

Economic Analysis of the Canada-United States Softwood Lumber Dispute: Playing the Quota Game

by

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ABSTRACT

The Canada-U.S. Softwood Lumber Agreement (SLA) was the latest measure to restrict Canadian exports of softwood lumber to the United States. Rather than a countervail duty or export tax, SLA employed a quota that provides a large windfall (quota) rent to Canadian lumber producers in addition to extra quasi rents to U.S. producers, all at the expense of U.S. consumers. However, Canadian producers have not taken full advantage of the quota regime to maximize their overall gains, which exceed what they could earn under free trade or an export/import tax. This is demonstrated using a theoretical framework and numerical illustration. It is shown that the net gain to Canadian producers does not occur when the quota rent is maximized, but rather when the sum of producer surplus and quota rent is maximized. It is also argued that the existence of resource rents from logging does not constitute a subsidy to lumber producers. It is concluded that, from Canada's perspective, the SLA is preferred to both free trade or an export/import tax, but only if all provinces and all softwood lumber products are included in the Agreement and a means for sharing the windfall rents can be found.

Key words: softwood lumber trade; types of rents in forestry; forest policy; quota regimes

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1. Background

Canadian imports of softwood lumber have been a source of aggravation to U.S. lumber producers since at least 1962. In 1981, as a result of recession and declining lumber demand, lobbyists in the Congress asked the Commerce Department to investigate whether the Canadian timber licensing system constituted a subsidy that would warrant imposing a countervail duty (CVD) on Canadian lumber. In 1983, the Commerce Department concluded that there was no evidence that Canadian producers were being subsidized. However, in 1986, as a result of pressure from the U.S. Coalition for Fair Lumber Imports, the U.S. government imposed a 15% CVD in response to the International Trade Commission's (ITC) judgment that Canadian producers were indeed being subsidized. Negotiations between the two governments led to a Memorandum of Understanding (MOU) whereby the Canadian government imposed an export tax of 15% beginning in 1987. In late 1991, the Canadian government announced that it would drop the MOU. In response, the U.S. imposed a CVD of 6.5% in mid 1992 as a result of an ITC ruling favoring U.S. lumber producers. After an extremely contentious process under the U.S.-Canada Free Trade Agreement binational dispute settlement procedure, the CVD was dropped and the U.S. refunded US\$800 million in duties collected (Lindsey 2000).

This process cost the Canadian industry dearly in legal fees, so, when further threats of duties arose in 1995 and 1996, the two governments concluded the Canada-U.S. Softwood Lumber Agreement (SLA), which employed a quota mechanism. The SLA ran from April 1, 1996 to March 31, 2001, and constrained annual lumber exports to

the U.S. from four provinces (British Columbia, Alberta, Ontario and Quebec), which in 1998 accounted for 87.4% of all softwood lumber exported by Canada to the U.S. (Canadian Forest Service 2000). By Article 2.2, Canada was bound to collect US\$50 per thousand board feet (mbf) for lumber exports exceeding 14.7 billion board feet (bbf) and a fee of US\$100 for amounts in excess of 15.35 bbf, with fees to be adjusted annually for inflation. The SLA has been the subject of disputes concerning the scope of coverage, particularly as to whether pre-drilled and notched studs and rougher-headed boards were included; high-priced, manufactured products were excluded, however. It has also created distortions as provinces not covered by the SLA increased exports to the U.S. from 1.04 bbf in 1995 to 2.75 bbf in 1999, while U.S. imports from *other* countries rose from 0.40 bbf to 0.94 bbf over the same period (Canadian Forest Service 2000). While the allocation of the total annual (and quarterly) quota is left up to Canada, it has been the subject of conflicts at both the provincial, regional (e.g., B.C. Coast vs Interior) and individual firm levels.¹

Although the SLA has not been renewed, the issue of lower priced softwood lumber imports from Canada is unlikely to disappear as long as Canada's economic institutions (and declining currency), the high degree of public ownership of forestlands and restrictions on log exports remain unchanged. Indeed, the province that accounts for nearly 60% of total lumber exports to the U.S., British Columbia, also has the highest degree of public ownership of forestlands of any major forest jurisdiction in the world and, arguably, is the most interventionist (see Wilson et al. 1998). Since the underlying

¹ The allocation was on the record of exports to the U.S. in the years before the SLA. Thus, a lumber producer that focused on Japan and/or Europe or the domestic market finds it nearly impossible to shift output to the U.S.

factors that led to the softwood lumber dispute remain, efforts to regulate softwood lumber exports from Canada will likely continue in the future.

The purpose of this paper is to provide some insights into this controversy, which has little to do with economic efficiency, but everything to do with politics and the creation and distribution of economic rents. Since these rents can be rather sizeable and come solely at the expense of U.S. consumers (Lindsey 2000), it is important to examine how different policies affect the collection of rents. In particular, the impacts of a quota scheme, such as the SLA, and export/import taxes (or countervail duties) that achieve the same level of trade as a quota, are considered. The results indicate that, while producers in the U.S. will always capture a quasi rent as a result of trade restrictions, the larger scarcity rent created by manipulating the quota or tax is dependent on the level of output and is “up for grabs”. It can be captured by the U.S. or Canadian government, or by U.S. or Canadian producers, or somehow divided among them.

A brief discussion of different rents and rent capture methods is provided in the next section to clarify possible confusion about what rents are available and how they impact lumber trade. Then, in section 3, a partial-equilibrium trade model is used to analyze Canada-U.S. softwood lumber trade, demonstrating how Canadian producers can be made better off under a quota than under an export tax or countervail duty. Any restriction on free trade results in the creation of rents at the expense of U.S. consumers; the methods used to create these rents determine who benefits. The numerical illustration in section 4 provides some indication of the potential size of the income transfers involved under various scenarios. The conclusions ensue.

2. Forest Rents and Rent Collection

It is important to distinguish several types of rent when analyzing forest resources and softwood lumber trade. One objective of governments in forest jurisdictions is to collect maximum rents but not distort the allocation of resources, and log output, in the process. However, much confusion remains about what rents are to be collected and how collection mechanisms affect log harvests (and supply of lumber). Clarification is important here because one complaint of U.S. lumber producers is that Canadian governments do not collect adequate rents from timber harvested on public lands. By not collecting enough rent, it is argued, these governments effectively subsidize the forest companies, giving them a competitive advantage. This advantage presumably comes about because it enables companies to harvest more logs (and produce more lumber) than otherwise, or simply because it gives them an unearned windfall (that makes them more competitive in lumber markets).

Rent concepts

In Ricardo's (1817) classic example of agricultural production on lands of various qualities, increasingly greater levels of *differential rent* accrue to land of successively greater productivity, with land at the extensive margin receiving no rent. Given an identical price per unit of a variable input applied to a fixed factor to produce a homogeneous product, profit maximization ensures that the value of the marginal product is identical across the fixed factor of production (land) irrespective of its productivity. For land of higher productivity, each successive unit of the variable input reduces its marginal product until the value of the marginal product equals the price of the variable input.

