Benefits and costs of impeding free trade: Revisiting British Columbia's restrictions on log exports

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Gerrit Cornelis van Kooten
University of Victoria
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Benefits and costs of impeding free trade: Revisiting British Columbia's restrictions on log exports

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G. Cornelis van Kooten *

University of Victoria, Canada

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ABSTRACT

The government of British Columbia (BC) imposes restrictions on the export of logs from public and private forestlands, primarily to promote local processing and associated employment benefits. Most economists wholeheartedly oppose BC's export restrictions, arguing that BC's citizens are worse off as a result of the government's measures. In this paper, it is shown that, while free trade in logs might well maximise global wellbeing, it might not necessarily result in the greatest benefit to BC. Indeed, both economic theory and a follow-up numerical analysis indicate that some restrictions on the export of logs can lead to higher welfare for BC than free trade. Thus, log export restrictions could be economically efficient from a local perspective, but only if the transaction costs of obtaining necessary permits are not excessive.

Introduction

Regardless of their political stripe (socialist or free market), governments in many jurisdictions attempt to manage or regulate their forest resources to achieve the greatest possible employment. This has resulted in log export restrictions in countries as diverse as the United States, Russia and Canada, which are often viewed as inefficient. In this paper, we examine the case of British Columbia

(BC), Canada, as economists have generally argued that BC needs to allow free trade in logs, because this would provide large economic benefits to the province (e.g., Fooks et al., 2013). This is true if there are no log exports to begin with, but, given that BC permits some log exports, the case for free trade needs to be made vis-à-vis what exists in the world and not the autarky (no-trade situation) that is assumed. The purpose here is to examine this issue using applied welfare economic analysis. In particular, we answer the question of whether BC should change its policy regarding limited log exports. We begin in the next section by providing a background to log export restrictions in various jurisdictions. Next we develop a theoretical framework for analysing the policy. This is followed by an empirical investigation of the BC policy, and a concluding discussion.

Background

In the United States, Oregon imposed a ban on the export of logs from state owned lands in 1961 in an effort to protect local manufacturing jobs; California followed suit in 1972. Then in 1973 the U.S. Congress prohibited the export of any logs harvested on federal lands west of the 100th Meridian, followed in 1990 by a ban on log exports from Washington's state-owned lands and harvest reductions on all forestlands in the Pacific Northwest (PNW) to protect the Spotted Owl as permitted under the U.S.'s Endangered Species Act of 1973. Log exports from the PNW soared from about 1.0 million m^3 in the early 1960s to 8.7 million m^3, or 24% of the total harvest, by 1988, before falling back down to just over 1.0 million m^3 by the early 2000s (Daniels, 2005). In 2010, 2.6 million m^3 of logs were exported, but this still constituted 19% of the total harvest (Kerr, 2012). Of course, the exported logs came from private lands as exports from federal lands are prohibited.

In Russia, investments in sawmilling and other processing capacity has historically lagged resource availability; by 2001, only two regions processed more than 25% of harvested logs while the other five regions utilised less than 10% (see Simeone and Eastin, 2012). This led the government to incentivize investment in processing capacity by restricting log exports. An ad valorem export tax of 6.5% was imposed beginning January 1, 2007; the tax was increased to 20% on July 1, 2007 and then to 25% on April 1, 2008; and it was set to increase to 80% on January 1, 2009, but this was delayed indefinitely as a result of the financial crisis and pressure from the Nordic countries. The trade measures reduced roundwood log exports from 51.1 million m^3 in 2006 to 25.8 million m^3 in 2012, although some of this decline could be attributed to the global recession (UNFAO, 2013; also see Fig. 3 below). On August 22, 2012, Russia officially joined the World Trade Organization (WTO) and, as part of its accession package, it agreed to reduce tariffs on log exports to 8% by 2015. However, since Russia was permitted to establish a volume tariff rate quota (TRQ), the 8% rate only applied to log exports below the quota. For exports above the quota, an export tax of 80% could be applied.[1]

British Columbia has likewise restricted log exports from provincial forestlands, including private lands that account for only about 4% of the province's commercial forestland (Wilson et al., 1998, p. 13).[2] A total ban on log exports from Crown (publicly owned) land was put in place as early as 1891, but legislation to allow exemptions already came a decade later (1901). The Timber Manufacture Act (1906) extended the ban on log exports from Crown land to private lands that had previously been granted to the private owner by the provincial (as opposed to federal) government; this was followed in December 1907 by Order-in-Council #901 that put a halt to the further transfer of Crown land to private ownership.[3] An amendment to the Timber Manufacture Act in 1909, however, provided a means for obtaining exemptions to the log export ban. Since then, enforcement of the export ban has

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[1] It should be noted that many major timber producing regions such as U.S. South, Nordic countries, and New Zealand (where native forests only produce less than 1% of timber) do not have log export restrictions.

[2] It is important to note that private forestlands are often managed as part of an integrated Tree Farm License that consists primarily of publicly own timberlands (see Wang et al., 2014). This then provides some justification for government control over log exports from private forests.

