U	$\div$	$+$	$\div$	$+$	$+/\div$	$+/\div$
W^D	$+$	$\div$	$+$	$+$	$+$	$+$

A summary of some of the most important results from this section is given in Table 1 above.

4 Concluding remarks

We have presented a comprehensive analysis of tax policy competition between exporting and importing countries in vertically linked industries, using a model of successive international Cournot oligopoly, with a particular emphasis on how the degree of concentration in the different parts of the industry affects the distribution of rents among the countries. Here we will not recapitulate all results of the paper, but rather provide some final thoughts and elaborations on a couple of our main findings regarding the welfare effects of increased competition in the industry.

Elaborating on and extending a similar result in the previous literature, we have shown that a more competitive upstream market can benefit an exporting (upstream) country, while hurting the importing (downstream) country. In our model, this result holds even in the case of supply from a second exporting country, provided that the policy maker in this country acts non-strategically. When both upstream policy makers engage in strategic trade policy, though, the result is generally reversed, although increased competition in *both* upstream countries *might* benefit both exporting countries in a few special cases. If the exporting countries were able perfectly to *collude* on their tax policies, though, we would effectually be back in the equilibrium where only one exporting country acts strategically. This has some interesting implications with respect to, for example, the optimal strategy of an international cartel like OPEC. To the extent that a tax response from importing countries can be spurred, it might be more important (i.e., profitable) for the OPEC countries to coordinate their *tax policies*, rather than their export volumes.

We also find that a more competitive downstream industry may in fact hurt exporting countries when policy makers act strategically. In our particular model, in the case of strategic behaviour by all involved countries, this will be always happen whenever the number of domestic firms exceeds three. This result suggests that the use of strategic trade policy is likely to increase the conflict of interest, with respect to competition policies, between exporting and importing countries. In the case referred to above, the conflict of interest is close to complete: the importing country would like to stimulate competition in all parts of the industry, whereas the exporting countries have generally the exact opposite interests.

It should be emphasized that our results in the welfare section depends crucially on the assumption that the downstream policy maker engages in strategic trade policy. If this is not the case, it can be shown that, in the case of $m_{-i} = 0$, increased upstream competition in country i has no effect on welfare either upstream or downstream.

The reason is simply that, with no foreign policy response, m_i and t_i^U are perfect policy substitutes for the upstream policy maker. An increase in m_i can therefore be perfectly compensated by an increase in t_i^U, leaving equilibrium output unaffected. However, in the case of $m_{-i} > 0$, an increase in m_i can be shown to harm the domestic upstream country while benefitting both other countries. The reason is that more competition in country i will provoke a tax reduction in the other exporting country, leading to lower output in country i, but higher aggregate output in the whole industry.

Finally, we should also emphasize that, in order to increase the richness of our analysis, relative to the received literature, generality of functional forms has to a certain extent—particularly in the welfare section—been sacrificed to the benefit of higher structural generality. Thus, we cannot claim a high degree of generality for all of our results. We do, however, believe that the main mechanisms at work apply to a wider class of demand and cost functions than the linear specifications. Besides, in the cases where opposing forces produce ambiguous results, these will obviously persist under more general demand and cost assumptions.

Acknowledgements Financial support from the Norwegian Research Council, through the PETROPOL research programme, is gratefully acknowledged. The paper has been greatly improved by the suggestions of two anonymous referees. We also thank Hisashi Hokari and Frode Meland for valuable comments and suggestions.

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