Until the last unit of the variable input is applied, each successive unit contributes more to revenue than it does to costs. The sum of these surpluses constitutes differential rent. At the extensive margin, there exists no differential rent as the average product is identical to the marginal product such that total revenue equals total cost.

Scarcity rent can only exist when there are (natural or legal) restrictions placed on the supply of a factor from natural capital and a corresponding limitation on the produce obtained. Howe (1979) defines it as “the user costs of the marginal unit being extracted at any point in time and, under appropriate market conditions, the market value of these marginal *in situ* resources” (p. 78). Unlike differential rent, scarcity rent can occur even if the units of the factor of production from the natural capital stock are identical (i.e., all land is of the same quality). For resources where the marginal cost of exploitation equals the output price, the scarcity rent will be zero, even though there exists differential rent.

Consider Figure 1 where the flow of services from land (Q) is restricted to an amount Q^0 by physical limits or by government decree. Let MC represent all human associated marginal costs of extracting services from land, such as logging and transportation costs. Then the *resource rent* is the area below price and above the marginal cost curve, and equals the sum of differential rent plus scarcity rent, if any. Differential and scarcity rents only apply to natural resources, which is why the marginal cost curve represents all human associated costs, including capital costs.

The term *quasi rent* refers to any payment made to a (human-created) capital asset that is fixed in supply for the time being; any return to the “sunk” component of capital represents quasi rent (Ruzicka 1979, p. 47). Quasi rent is commonly defined as the difference between total revenue and total variable cost, but this is clearly not correct in

the case of natural resources. In Figure 1, the differential rent is not quasi rent since all returns accruing to the human investment are already taken into account in the construct of MC; the differential rent properly accrues to the remaining factor, the natural resource (or land). As a return to human created assets and not natural ones, quasi rent can thus be considered equivalent to *producer surplus*. In forestry, quasi rents exist in addition to resource rent, but these are the result of investments in processing facilities or capital improvements (often required in Canada as a condition of receiving a forest license), and even silvicultural investments.

Resource (scarcity plus differential) rents can be taxed without affecting the behaviour of resource suppliers, if the correct rent capture mechanism is chosen. By taxing quasi rents, however, the authority affects long-run efficient behaviour of resource suppliers.

Methods of rent capture

Several methods may be employed to collect economic rents from public timberlands (Hyde and Sedjo 1992; Vincent 1990, 1993). Five methods are illustrated using Figure 2. Declining log quality is plotted along the abscissa, so the logging concessionaire sells different quality logs at different prices. In the absence of taxes, the concessionaire harvests H^* and the available rent is given by area *abe* minus the fixed cost, because otherwise quasi rent would be captured. Ignore quasi rent and assume that economic efficiency occurs at H^* .

(1) A fully differentiated tax enables the authority to capture the entire area *abe*. Taxes would vary by tree species, size of tree, land quality, harvest costs by site, delivery costs and so on. Such tax discrimination is impractical, however, because informational

requirements are simply too great.

(2) A uniform fixed tax (t_U) is shown in Figure 2 by the shift in MC to $MC + t_U$, where the vertical distance between the two curves is held constant at the fixed rate ($t_U = ad = cf$). The concessionaire reduces harvest levels from H^* to H' . The rent collected by the government amounts to area $afcd$, while the concessionaires receive a windfall of dce . Area cbf is the rent lost to high grading because concessionaires leave felled and/or standing trees on the site to avoid excessive charges. As noted by Hyde and Sedjo (1992), the incentive to “trespass, high-grade, and ignore off-site environmental values” (p. 346) is greatest for the best sites and trees. This is clear from Figure 2. Better quality sites and trees are found near the origin where the difference between the tax and marginal cost is greatest.

(3) An *ad valorem* tax ($0 \leq t_A < 1$) is set as a proportion of the selling price or revenue. The tax on revenue shifts the MC curve in Figure 2 upwards to $MC/(1-t_A)$. For convenience, the tax is shown so that MC intersects MR at c (so that $H' < H^*$ maximises the concessionaire’s profit). The effect of the revenue tax on harvest level (efficiency) is the same as for the uniform fixed tax (efficiency declines as high grading occurs), but the distribution of the rent is different. The government gets acf , while the logging company gets ace . Again cbf is the rent lost due to high grading. For the same harvest level (degree of high grading), the government collects less rent under the *ad valorem* tax on revenue (or price) than under the uniform tax. Further, the uniform tax is easier to administer, thereby reducing administrative costs relative to the revenue tax.

(4) An *ad valorem* tax on the difference between price and marginal cost for each log – in essence, a profit tax – leads to the optimality condition that $MR=MC$. The tax-

adjusted MC curve in Figure 2 (dark dashed line with the long dashes) shifts up, but intersects MR at the original level of harvest H^* . For example, if the tax-adjusted MC is given by segment db for the first unit produced, declining to zero at H^* , the government collects an amount abd of the rent, leaving dbe to the concessionaire. The important point is that such a tax on rent does not distort economic efficiency. The only problem is that the Ministry must know not only selling prices but also something about marginal costs of harvesting and delivering timber to a mill or export point. In that case, a fully differentiated tax can also be used, but then to capture the entire rent. Unlike with a fully differentiated tax, an *ad valorem* tax on profit might work if one does not attempt to calculate the net revenue on each and every log, but only on the company's net return from logging operations on public land in each year. For integrated forest companies, informational requirements may make it difficult to collect the rent in this fashion.²

(5) Finally, Hyde and Sedjo (1992) recommend a competitively bid lump sum fee for the right to harvest a particular site. In theory, this will capture the entire area abe in Figure 2. This method is used in the U.S., where the federal government auctions off the harvest rights to tracts of public forestland, and in BC under the Small Business Enterprise Program through competitive bidding for Minor Timber Sale Licenses. In practice, competitive bidding for harvesting rights does not ensure that the resource owner collects all the economic rents as it is an *ex ante* rather than an *ex post* method of rent capture. If firms' expectations are incorrect due to unexpected changes in demand or technological advances (or because they use a different discount rate than the

² Attempts to obtain the information required to implement either a fully differentiated tax or profit tax so that the government can collect all of the available rent from public timber lands encounter the well-known principal-agent problem (see Wang and van Kooten 2001).

government), the appropriate amount of rent will not be collected. Further, monopoly or oligopoly power is a real problem with competitive bidding.