[3] The federal government had granted land to the Canadian Pacific Railroad (CPR) for constructing a transcontinental railway; National Parks are also federal. Private forestlands were thus purchased from or granted by the province, or purchased from CPR. An example of the latter is the Darkwoods property in southeastern BC that is now owned by the Nature Conservancy of Canada (see van Kooten et al., 2014).
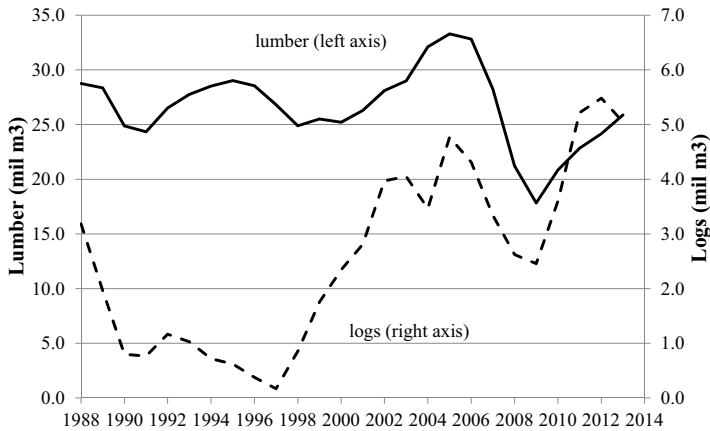
Fig. 1. British Columbia log and softwood lumber exports, 1988–2013.
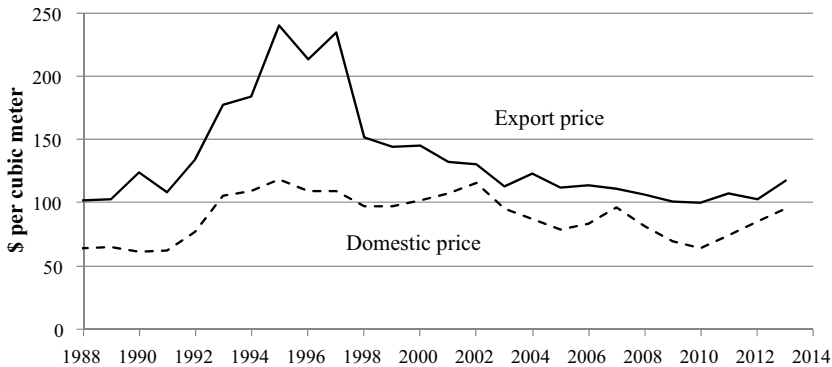
Source: BC Stats. (2013a).

been relaxed or tightened depending on the economic and political situation, but the government has always maintained some flexibility to permit log exports (see Dumont and Wright, 2006).

Forest companies in BC currently can only export logs if they are declared 'surplus' to domestic requirements – that is, no domestic buyer for the logs is forthcoming, or offers to purchase 'surplus' logs are deemed inadequate. A provincial Timber Export Advisory Committee (TEAC) advises on disparities between offers and bids, permitting log exports when 'warranted'.[4] Companies exporting logs pay a fee in 'lieu of manufacture' – a payment (or penalty) for lost opportunities in the processing sector – and must obtain an export permit from the Canadian Border Services Agency (a payment to the federal government). The former fee depends on domestic and export prices and is in addition to any stumpage fees the logging company pays to the province.

Historically, log exports rose when U.S. lumber markets were weak, but fell as demand picked up. Today, despite regulatory oversight, log exports from BC have become an important feature of BC's external trade. In 1987, BC exported nearly 4 million m^3 of raw logs, but a decade later exports had fallen to less than ½ million m^3. Log exports rose dramatically since 1997; by 2005, they reached nearly 5 million m^3, falling to about 3 million m^3 by 2009 as a result of the global financial crisis, and then rising rapidly to 5.7 million m^3 in 2012 and an estimated 6.5 million m^3 or more in 2013 (Fig. 1). Meanwhile, exports of softwood lumber remained relatively constant from 1988 to the early 2000s, then rose rapidly to a peak of 32.8 million m^3 in 2006 before falling to 17.8 million m^3 in 2009, after which they began to climb back towards historic levels. In 2012, BC's log exports were valued at $576.8 million compared to $4204.0 million for softwood lumber exports, or 13.7% of lumber export value; in 2013, log exports were valued at $801.8 million compared to lumber exports of $5311.0 million, or 15.1% of lumber export value.
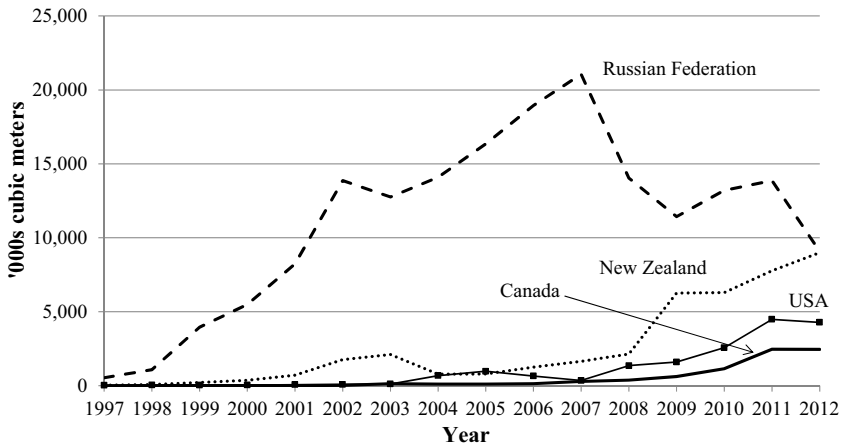
The debate about log exports assumes that the scale of BC's log exports is sufficiently large to affect world prices (Margolick and Uhler, 1992; Zhang, 1996; Fooks et al., 2013). Empirical support for this assumption has recently been provided by Niquidet and Tang (2013). Some support for this is also provided in Fig. 2. As BC's log exports rose beginning in the late 1990s (Fig. 1), export and domestic prices began to converge.

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[4] TEAC falls under the purview of the Ministry of Forests, Lands and Natural Resource Operations. Information about the steps required to be able to export logs can be found at the provincial website http://www.for.gov.bc.ca/het/export.htm and, since a federal export permit is also required, at the website of Foreign Affairs, Trade and Development Canada http://www.international.gc.ca/controls-controles/logs-bois/index.aspx?view=d (both viewed 21 November 2013). Once logs are declared surplus to domestic requirements, they may be exported but there is no guarantee that all logs that companies consider to be surplus are subsequently declared as such.

Fig. 2. Domestic and export prices for British Columbia logs, 1988–2013.
Source: BC Ministry of Forests, Land and Natural Resource Operations (2013), BC Stats. (2013b).

Fig. 3. Exports of industrial roundwood logs to China by major supplier, 1997–2012
Source: UNFAO (2013).

Demand for BC logs has come almost exclusively from countries in the Pacific Rim, particularly Japan, China, South Korea and even the United States.[5] China has become a major importer of raw logs, now accounting for nearly half of BC's log exports. From importing an insignificant amount of logs in the mid-1990s, China now purchases well over 20 million m^3 annually, with nearly 3 million m^3 coming from BC (2013). Given its proximity, Chinese imports of Russian logs rose rapidly from almost nothing in 1997 to over 20 million m^3 in 2007, after which Russia's exports of raw logs declined significantly (as discussed above). Given China's apparently insatiable demand for logs, the Russian policy caused log prices to rise and, along with the financial crisis and accompanying recession in the developed countries, this provided the opportunity for New Zealand, the U.S. and Canada to increase log exports to China as indicated in Fig. 3.

Trade economists are almost all agreed that "log export bans and restrictions could have detrimental effects on the overall economic efficiency of a nation or region" (Fooks et al., 2013, p. 1103). Indeed,

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[5] Although no distinction is made in this study between species and grade composition of exported logs, they are often quite different from those processed domestically. Almost all log exports from BC come from the coast, while some three-quarters of BC's lumber is produced in the Interior. For example, in 2013, 45% of logs exported from BC were from species that did not grow in the interior. Hence, this will impact the results of the not available. This also impacts your estimation results.
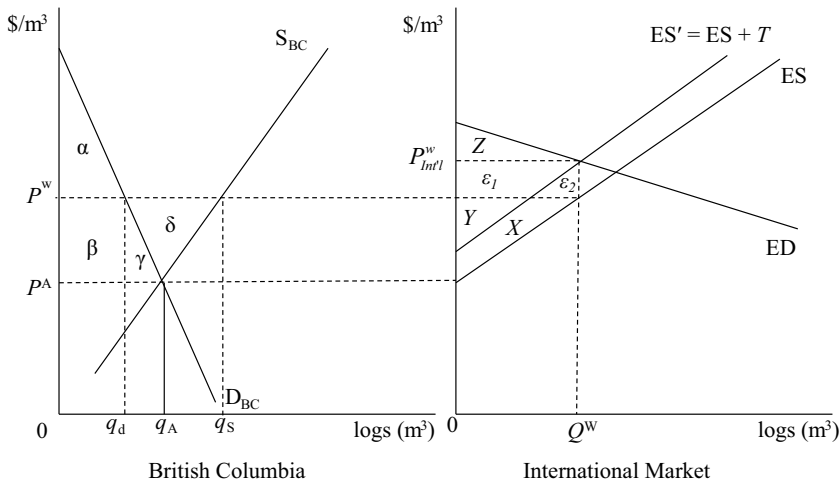
Fig. 4. Analysis of British Columbia permitting free trade in logs.

in their empirical investigation of BC's log export policy, Fooks et al. (2013, p. 1111) conclude that the province has substantial potential to gain from the removal of its export restrictions.[6] Margolick and Uhler (1992) and Zhang (1996) make similar arguments in favour of removing all restrictions on BC's log exports. By eliminating restrictions on log exports, producers will generally gain more than consumers lose and, as a result, the economy as a whole benefits. As demonstrated in this article, this conclusion is not necessarily supported theoretically or empirically at the local level. The reason is that none of the aforementioned studies includes the potential scarcity rents that one finds in log markets (see van Kooten and Johnston, 2014).

As opposed to a static argument against log export restrictions, a dynamic one might have greater traction. By permitting log exports, timber owners receive higher prices for logs than they would otherwise. This provides an incentive to increase investment in the production of logs – in activities that increase the commercial timber value of stands. In so doing, more logs are produced, log prices fall and local manufacturers can also benefit. Employment in forest-level activities increases, but anticipated job loss in downstream manufacturing might not materialise. Yet, even in this case, the outcome depends on how scarcity rents created by log export restrictions are allocated. Clearly, if they are wasted through needless transaction costs imposed on firms seeking to export logs, the situation differs from that where the log producer (or landowner) captures the (scarcity) rents from restricting log exports. We now examine this issue using applied welfare economic analysis.

Welfare economics of log export restrictions

The case for free trade in logs can be examined with the aid of Fig. 4.[7] Price and quantity under autarky are P^A ($/m^3) and q_A (m^3), respectively. With complete free trade, BC faces an excess demand for logs from the rest of the world given by ED, while ES is BC's excess supply and ES′ = ES + T is the relevant excess supply as it includes transportation costs of T/m^3. The gains from trade are determined as follows: Compared to autarky (no trade), consumers in BC lose ($\beta + \gamma$), but producers gain ($\beta + \gamma + \delta$) for a net gain to the province from trade of δ. This gain can be represented in the international market as well, with $\delta = X + Y$; the gain to foreigners, on the other hand, is given by area Z, although it is not possible in this diagram to determine the extent to which foreign producers lose and foreign consumers

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[6] The authors make no distinction between a log export ban and log export restrictions, using the terms interchangeably throughout.