Prior to 1987, British Columbia used a uniform fixed tax to collect rents, and an *ad valorem* tax (as a percentage of selling price) after 1987 (Grafton et al. 1998). As noted, both forms of rent collection lead to high grading because they reduce the optimal level of log harvests. Further, neither tax collects all of the available rents, with Grafton et al. (1998) estimating that the Province collected only 71% of available forests rents between 1970 and 1994. The remaining rents have been dissipated by utilization standards (that require companies to harvest more logs than profitable, shifting harvests from H' towards or even beyond H^* in Figure 2), higher wages than warranted by productivity, and onerous environmental regulations (Grafton et al. 1998; Haley 1996). Any rents that are not dissipated constitute a windfall for forest companies. But, given that rates of return for integrated forest companies in Canada tend to be lower than those of other Canadian firms (Zhang and Binkley 1995; Zhang and Pearse 1996), logging concessionaires do not appear to have benefited from uncollected resource rents. Overall, the results of these analyses suggest that Canadian harvests of logs from public lands are likely below what they would be in the absence of government efforts to collect resource rents.

Suppose integrated forest companies did earn a windfall from logging on public lands. Does such a windfall translate into a subsidy that increases softwood lumber output over what it would be in the absence of the logging windfall? The answer is not necessarily because, even if firms purchased machinery and equipment to produce lumber with the windfall rents, it would be costed in the same way as capital purchased using

borrowed funds. Firms with windfall gains would invest those gains where returns are highest, and this may not be in the production of softwood lumber for export to the U.S.

3. Model of Canada-U.S. Softwood Lumber Trade

A partial-equilibrium model of Canada-U.S. trade in softwood lumber is illustrated in Figure 3. The assumption that Canada and the United States are the only relevant regions serves as a good first approximation since U.S. imports of lumber from other countries are small – less than 1 bbf per year compared to annual imports from Canada exceeding 18 bbf. Canadian exports to other countries (mainly Japan) are also relatively small (less than 4 bbf annually). Further, separate exporting and/or importing regions in each country are not considered (rather, see Adams and Haynes 1980, 1987; Boyd et al. 1993), because the objective here is only to examine creation of rents and their distribution, and associated public policies.

In Figure 3, Canadian and U.S. domestic demand and supply functions are labeled D_C and S_C , and D_{US} and S_{US} , respectively. Without trade, an amount q^* of lumber will be consumed in Canada at a domestic price of P_C (panel a); in the U.S., consumption will be q' at price P_{US} (panel c). The well being of citizens in each country is determined by the sum of the consumer and producer surpluses (ignoring foreign ownership). In the absence of trade, the consumer surplus associated with softwood lumber production is given by area $(a+b+c)$ in Figure 3(a) for Canada and area α in Figure 3(c) for the U.S. In the absence of trade, the producer surplus (quasi rent) for Canada can be measured by area $(e+d)$, and for the U.S. by area $(\beta+\gamma)$. For Canada, total surplus in the absence of trade is given by area $(a+b+c+d+e)$, while it is area $(\alpha+\beta+\gamma)$ for the United States.

Unrestricted free trade

Trade improves the well being of citizens in each of the countries, as it increases the total surplus in each. Since $P_{US} > P_C$ in the absence of trade, lumber will flow from Canada to the U.S. as long as the difference in price between the two regions exceeds the transportation cost. With trade, the price in Canada rises from P_C to P_C^T in Figure 3, while U.S. price falls from P_{US} to P_{US}^T . Canadian consumers lose as a result of the price increase, consuming less; consumption in Canada falls from q^* to q_D^C and consumer surplus falls to area a . However, Canadian producers face a higher price ($P_C^T > P_C$), causing them to increase production from q^* to q_S^C . An amount $q_S^C - q_D^C$ ($=Q^T$ in the international market) is traded to the U.S., while producer surplus increases to $(b+c+d+e+g)$. The well being of Canadians as a whole increases by area g , with producers (and those earning a living in the softwood lumber sector) being the main beneficiaries from trade.

The situation in the U.S. is a mirror image of that in Canada. The fall in U.S. prices causes consumers to purchase more lumber (from q' to q_D^U) and increase their overall consumer surplus by an amount given by $(\beta+\phi+\delta)$. U.S. producers now face a lower price and curtail output to q_S^U , giving up a producer surplus of β in the process. However, the gain to consumers is greater than β , with the net gain to U.S. residents given by $(\phi+\delta)$.

The main results can be summarized in the international market, panel (b) of Figure 3. The amount traded is $Q^T = q_S^C - q_D^C = q_D^U - q_S^U$. The net gain to the U.S. is area A , which is equal to area $(\phi+\delta)$ in panel (c); this net gain accrues to U.S. consumers and therefore is measured under the excess demand curve ED . The gain to Canada equals the

area above the excess supply curve ES below the demand price, or area $(B+C+E+G)$, but transportation costs of $(B+C)$ are incurred. Hence, the net gain from trade is $(E+G)$, which is equal to area g in panel (a). Both countries are better off with trade.

In addition to unrestricted free trade, three other scenarios are considered: (1) the case of an export quota (including SLA), (2) an *ad valorem* countervail duty (CVD) or import tax, and (3) an *ad valorem* export tax.

Quota on Canadian lumber exports

Consider first the quota model illustrated in Figure 4 (see also Figure 5). With a quota, the excess supply curve in Figure 4(b) has a vertical segment at the quota amount Q' . The consumer surplus is given by area r for Canada and by area $(\delta+\varepsilon)$ for the U.S. Canadian producers gain area $(s+u+v)$, while U.S. producers gain γ . Even with a quota, the two countries are better off than under autarky. The gains over autarky are shown in Figure 4(b). In this case, transportation costs are given by area $(C+D)$, while the net producer surplus as a result of trade is F . The net gain to the U.S. (to consumers) is area A . Area B represents an unearned (scarcity) rent attributable to the quota (the *quota rent*), and it accrues to Canadian producers. A Canadian quota only provides quasi rents to U.S. producers, and thus cannot be taxed away like a quota rent.

Compared to unrestricted free trade, with a quota the Canadian price is lower (Canadian consumers are better off) and the U.S. price is higher (U.S. producers are better off, consumers worse off). Overall, compared to free trade, the two countries are worse off with the quota by area G .

Canadian producers are better off with a quota than under unrestricted free trade, because the loss of producer surplus caused by the lower price in Canada is more than

overcome by the quota rent (as demonstrated below). Since Canadian consumers are also better off (due to a lower domestic price in Canada) as are U.S. producers (due to the higher domestic U.S. price), the big loser is the U.S. consumer. Indeed, because free trade in lumber yields the greatest welfare, the U.S. consumer will of necessity lose more than the benefits to the gainers. The extent of any increase to Canadian lumber producers depends on the nature of the price changes, or the extent to which U.S. prices are sensitive to the level of Canadian imports. It depends on the eventual size of the wedge that the quota drives between Canadian and U.S. prices, which is an empirical issue, with Lindsey et al. (2000) indicating that it amounts to more than \$100 per mbf.