[7] In Figs. 4 and 5, the scale of exports relative to domestic consumption is larger than would be the case in BC.
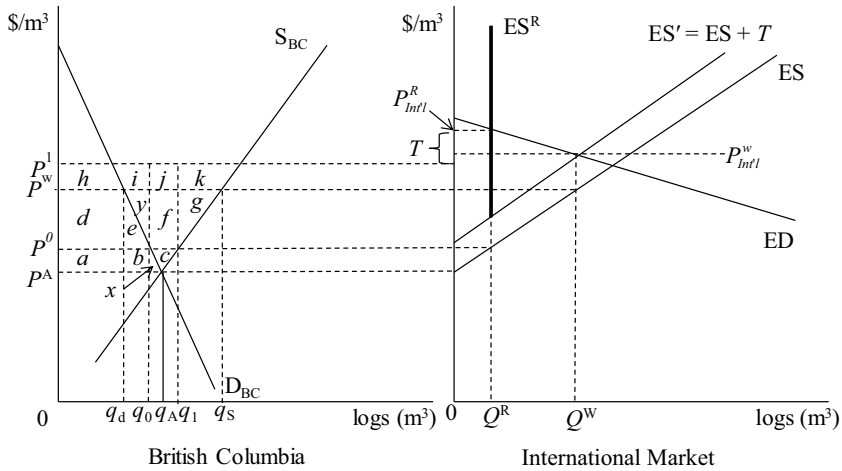
Fig. 5. Analysis of the welfare impacts to British Columbia of free trade in logs when log export restrictions exist.

gain. However, since the price in the foreign market ($P_{Int'l}^{w}$) is less than the excess demand choke price (equal to the autarkic price in the foreign market), foreign consumers must gain more than the loss by foreign producers. Finally, notice that the price in the international market exceeds that in the BC domestic market $P_{Int'l}^{w} > P^{w}$, as a result of transportation costs, which amount to area ($\varepsilon_1 + \varepsilon_2$).

Now consider an alternative situation where the starting point is not autarky, but one where limited log exports are already permitted. Let $Q^R = q_1 - q_0$ be the level of log exports that BC permits in any year, although it does not permit free trade. The discussion of the changes in welfare in going from restricted log exports to free trade in logs is facilitated with the aid of Fig. 5, which expands upon Fig. 4.

If BC restricts log exports to the amount Q^R (=$q_1 - q_0$), this shifts the relevant excess supply function to ES^R. Logs are sold at price $P_{Int'l}^{R}$ in the international market, but the price received by domestic log producers is P^1 as a result of transportation costs T. To clear the domestic market, however, the price that BC consumers pay under restricted log exports is P^0. Compared to autarky, the limited export of logs causes domestic consumers to lose ($a + b + x$) while producers gain ($a + b + x + c$) for a net gain of c. In addition, area ($j + f$) is a surplus created by policy-induced scarcity; it could be wasted through the export-permitting process, or captured by the log exporter, public or private landowner, government, or some other entity.

Starting from limited exports, if log exports are now freely permitted, the world price P^w becomes relevant for BC and it exports Q^W logs (at the price given in the international market). Compared to the restricted log export situation, free trade in logs causes BC consumers to lose ($d + e$) and producers to gain ($d + e + y + g - j$), assuming for simplicity that areas f and j accrued to the producers when log trade was restricted to Q^R. The net change in welfare from the perspective of BC is thus ($y + g - j$), with j lost because of the price decline in the international market as monopoly power is removed. Most analyses of log export restrictions ignore this policy-induced scarcity-rent component of the trade restriction. It is important, however, because if $j > y + g$, BC is worse off under free trade than with a trade restriction on logs, while it is better off if $j < y + g$. If the elasticities of supply and demand in each of the markets are known, it would be possible to calculate the relevant welfare areas and determine whether an exporting region would prefer free trade in logs or to limit the amount it trades.

Implementing the trade model

Margolick and Uhler (1992), Zhang (1996), and Fooks et al. (2013) approach the trade restriction in the same fashion. They estimate supply and demand functions for logs in BC and then employ assumptions about how prices in international markets are impacted by changes in BC log exports. Indeed, Margolick and Uhler (1992) and Zhang (1996) construct demand and supply curves for the foreign

market (presumably equivalent to the international market in Figs. 4 and 5), with Zhang even estimating the supply and demand functions for both BC (as do Fooks et al., 2013) and the PNW. Nowhere do any of these authors construct excess supply and demand curves, or otherwise explicitly link the domestic and foreign markets. As a result, the extent to which prices in other markets are impacted by changes in BC log export policy has to be determined exogenously rather than endogenously within a trade model.

Demand and supply assumptions

To quantify the welfare impacts of log export restrictions, linear supply and demand functions are assumed. In particular, we assume the following domestic supply and demand functions:

$$P^d = \alpha - \beta q, \quad \alpha, \beta \geq 0 \tag{1}$$

$$P^s = a + bq, \quad a, b \geq 0 \tag{2}$$

We can solve for the excess supply function as the quantity difference between supply and demand at each given price. First rearrange functions (1) and (2) in terms of quantity demanded (q^d) and quantity supplied (q^S), respectively. Then, the excess supply for a given price P is ES $= q^S - q^d = (P - a)/b - (\alpha - P)/\beta$. Letting $q =$ ES and solving for the excess supply price P gives:

$$P^{ES} = \frac{\beta a + \alpha b}{b + \beta} + \frac{b\beta}{b + \beta} q \quad \text{and} \tag{3}$$

$$PES' = \frac{\beta a + \alpha b}{b + \beta} + T + \frac{b\beta}{b + \beta} q, \tag{4}$$

where T refers to the shipping and handling (or transaction) costs.