Determining the Optimal Quota

It is possible to determine the optimal quota level analytically. Suppose each country's demand and supply curves are linear:

$$(1) \quad P^d = \alpha^j - \beta^j q^j, \quad \alpha^j, \beta^j \geq 0,$$

$$(2) \quad P^s = a^j + b^j q^j, \quad a^j, b^j \geq 0,$$

where j ($=C, U$) refer to Canada and the U.S. Then, the excess demand and supply curves in Figures 4(b) and 5 are calculated as:

$$(3) \quad ED = \alpha - \beta q, \quad \text{with } \alpha = \frac{\beta^U a^U + \alpha^U b^U}{\beta^U + b^U} \geq 0 \text{ and } \beta = \frac{b^U \beta^U}{\beta^U + b^U} \geq 0$$

$$(4) \quad ES = a + b q, \quad \text{with } a = \frac{\beta^C a^C + \alpha^C b^C}{\beta^C + b^C} + t_R \geq 0 \text{ and } b = \frac{b^C \beta^C}{\beta^C + b^C} \geq 0$$

where q refers to the traded amount and $t_R > 0$ is the per unit transportation cost. Setting $ED=ES$ yields the trade equilibrium:

$$(5) \quad q^* = \frac{\alpha - a}{\beta + b}.$$

Now, quota rent QR is a function of the quantity traded:

$$(6) \quad QR(q) = (ED - ES) q = (\alpha - \beta q - a - b q) q.$$

The quota rent for $q=q^T$ is area $(m+n)$ in Figure 5, but changes for various levels of quota as graphed in Figure 6. Note that $QR=0$ when $q=0$ and when $q=q^*$. Set the first derivative of QR to zero and solve to find the quota that maximizes rent:

$$(7) \quad q^R = \frac{\alpha - a}{2(\beta + b)} = \frac{1}{2} q^*.$$

Substituting (7) into (6) gives:

$$(8) \quad QR(q^R) = \frac{1}{4} \left(\frac{(\alpha - a)^2}{\beta + b} \right).$$

Although producers collect the quota rent, they forego producer surplus as a result of reducing output below the unrestricted free trade output. The reason is that price in the domestic market falls, while supply price (but not demand price) falls in the trade market. Therefore, in order to determine the optimal level of the quota from the perspective of producers, it is necessary to determine the level of trade that maximizes the sum of producer surplus and quota rent, and not just the level that maximizes the quota rent:

$$(9) \quad B(q) = \frac{1}{2} (P_C - a^C) (q^C_D + q) \\ = \frac{1}{2} \left((a + bq - t_R) - a^C \right) \left[\frac{1}{\beta^C} (\alpha^C + t_R - (a + bq)) + q \right].$$

If there is no trade, $B(q=0)$ is simply the producer surplus from domestic sales only – the same as under autarky. At q^* , the benefit from quota equals that from free trade, so the quota benefit is zero.

The optimal quota, q^m , is determined by taking the first derivative of $B(q)$, setting it to zero and solving, thereby giving

$$(10) \quad q^m = \frac{(\beta^C - b)(a - a^C) - (\beta^C - 2b)t_R + 2\beta^C(\alpha - a) + b(\alpha^C - a)}{4\beta^C\beta + 2\beta^C b + 2b^2}.$$

It is not possible to demonstrate unambiguously that $q^R < q^m$,³ but it can be shown numerically (see also Figure 6). That is, the quota level that maximizes the quota rent is set lower than that which maximizes the total benefit to producers.

Comparative Static Results

Canadian and American demand and supply relations are impacted by many factors, including changes in consumer tastes, forest regulations and certification programs, new sources of wood supply, technological changes, development of substitutes, and so on. Transportation costs also rise and fall with changes in energy prices and modes of transport. These changes affect the optimal level of the quota. An indication of their directional changes is provided in Table 1.

Upward shifts in the U.S. demand curve for softwood lumber and upward shifts in the U.S. supply curve raise the optimal level of the trade quota.⁴ The opposite occurs when there are similar shifts in Canadian demand and/or supply. Both these results are as expected. An increase in U.S. demand responsiveness – a more elastic demand curve (lower value of β^U)⁵ – is ambiguous since, from relation (3), the excess demand curve will shift while it also becomes flatter. However, based on the numerical results discussed

³ The underlying domestic supply and demand function parameters can be substituted into Equation (10), but the resulting expression is quite complicated. It is available upon request.

⁴ These and other results provided in Table 1 were determined using Maple (Char et al. 1991). The numerical analysis provided below supports these results.

⁵ The elasticity of demand varies along a linear demand curve.

below, the tendency will be to increase the optimal quota (moving it towards the free trade equilibrium quantity), because increased demand responsiveness implies that consumers are more sensitive to lumber prices and more likely to switch to non-wood substitutes as lumber prices rise. An increase in Canadian demand responsiveness has the opposite effect because Canadian producers will look to sell more abroad. That is, a reduction in β^C will tend to shift the excess supply curve downwards and flatten it at the same time, as is evident from equation (4). This causes the optimal quota level to increase.

An increase in the slope of the U.S. supply function will also have an ambiguous effect on the optimal quota level, because, from relation (3), it will shift the excess demand function up (increasing the optimal quota) while flattening it (reducing the optimal quota). An increase in the slope parameter of the Canadian supply curve will reduce the optimal quota because the excess supply curve will shift up and become steeper. Finally, increases in transportation costs will unambiguously reduce the optimal level of the quota.

Exports by Non-quota Constrained Provinces

As noted in the above, only four provinces were covered by the SLA. Non-quota constrained provinces, particularly New Brunswick and Nova Scotia, increased exports of lumber to the U.S. at an annual rate of 27.9% between 1996 and 1999, while exports from quota-constrained provinces fell at a rate of just over 2.0% during this time of increasing U.S. demand. Total Canadian exports of lumber increased slightly during this time to 18.2 bbf, with 15.4 bbf supplied under quota (as the over-quota charge is effective at that quota). With quota busters, the quota can no longer be modeled as a vertical excess

supply curve at the quota amount Q' ($= 15.4$ bbf), but by an excess supply curve that becomes substantially steeper at Q' , and indicated in Figure 4(b) by ES^M . Since ES^M intersects (downward sloping) ED to the right of Q' , the result is to reduce P_{US} slightly, and slightly increase trade and the Canadian domestic price (Figure 4). There is also a (deadweight) loss due to allocative inefficiency given by the difference between ES^M and ES for each unit sold by the quota busting provinces above amount Q' . The effect that this has on determination of the optimal quota is likely small, but is explored in the numerical illustration.

Export taxes and import tariffs

A countervail duty levied by the U.S., or an export tax levied by Canada, has the same effect on price as a quota if the duty or tax is set to achieve the same quantity reduction. Countervail duties and export levies are *ad valorem* taxes that pivot the ED and ES curves, respectively, to ED' and ES' (Figure 5). Assume taxes result in the same trade quantity as with the quota ($q^T=q^Q$). Again the tax (whether export or import) creates a wedge between the U.S. price and the Canadian price that exceeds the transportation cost. The only difference between the quota and tax cases is the distribution of rents. In the case of quota, Canadian lumber producers collect the quota rent. With an export tax, the Canadian government collects area $(m+n)$ in Figure 5, while, with a countervail duty, the U.S. government collects this same area.

Note that an optimal import tariff would be set so that $q=1/2 q^*$, which is identical to the quota level that would maximize the quota rent (see Figure 6). However, as indicated above, it would be smaller than the optimal quota from the perspective of

producers. Further, with either a countervail duty or export tax, Canadian producers are worse off than under either free trade or a quota,⁶ because they do not collect the rent while they continue to lose surplus due to lower domestic prices.

4. Numerical Illustration

The foregoing model can be used to provide some indication of the magnitude of various trade regimes and scenarios on producer incomes and the distribution of rents. For illustrative purposes, the following parameter values were employed: $\alpha^U=2,400$; $\beta^U=32.5$; $a^U=0$; $b^U=11.5$; $\alpha^C=600$; $\beta^C=30$; $a^C=0$; $b^C=15$, with quantity measured in bbf and price in US\$ per mbf. An average transportation cost of US\$50 per mbf was assumed. The values were calibrated to achieve a free-trade equilibrium of just over 20 bbf, and realistic autarkic prices and quantities (\$625/mbf and 54 bbf for U.S., \$250/mbf and 11 bbf for Canada). The free-trade equilibrium quantity and price in the model are 20.4 bbf and \$453/mbf, respectively. Under free trade, Canadian and U.S producers would earn annual quasi rents of \$5,440 million and \$8,960 million, respectively. For this scenario, the optimal quota level would be 15.9 bbf, while 10.2 bbf maximizes the size of the quota rent.

A comparison of alternative scenarios against unrestricted free trade is provided in Table 2. Under both the previous SLA and an optimal quota of 16.84 bbf, Canadian producers gain compared to unrestricted trade. By playing the quota game and forming a cartel to sell Canadian softwood lumber to the U.S., lumber producers in Canada could gain some \$190 million annually compared to what they would earn under free trade.

⁶ Of course, it is possible that, with a quota, there exists a middleman who collects the quota rent.

However, for this illustration, U.S. producers would gain substantially more from a Canadian softwood lumber cartel (some \$1.2 billion yearly). Even Canadian consumers would gain more than Canadian producers (some \$60 million more). The big loser is the U.S. consumer, who collectively loses some \$1.8 billion per year (see Lindsey et al. 2000).

The effect of quota busters is to lower the available gains from playing the quota game. While the SLA restricted quota from four Canadian provinces to 15.4 bbf, exports to the U.S. by non-quota constrained provinces undermined the gains to producers on both sides of the border and, more importantly, increased the loss due to allocative inefficiency – the deadweight loss. More than 98% of the deadweight loss under the SLA (or \$112 million annually) is attributed in the numerical illustration to a shift in production from more efficient to less efficient sources of lumber supply within Canada.

Countervail duties and export taxes have a similar impact on U.S. and Canadian consumers and on U.S. producers as a quota scheme, whether imposed or determined voluntarily. The big difference is in how the excess (quota) rent gets distributed. With a CVD or export tax, Canadian producers are worse off than under free trade, with either the U.S. or Canadian government collecting rents (of some \$0.5 billion annually) that would otherwise have gone to Canadian lumber producers. However, for a similar level of trade, the size of the deadweight loss is much smaller with a CVD or export tax than under the SLA, because there is no distortion of supply within Canada as was the case under the SLA. Notice also that a 6½% CVD has a similar impact as a 15% export tax and that the level of trade is close to what it was under the SLA, while a 15% CVD is much more distorting.

Finally, as indicated in Table 2, an optimal quota will benefit Canada the most and, at the same time, provide the greatest benefits to U.S. producers, all at the expense of U.S. consumers. However, a quota scheme can only be implemented if lumber producers in Canada's various provinces can get together to form a cartel. The effectiveness of the cartel depends on assumptions about the responsiveness of U.S. demand to Canadian imports, or on domestic U.S. supply, the ability of foreign competitors (e.g., Scandinavia) to sell into the U.S. market and possibilities of U.S. consumers to substitute non-wood for wood products. It also depends on the ability of Canadian lumber producers to increase sales to the U.S. in response to price increases in the U.S., and their ability to sell into other export markets. Sensitivity analysis is used to explore these issues.

High demand responsiveness simulates the case where other softwood lumber exporters are able to sell into the U.S. market (as a result of quota on Canadian lumber, say), or where non-wood products more readily substitute for wood products. This is likely truer in the long rather than the short term. This implies that the U.S. demand curve is flatter, so the U.S. price will vary little as Canadian suppliers sell more lumber into the U.S. Further, the wedge that a quota drives between Canadian and U.S. prices is lowest in this case. Low demand responsiveness has the opposite effect.

Low supply responsiveness simulates the case where Canada has many opportunities to export lumber into Asia and other markets (as was the case in the late 1980s), and/or where government restrictions (e.g., a forest practice code) prevent wood product companies from responding quickly to changes in U.S. prices. The Canadian supply curve is steeper as a result. High supply responsiveness assumes quick response to

changes in U.S. prices as Canadian producers have the ability to shift sales to and from other markets, and/or can respond readily to price signals by harvesting more or less logs.

The effect of changes in U.S. demand responsiveness and Canadian supply responsiveness is illustrated in Table 3. Higher U.S. demand responsiveness leads to a higher free-trade equilibrium and optimal quota, but the quota is smaller relative to what would be traded under free trade. The same holds true as Canadian supply responsiveness increases. Further, higher U.S. demand and Canadian supply responsiveness lead to larger proportional gains in producer well being on both sides of the border. Interestingly, U.S. lumber producers stand to gain more from a made-in-Canada softwood lumber cartel than do Canadian producers.

5. Discussion and Policy Implications

Given that the underlying causes of the Canada-U.S. softwood lumber trade dispute remain (a high degree of public ownership of timber in Canada, log export restrictions, and a weak Canadian dollar), U.S. efforts to restrict Canadian lumber imports are likely to continue in the future. The forgoing analysis has clearly demonstrated that restrictions on softwood lumber trade will benefit producers on both sides of the border, as well as Canadian consumers, all at the expense of U.S. consumers. In light of this, it helps to view the dispute from a game theoretic perspective. Consider a two-player game involving Canada and the U.S. As long as both countries ignore the well being of consumers, the solution to the trade dispute, or to the game, is straightforward – restrict imports of Canadian lumber into the U.S. market.

From Canada's perspective, the best strategy is to encourage Canadian softwood lumber producers to form a cartel to sell lumber to the United States. This provides the

greatest benefits to Canadian producers, while U.S. producers would welcome such a cartel, although their preferred solution (with the greatest producer surplus or quasi rent) would be no trade whatsoever. Unlike a U.S. attempt to tax the increase in quasi rent accruing to U.S. producers, the Canadian government could even tax the quota rent without affecting output, because the quota rent constitutes a form of scarcity (resource) rent. Alternatively, Canada could employ an export tax and directly collect the rent created by the trade restriction. Game theory suggests that the most troublesome solution would be a countervail duty. As demonstrated in this paper, a CVD results in large U.S. government revenues at the expense of Canadian lumber producers (with U.S. producers no better or worse off than under a quota or Canadian export tax). Since a CVD provides no benefits to Canada, Canada will always seek to get around it. It did this in 1987 via the MOU to impose a 15% tax on lumber exports and again in 1996 with the SLA.