The respective domestic demand and supply elasticities are given by:

$$\varepsilon_d = \frac{dq}{dp}\frac{p}{q} = -\frac{1}{\beta}\frac{p}{q} \quad \text{and} \quad \varepsilon_s = \frac{dq}{dp}\frac{p}{q} = \frac{1}{b}\frac{p}{q}. \tag{5}$$

We can then calculate the parameters in (1) and (2) as a function of ε_d, ε_s, p and q, which are the available from various sources (as discussed below). The parameters for domestic supply and demand functions are thus:

$$\beta = \frac{-1}{\varepsilon_d}\frac{p^d}{q}, \quad \alpha = p^d\left(1 - \frac{1}{\varepsilon_d}\right), \quad b = \frac{1}{\varepsilon_s}\frac{p^S}{q}, \quad \text{and} \quad a = p^s\left(1 - \frac{1}{\varepsilon_s}\right). \tag{6}$$

We can do the same for an assumed linear excess demand function, $P^{ED} = k_0 - k_1 q$. The price elasticity of ED is given by:

$$\varepsilon_{ED} = \frac{dq}{dp}\frac{p^R_{Int'l}}{Q^R} = -\frac{1}{k_1}\frac{p^R_{Int'l}}{Q^R}, \tag{7}$$

so that $k_1 = (-1/\varepsilon_{ED})(p^R_{Int'l}/Q^R)$ and $k_0 = p^R_{Int'l}(1 - (1/\varepsilon_{ED}))$. In these cases, $p^R_{Int'l}$ refers to the excess demand price in the international market for the quota-constrained quantity of logs Q^R exported by BC (Fig. 5).

Optimal log export restrictions

Following van Kooten (2002), we begin by examining the scarcity or quota rent available in the international market as a function of the quantity traded:

$$R(Q) = (P^{ED} - P^{ES'})Q = [(k_0 - k_1 Q) - (r + wQ + T)]Q, \tag{8}$$

where Q refers to the quantity of logs exported by BC, $r = (\beta a + \alpha b)/(b + \beta) = P^A$ (autarkic price), and $w = b\beta/(b + \beta)$. By setting $P^{ED} = P^{ES'}$, we find the respective free-trade quantity and price:

$$Q^W = \frac{k_0 - r - T}{w + k_1} \quad \text{and} \quad P^W = \frac{rk_1 + w(k_0 - T)}{w + k_1}. \tag{9}$$

The quota rent $R(Q)$ is given by area $Q^R \times (P^R_{Int'l} - T)$ in Fig. 5; it varies as Q changes, with $R(Q=0)=0$ and $R(Q=Q^W)=0$. Upon setting the first derivative of $R(Q)$ to zero and solving, we find the level of log exports that maximises the quota rent:

$$Q^{R*} = \frac{k_0 - (r + T)}{2(w + k_1)} = \tfrac{1}{2}Q^W. \tag{10}$$

When there is a quota on log exports, however, provincial log producers forego some quasi-rent as a result of reducing output below the unrestricted free trade amount.[8] The reason is that, while a quota increases the demand price in the international market compared to free trade, the supply price falls; in the domestic market, it is the supply price that determines the price processors pay for logs (see Fig. 5). Naturally, domestic lumber and other wood product manufacturers prefer zero log exports since this keeps the price of logs at their lowest.

To find the optimal level at which to restrict log exports (or quota) from the perspective of BC, it is necessary to determine the level of trade that maximises the sum of the quasi-rents accruing to log producers (producer surplus) and wood processors (measured as a consumer surplus under the derived demand function) plus the quota rent:

$$B(Q) = \tfrac{1}{2}(P^{ES} - a)(q_d + Q) + \tfrac{1}{2}(\alpha - P^{ES})q_d + (P^{ED} - P^{ES} - T)Q, \tag{11}$$

where P^{ES} is the (excess) supply price and P^{ED} the (excess) demand price found in the international market; q_d represents logs consumed domestically; and $Q = q_s - q_d$ refers to exports of logs, with q_s the amount harvested in BC. The first term on the right-hand-side of (11) refers to the quasi-rent accruing to log producers, the second term to the quasi-rent (consumer surplus) accruing to domestic lumber and other wood product manufacturers, and the third term to the quota rent (if any).[9]

As the first term deals with the producer surplus in the domestic log market, we substitute for Q and rewrite Eq. (11) as:

$$B(Q) = \tfrac{1}{2}(P^{ES} - a)q_s + \tfrac{1}{2}(\alpha - P^{ES})q_d + (P^{ED} - P^{ES} - T)Q. \tag{12}$$

Setting the first derivative of $B(Q)$ in (12) equal to zero and solving for Q gives[10]:

$$Q^B = \left(\frac{2w + 2k_1}{3w + 4k_1}\right)Q^W. \tag{13}$$

As long as trade is possible, $(k_0 - r - T) > 0$, and thus $Q^B > 0$. Further, $Q^B < Q^W$ because the denominator in (13) is greater than the numerator. Finally, upon comparing results (10) and (13), it can easily be demonstrated that $Q^B > Q^{R*}$, so that $0 < Q^{R*} < Q^B < Q^W$. Numerical analysis using empirical values of the various parameters is needed to determine whether BC's policy is preferred to the alternative of free trade.