The Softwood Lumber Agreement was flawed from Canada's perspective because it (1) permitted quota busting by non-covered provinces, (2) failed to include all softwood lumber products, and (3) did not include a mechanism for allocating quota among covered provinces and producers in those provinces. A successful quota scheme requires that all of Canada's softwood lumber exports be included. Any supplies of non-covered lumber (roughers, pre-drilled studs, high-end products that are exempt from quota) and sales by non-quota provinces reduce the U.S. price and the potential gains from playing the quota game. A successful lumber cartel also needs to abandon the notion of a "threshold" price, above which lumber products could under the SLA enter the U.S. outside the quota scheme. A trigger mechanism simply constitutes another means by which some producers are able to get around the quota scheme, thereby undermining it to

the detriment of producers on both sides of the border. It also encourages value added that could more efficiently take place elsewhere, namely in the U.S.

Insights from the two-player game are limited because the problem in Canada is to get agreement among provinces and producers. Provinces vigorously guard their autonomy over forestry policy and the wood products industry, making it difficult to agree on a method for allocating quota.⁷ Based on the numerical illustration provided in this paper, the benefits of forming a made-in-Canada softwood lumber cartel could be some \$190 million annually. As with any cartel, the cartel must determine how to distribute the gains (or quota) and compensate high-cost producers, and deal with the existence of (foreign) producers outside the cartel. That this has not yet been tried suggests that the transaction costs of forming a cartel exceed its perceived benefits (perhaps the estimate of benefits provided here is too large) and/or that Canadian policy makers have failed to recognize the potential benefits of restricting trade.

In any event, Canada's position has favored free trade. Based on the above insights and the analysis in this paper, Canada should nonetheless make an effort to form a softwood lumber cartel to restrict lumber exports. U.S. producers should not oppose such a cartel and may even support it (viz., U.S. companies producing lumber on both sides of the border). The eventual outcome of this "game" will be either to enhance the incomes of U.S. and Canadian lumber producers or bring the U.S. Justice Department into the fray. In the latter case, free trade will be the most likely outcome. While export taxes might be considered a second best alternative, Canada should reject a countervail duty under any circumstances.

⁷ To gain insights into what it might take to achieve agreement requires a more complex, multiple-player game, the development of which is beyond the scope of the current paper.

Literature Cited

- Adams, D.M., and R.W. Haynes. 1980. The 1980 softwood timber assessment market model: Structure, projections, and land policy simulations. Monograph 22, Supplement to For. Sci. 26 (3).
- Adams, D.M. and R.W. Haynes. 1987. Interregional modeling. Chapter 16 in The global forest sector: An analytical perspective, M. Kallio, et al. (eds.). John Wiley & Sons, New York.
- Boyd, R., K. Doroodian, and S. Abdul-Latif. 1993. The effects of tariff removals on the North American lumber trade. *Can. J. of Agric. Econ.* 41: 311-28.
- Char, B.W., K.O. Geddes, G.H. Gonnet, B.L. Leong, M.B. Monagan and S.M. Watt. 1991. *Maple V library reference manual*. Springer-Verlag, Berlin.
- Grafton, R.Q., R.W. Lynch, and H.W. Nelson. 1998. British Columbia's stumpage system: Economic and trade policy implications. *Can. Pub. Pol.* 24: S41-50.
- Haley, D. 1996. *Paying the piper: The cost of British Columbia's Forest Practices Code*. Working Paper, Dep. of For. Res. Man., Univ. of British Columbia, Vancouver, Canada.
- Howe, C.W. 1979. *Natural resource economics*. John Wiley & Sons, Toronto.
- Hyde, W.F., and R.A. Sedjo. 1992. Managing tropical forests: Reflections on the rent distribution discussion. *Land Econ.* 68: 343-50.
- Lindsey, B., M.A. Groombridge and P. Loungani. 2000. Nailing the homeowner. The economic impact of trade protection of the softwood lumber industry. Center for Trade Policy Studies Report No. 11 (July 6), CATO Institute, Washington DC. 16 p.

- Canadian Forest Service. 2000. Canada-United States Softwood Lumber Agreement. Quarterly Statistical Monitor. No. 14. Natural Resources Canada, Ottawa.
- Ricardo, D. 1817 (1977). Principles of political economy and taxation. J.M. Dent & Sons Ltd., London.
- Ruzicka, I. 1979. Rent appropriation in Indonesian logging: East Kalimantan 1972/3 – 1976/7. Bull. of Indonesian Econ. Stud. 15: 45-74.
- Vincent, J.R. 1990. Rent capture and the feasibility of tropical forest management. Land Econ. 66: 212-23.
- Vincent, J.R. 1993. Managing tropical forests: Comment. Land Econ. 69: 313-18
- Wang, S., and G.C. van Kooten. 2001. Forestry and the new institutional economics. Ashgate Publishing, Aldershot, UK. 201 p.
- Wilson, B., G.C. van Kooten, I. Vertinsky, and L.M. Arthur. 1998. Forest policy: International case studies. CABI Publishing, Wallingford, UK. 273 p.
- Zhang, D., and C.S. Binkley. 1995. The economic effect of forest policy changes in British Columbia: An event study of stock-market returns. Can. J. of For. Res. 25: 978-986.
- Zhang, D., and P.H. Pearse. 1996. Differences in silvicultural investment under various types of forest tenure in British Columbia. For. Sci. 42: 442-449.

Table 1: Effect on Optimal Quota Level of Changes in U.S. and Canada Supply and Demand Parameters, Comparative Static Results

Item	Canada	United States
Shifts in Demand	$\frac{\partial q^m}{\alpha^C} < 0$	$\frac{\partial q^m}{\alpha^U} > 0$
Changes in Slope of Demand	$\frac{\partial q^m}{\beta^C} > 0$	$\frac{\partial q^m}{\beta^U} ??$
Shift in Supply	$\frac{\partial q^m}{a^C} < 0$	$\frac{\partial q^m}{a^U} > 0$
Changes in Slope of Supply	$\frac{\partial q^m}{b^C} < 0$	$\frac{\partial q^m}{b^U} ??$
Change in Transportation Costs		$\frac{\partial q^m}{t_R} < 0$

Table 2: Trade Levels, Economic Surpluses, Prices and Transportation Costs under Various Model Assumptions