Parameter values

To determine the welfare areas identified in Fig. 5, it is necessary to have information on domestic consumption and production of logs, exports of logs (quota amount), the elasticities of domestic

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[8] Quasi-rent refers to the quantity sold multiplied by the supply price minus the variable cost of supplying that quantity (area under the supply curve); it does not include the policy-induced scarcity (or quota) rent, which we measure separately. See van Kooten and Folmer (2004, pp. 38–44) for further details.

[9] As van Kooten and Johnston (2014) show, the surplus area under the derived demand curve for logs is a quasi-rent measured as a (producer) surplus above the supply curve and below the output price faced by lumber manufacturers and other wood processors.

[10] $B'(Q) = \tfrac{1}{2}wq_s - (k_1 + w)Q + (P^{ED} - P^{ES} - T) - \tfrac{1}{2}wq_d = 0$. This implies, $\tfrac{1}{2}w \ (q_s - q_d) - (k_1 + w)Q + k_0 - k_1Q - r - wQ - T = 0$, and, finally, $-3/2wQ - 2k_1Q + k_0 - r - T = 0$.

Table 1

Data used to analyse economic impacts of log export restriction for base years 2011 and 2007.

Item	2011	2007
Domestic log price ($/m^3)	74.03	96.33
World price ($/m^3)	107.61	110.68
Total log harvest ('000s m^3)	69,328.0	72,166.3
Domestic log consumption ('000s m^3)	63,878.1	68,827.4
Log exports from BC ('000s m^3)	5449.9	3338.8

Item	Range of Values for Simulations ['Lowest', 'Most Likely', 'Highest']
Elasticity of supply	[0.3, 1.0, 1.1]
Elasticity of demand	[−0.2, −1.1, −2.0]
Elasticity of excess demand	[−1.25, −1.54, −1.83]
Transportation cost ($/m^3)	[5.0, 10.0, 12.0]

demand and supply, and the elasticity of excess demand. Elasticity of demand and supply estimates for BC are available from various sources. For example, Fooks et al. (2013) estimated a price elasticity of demand of −1.10, while Zhang (1996) employs an estimate of $\varepsilon_D = -0.76$. In a survey of the forest economics literature, Devadoss (2008) finds estimates for BC range between −0.2 and −2.0.

As to the price elasticity of supply, van Kooten and Johnston (2014) found estimates ranging from 0.8 to 1.1, but employed $\varepsilon_s = 1.0$ because it has the convenient property that any linear supply function with an elasticity of 1.0 passes through the origin. Fooks et al. (2013) estimate the elasticity of supply to equal 1.03, while Zhang (1996) estimated an unusually low elasticity of supply for BC of $\varepsilon_s = 0.11$. Since logs for export originate almost exclusively on the BC coast, Margolick and Uhler (1992) employ $\varepsilon_s = 0.3$ (for the BC coast only).

Finally, we require estimates of the elasticity of excess demand for BC logs. Niquidet and Tang (2013) estimate Marshallian excess demand elasticities for Canadian log imports by China and Japan. Since imports of Canadian logs originate entirely from BC, these estimates constitute the excess demand elasticities for the purposes of our model. The estimates are as follows: $\varepsilon_{ED} = -1.40$ (China) and $\varepsilon_{ED} = -1.67$ (Japan).

A summary of the reference data is provided in Table 1. Log sales and price data come from BC Stats. (2013a), with log export data also available from BC Stats. (2013b). Price elasticity data come from the sources indicated above. Given that there are various estimates of the domestic demand and supply elasticities, a 'most likely' value and range of values from 'lowest possible' to 'highest possible' are provided. For the elasticity of the excess demand function for BC logs, an average of the Chinese and Japanese values is employed as a 'most likely' value, with a highest value taken to be 10% above the Chinese estimate and a lowest value determined to be 10% below the Japanese estimate. Finally, the transportation costs are derived from van Kooten and Johnston (2014), but since there is anecdotal evidence suggesting that the actual costs might be lower (e.g., in containers as backhaul), high and low values are constructed about the point estimate (Table 1). In the simulation analysis discussed below and for convenience, the elasticity and transportation values are assumed to be drawn from triangular distributions.[11]

Results

Monte Carlo simulation is used to calculate the welfare measures in Fig. 5. In each iteration, values of the three elasticities and the transportation cost are drawn from a triangular distribution with parameters given in Table 1. We employ 10,000 iterations with random draws from triangular distributions about each of the parameters in Table 1 using the 'Runuran' package in R (version 3.0.1). In addition to the base values provided in Table 1, we examine situations where the parameters of

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[11] Many of the assumptions used in the model are arbitrary and employed mainly for convenience – linearity of supply and demand, use of triangular distributions, ranges of potential values chosen for use in the triangular distribution, etc. Nonetheless, these assumptions are likely sufficient to demonstrate the robustness of the conclusions.

Table 2

British Columbia log exports under free trade, maximisation of quota rent, and maximisation of domestic benefits.[a]

Scenario	2011			2007[b]		
	Free trade	Quota rent	Domestic benefit	Free trade	Quota rent	Domestic benefit
1. Base case (as in Table 1)	7.251 (0.136)	3.625 (0.068)	3.659 (0.070)	3.512 (0.029)	1.756 (0.015)	1.768 (0.015)
2. Lower transport cost [5.0, 8.5, 10.0]	7.451 (0.102)	3.726 (0.051)	3.760 (0.053)	3.596 (0.024)	1.798 (0.012)	1.810 (0.013)
3. Lower BC ε_s [0.1, 1.0, 1.1]	7.313 (0.101)	3.656 (0.050)	3.690 (0.052)	3.596 (0.024)	1.798 (0.012)	1.810 (0.013)
4. Less elastic BC ε_d [−0.2, −1.1, −1.2]	7.303 (0.099)	3.652 (0.050)	3.690 (0.052)	3.595 (0.024)	1.797 (0.012)	1.811 (0.013)
5. Greater ε_{ED} [−1.25, −1.54, −2.25]	7.503 (0.221)	3.751 (0.111)	3.789 (0.116)	3.622 (0.038)	1.811 (0.019)	1.825 (0.020)
6. Much greater ε_{ED} [−1.54, −1.80, −2.25]	7.664 (0.147)	3.832 (0.074)	3.874 (0.077)	3.645 (0.031)	1.822 (0.016)	1.837 (0.016)

[a] Standard deviations of 10,000 randomly determined values provided in parentheses.