Item	Scenarios				
	SLA ^a	Optimal Quota	15% CVD	6½% CVD	15% Export Tax
Quantity traded ($\times 10^9$ mbf)	18.80	16.84	16.99	18.86	18.87
Deadweight Loss (\$ mil)	135.95	117.15	107.27	21.96	21.65
Canada					
Domestic price (\$/mbf)	388.00	368.40	369.93	388.58	388.69
Δ Consumer surplus (\$ mil)	108.76	253.67	241.86	104.67	103.89
Δ Producer surplus (\$ mil) ^b	21.56	192.13	-878.65	-407.23	-404.37
Δ Government revenue (\$ mil)	n.a.	n.a.	0.00	0.00	534.06
United States					
Domestic price (\$/mbf)	467.58	484.23	482.92	467.09	466.99
Δ Consumer surplus (\$ mil)	-810.63	-1,796.29	-1,719.42	-781.35	-775.78
Δ Producer surplus (\$ mil)	544.36	1,233.34	1,178.52	524.35	520.55
Δ Government revenue (\$ mil)	n.a.	n.a.	1,070.42	537.60	0.00

^a If trade quantity is supplied efficiently, Δ in producer surplus would be \$133.86 million and deadweight loss \$23.65 million. Gain in Canadian producer surplus is smaller, and deadweight loss larger, because lumber in excess of 15.4 bbf is supplied from a higher-cost source, at a net cost of \$112.30 million. This value is the area between the ES^M and $ES +$ transportation costs curves in Figure 4(b), and between 18.8 and 15.4 bbf.

^b Includes a quota rent, where applicable.

Table 3: Impact of a Countervail Duty or Export Tax (Tax rate=15%)

	U.S. Demand Responsiveness					
	Low ($\beta^U=35$)			High ($\beta^U=30$)		
	Canadian supply responsiveness:					
	Low ($b^C=17$)	Medium ($b^C=15$)	High ($b^C=13$)	Low ($b^C=17$)	Medium ($b^C=15$)	High ($b^C=13$)
Free trade quantity (bbf)	16.74	18.41	20.43	20.77	22.66	24.95
Optimal quota (bbf)	14.49	15.56	16.78	17.09	18.30	19.70
Quota as proportion of free trade output	0.866	0.845	0.821	0.823	0.808	0.790
<i>Gain in producer well being from an optimal quota</i>						
Canadian producers	1.7%	2.5%	3.8%	3.7%	4.7%	6.1%
U.S. producers	8.9%	11.7%	15.7%	15.8%	12.8%	20.0%