[b] For 2007, the lower transportation costs of scenario 2 are used in scenarios 3 through 6 as well.

Table 3

Welfare Analysis of the Costs of Log Export Restrictions, 2011 ($ millions).[a]

| Scenario[b] | Autarky to free trade | Welfare impacts of moving from the current restricted level of log exports to free trade in logs | | | | |
	Net gain	Gain to consumers	Gain to producers	Net gain	Quota rent	Transport cost
Base case (as in Table 1)	53.608 (3.911)	−50.576 (6.047)	−22.243 (9.911)	−72.819 (10.717)	119.843 (7.008)	83.902 (8.065)
Lower transportation cost [5.0, 8.5, 10.0]	46.353 (1.902)	−56.168 (5.977)	−37.263 (7.253)	−93.431 (3.752)	133.199 (2.320)	68.087 (2.988)
Lower BC ε_s [0.1, 1.0, 1.1]	51.448 (2.144)	−52.310 (5.636)	−26.802 (7.203)	−79.112 (4.831)	123.976 (3.076)	79.185 (3.753)
Less elastic BC ε_d [−0.2, −1.1, −1.2]	53.057 (1.847)	−59.552 (3.343)	−18.893 (5.026)	−78.445 (4.790)	123.976 (3.076)	79.081 (3.748)
Greater ε_{ED} [−1.25, −1.54, −2.25]	53.108 (2.778)	−57.590 (8.172)	−19.862 (10.434)	−77.452 (5.149)	123.976 (3.076)	81.241 (4.369)
Much greater ε_{ED} [−1.54, −1.80, −2.25]	54.516 (2.389)	−62.073 (7.068)	−13.971 (8.726)	−76.044 (4.945)	123.976 (3.076)	82.986 (4.015)

[a] Based on data for 2011. Standard deviations of 10,000 randomly determined values provided in parentheses.

[b] In order, the values in [] refer to the 'lowest possible', 'most likely' and 'highest possible' values for the triangle distribution. The base case scenarios are provided in Table 1.

Table 4
Welfare analysis of the costs of log export restrictions, 2007 ($ millions).[a]

Scenario[b]	Autarky to free trade	Welfare impacts of moving from the current restricted level of log exports to free trade in logs				
	Net gain	Gain to consumers	Gain to producers	Net gain	Quota rent	Transport cost
1. Base case (as in Table 1)	22.366 (0.855)	−6.476 (1.248)	14.066 (1.806)	7.589 (2.671)	11.747 (1.885)	38.028 (1.679)
2. Lower transportation cost [5.0, 8.5, 10.0]	19.940 (0.721)	−9.589 (1.287)	9.102 (1.692)	−0.488 (2.051)	17.398 (1.421)	32.853 (1.342)
3. Lower BC ε_s [0.1, 1.0, 1.1]	19.940 (0.721)	−9.589 (1.287)	9.102 (1.692)	−0.488 (2.051)	17.398 (1.421)	32.853 (1.342)
4. Less elastic BC ε_d [−0.2, −1.1, −1.2][c]	20.444 (0.632)	−10.944 (1.053)	10.520 (1.324)	−0.424 (2.045)	17.398 (1.421)	32.844 (1.342)
5. Greater ε_{ED} [−1.25, −1.54, −2.25]	20.113 (0.738)	−10.577 (1.734)	10.262 (2.075)	−0.315 (2.051)	17.398 (1.421)	33.094 (1.358)
6. Much greater ε_{ED} [−1.54, −1.80, −2.25]	20.259 (0.717)	−11.416 (1.592)	11.248 (1.803)	−0.168 (2.038)	17.398 (1.421)	33.299 (1.333)

[a] Based on data for 2007. Standard deviations of 10,000 randomly determined values provided in parentheses.

[b] The values in [] refer to the 'lowest possible', 'most likely' and 'highest possible' values for the triangle distribution. The base case scenarios are provided in Table 1; scenarios 3 through 6 also employ the lower transportation costs of scenario 2.

[c] Results are similar if the absolute value of ε_d is increased from 1.1 to 1.5 or reduced to 0.8.

the triangular distribution are changed for each of the four random variables independently. We also examine conditions for 2011 and 2007 as these represent a year of low North American lumber demand conditions and one of high demand, respectively. A comparison of the free trade and optimal levels of log exports across years and scenarios is provided in Table 2, while the welfare results are provided in Tables 3 and 4 for 2011 and 2007, respectively.

The results in Table 2 indicate that, in a low demand year (2011), the optimal level of log exports should be greater than in a year when domestic demand for logs is high (2007). Thus, both the theoretical and actual levels of BC log exports were higher in 2011 than 2007 because demand for lumber and other wood products in the former year was much lower than in 2007 – the year before the collapse in the U.S. housing market due to the financial crisis. More importantly, however, is the comparison between the actual and optimal levels of log exports. BC exported 7.86% (5.4 million m^3) of the logs harvested in 2011, and 4.63% (3.3 million m^3) of total log production in 2007. Yet, the permitted levels of log exports exceeded the optimal level of exports (Q^B) – that which would yield the greatest benefit to the province – by 45% given 2011 market conditions and by 85% given conditions in 2007. It would seem that, while the government appears to adjust log exports to economic conditions, it has landed at a level of exports that is greater than the level that provides the greatest net benefits to the province and the free trade amount. Nonetheless, a policy that increases exports towards the free trade level would likely reduce rather than enhance the wellbeing of BC as shown in Tables 3 and 4.

For the scenarios in Tables 3 and 4, there is always an overall net gain to BC in going from autarky to free trade in logs. Indeed, this is the conclusion that commentators such as Fooks et al. (2013) and Margolick and Uhler (1992), use to justify free trade in raw logs and removal of any restrictions on log exports. However, the results in Table 3 clearly indicate that, once log exports are in place, BC would be made worse off by moving to complete free trade in logs. This conclusion is robust across the range of elasticities and transportation costs explored here. It would seem, therefore, that the current level of BC log exports is preferred to free trade in logs. Is this always the case?

The unambiguous answer to this question is that, in the static model where BC faces a downward sloping excess demand curve for its logs, the province will always be better off by restricting log exports than it would be with free trade in logs. The results in Table 4 are ambiguous, however, because actual log exports for 2007 (3.34 million m^3) are already close to the free trade amount (3.6 million m^3). For example, if transportation costs are significantly high compared to the excess demand choke price, the province could benefit from free trade in logs. The reason is that the high transportation costs reduce the available quota rent, and thereby it pays to increase exports to the free trade level. For the lower transportation cost scenarios 3 through 6, there remains a cost to moving to free trade in logs, although the associated high standard deviations suggest that this is not always the case. That is, area $(y + g)$ in Fig. 5 is almost always but not unambiguously smaller than area j.

Concluding discussion

Economists have generally condemned British Columbia's log export policies, arguing that the province is forgoing significant benefits from failing to permit free trade in logs. The province's policy regarding log exports is primarily designed to protect and promote downstream processing jobs, a questionable objective at best. Yet, historically the government has recognised the potential employment and other benefits that can be captured by permitting some log exports when lumber and other wood product markets are weak. Because log exports continue as they have in the past, although past levels varied over time due to (perhaps arbitrary) factors that impacted policy, the proper comparison in evaluating BC's log export restrictions is the change in wellbeing upon moving from current levels of log exports to those expected under free trade, and not the change in welfare in moving from autarky (no-trade) to free trade.

The theoretical and empirical results in this article suggest that BC's current policy of restricting log exports is preferred to free trade, ceteris paribus. As demonstrated here, the level of log exports that maximises the total economic surplus available to British Columbians is slightly greater than one-half of the free trade level of exports, or slightly more than the level that garners the greatest quota rent. In the context of the current model, any other level of log exports is inferior. From this perspective,

too many logs may have been exported in both 2007 and 2011, at least given the assumptions upon which the analysis used in this article are based.

Since the perspective in this study is that of BC, should the province strive to permit free trade in logs? This is a different question than that of determining an optimal quota. For one thing, it depends on what happens to the policy-induced, scarcity (quota) rent. If the policy-induced rent is entirely wasted via high transaction costs associated with obtaining log-export permits, the province might be as well off promoting free trade in logs. If the available quota rents are captured by the log exporter or by a foreign importer of BC logs, and is thereby transferred out of the province, free trade may also be preferred. However, if the government is able to capture the quota rents and/or if the rents are used to promote investment in R&D, silviculture and manufacturing facilities, then log export restrictions are to be embraced. Indeed, in the region that imposes export restrictions, the net surplus accruing to producers might increase, thereby promoting investment in growing forests.

One caveat might explain why the government chose to permit a level of log exports that exceeded the optimal quota amount (by 85% in 2007 and 45% in 2011). In this study, no distinction was made between species and grade composition of exported logs, which are often quite different from those processed domestically. Almost BC's entire log exports come from the coast, while some three-quarters of BC's lumber is produced in the Interior. The species grown on the coast differ from those of the interior so that, for example, in 2013 45% of logs exported from BC were from species that did not grow in the interior. Future research needs to address this shortcoming. However, the overall conclusion of the results presented here will remain unaffected, but the magnitude of the estimates will undoubtedly be affected.

There remains one other aspect of BC's log export restrictions that could favour free trade. In a global economy, log export restrictions are viewed as an impediment to trade. As such, they could be the target of trade counter measures – duties on imports of other Canadian goods, or a bargaining chip used against Canada in trade negotiations. A benefit of freer trade in logs might be that of avoiding adverse trade measures. However, it is highly unlikely that other countries will single out BC's log export policies for targeting. The list of countries that have log export restrictions is rather lengthy, and includes China, Chile, Russia, New Zealand, the United States and Canada.[12] These countries often restrict log exports from public lands as well as from native as opposed to plantation forests, policies that are often supported by environmental groups. Since logs from BC originate primarily from native, publicly owned forestlands and not plantation forests, it is unlikely that BC will need to be concerned about being the target of counter measures in the foreseeable future.

Acknowledgements

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[12] China restricts log exports from certain provinces, New Zealand restricts exports from native forests, the U.S. bans log exports from public lands west of the 100th meridian and Alaska, Russia restricts exports using the WTO's TRQ mechanism, Chile bans exports of certain species, and BC only permits export of 'surplus' logs. There are many other countries that restrict exports of various hardwood species, or ban log exports entirely. For a review, see van Kooten (2013).

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