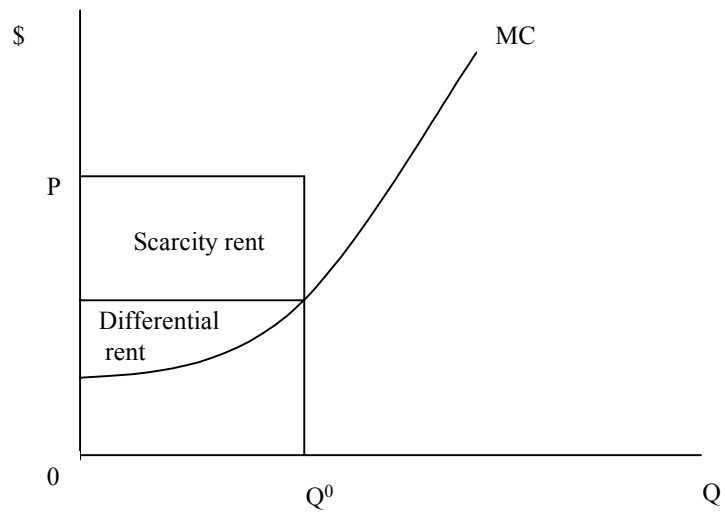


Figure 1 Differential and scarcity rents

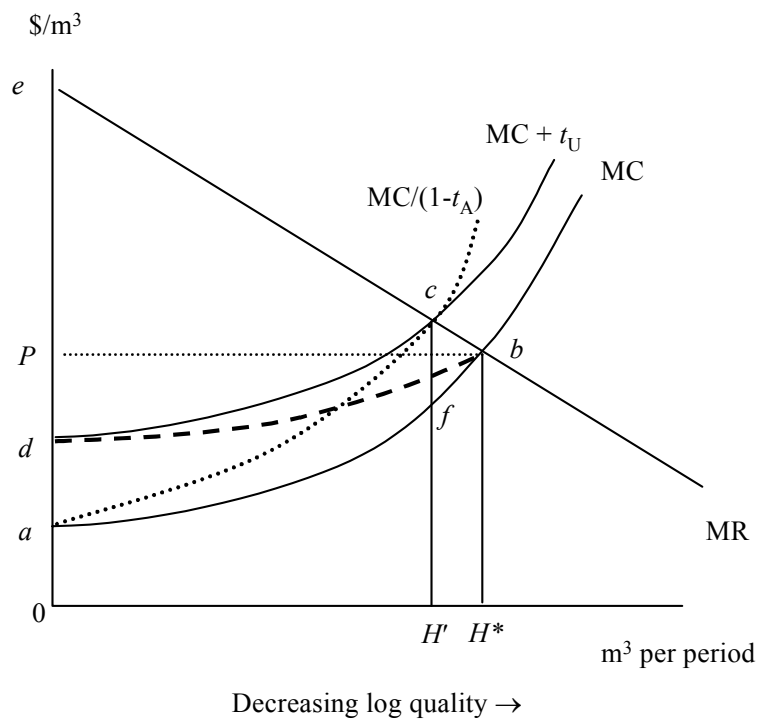


Figure 2: Methods of rent capture in forestry

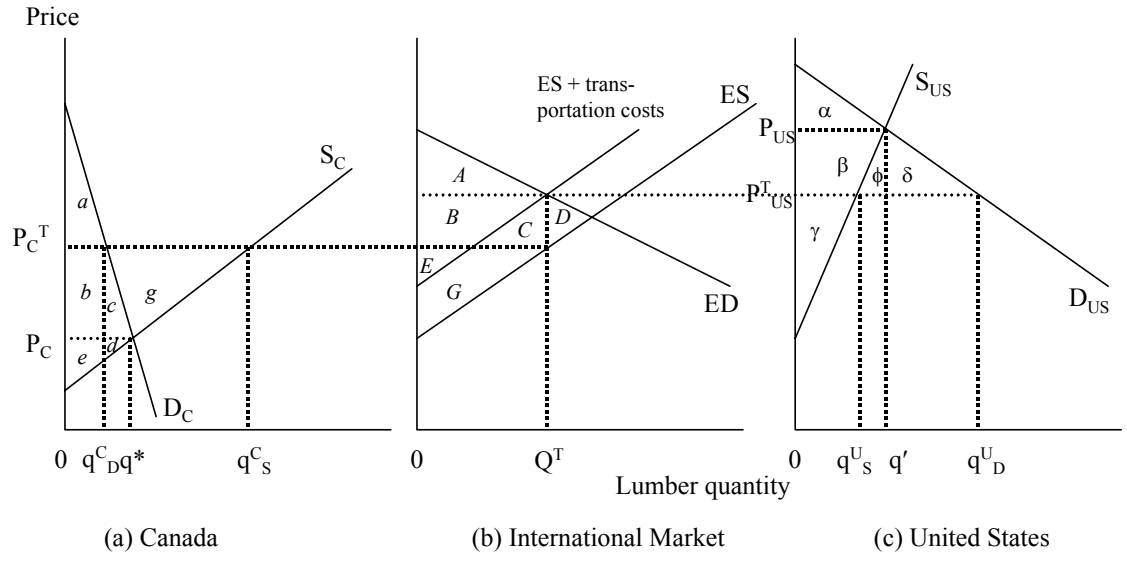


Figure 3: Model of international trade in softwood lumber

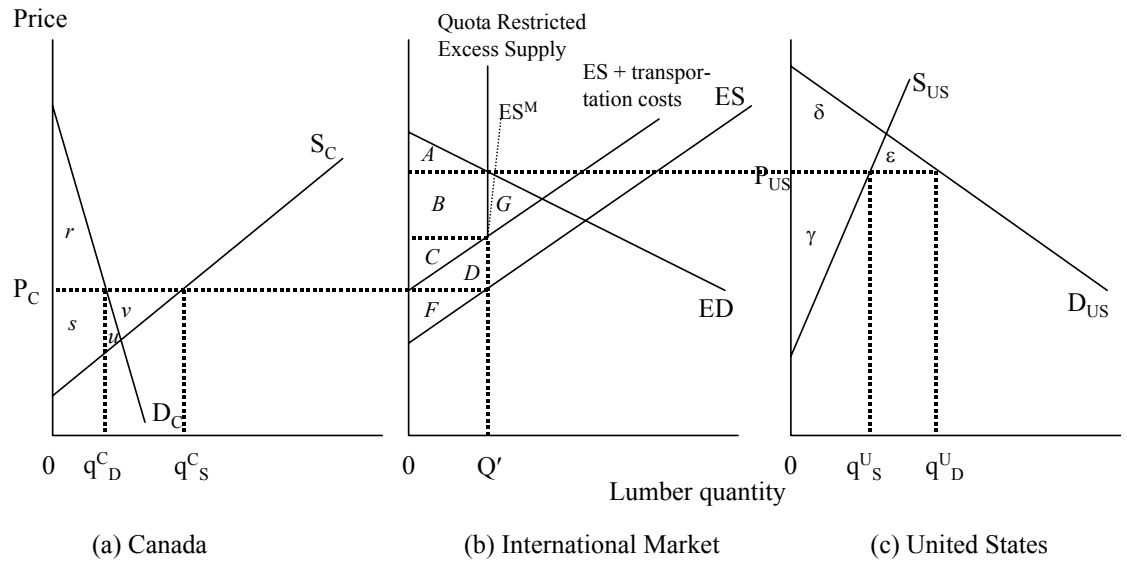


Figure 4: Economics of softwood lumber quota in an international trade model

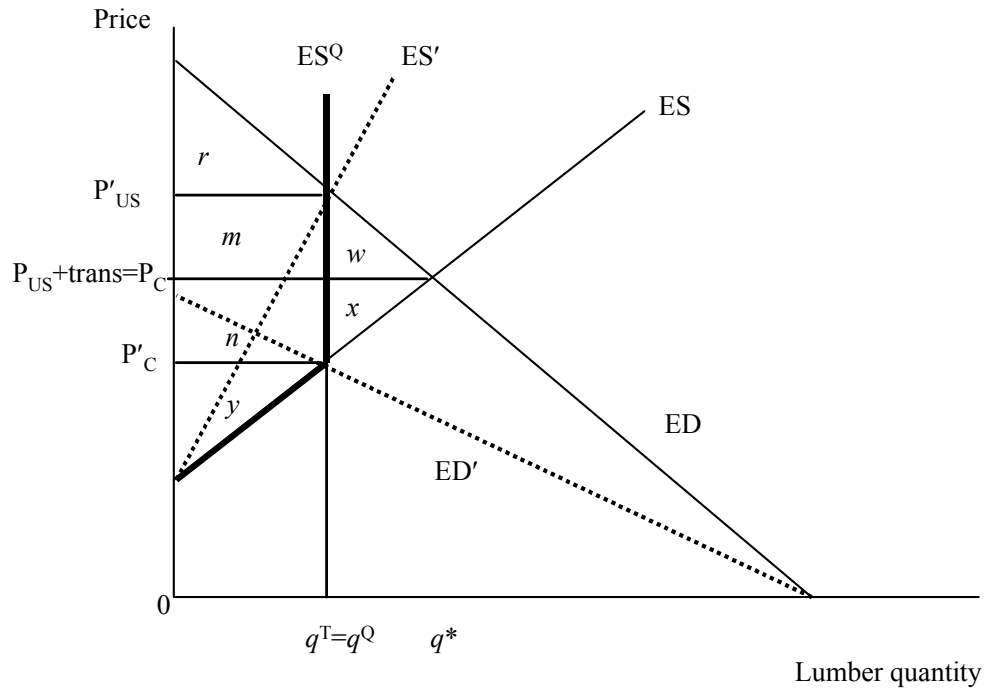


Figure 5: Available U.S. market under a quota, and with export and import taxes

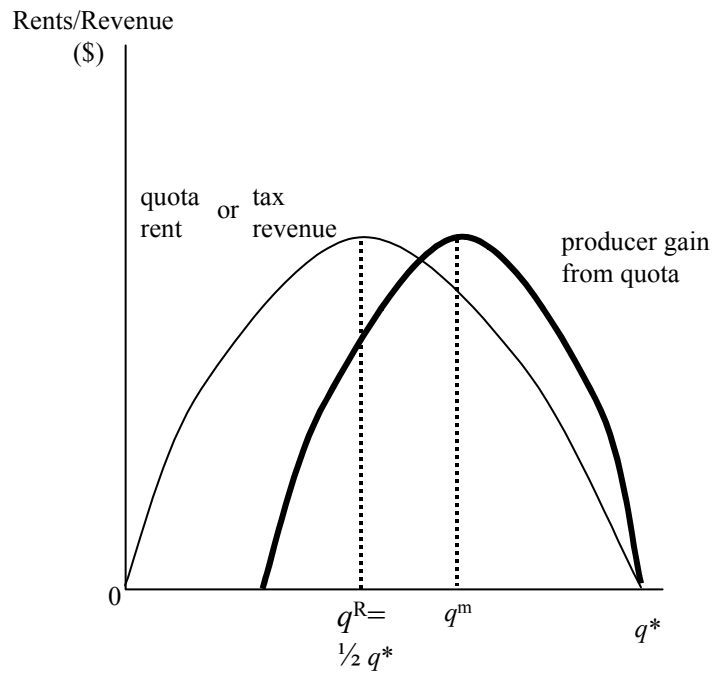


Figure 6: Quota rents versus producer gains from quota