
Faculty of Social Science

Faculty Publications

This is a post-print version of the following article:

COVID-19 impacts on U.S. lumber markets

G. Cornelis van Kooten, Andrew Schmitz

2022

This article is distributed under the terms of the Creative Commons Attribution License. <https://creativecommons.org/licenses/by-nc-nd/4.0/>

The final publication is available at:

<https://doi.org/10.1016/j.forpol.2021.102665>

Citation for this paper:

van Kooten, G. C. and Schmitz, A. (2022). COVID-19 Impacts on U.S. Lumber Markets, *Forest Policy and Economics* 135(February): 102665.
<https://doi.org/10.1016/j.forpol.2021.102665>

COVID-19 Impacts on U.S. Lumber Markets

by

G. Cornelis van Kooten*

Department of Economics

University of Victoria, Victoria, Canada.

Email: kooten@uvic.ca

and

Andrew Schmitz

Department of Food and Resource Economics

University of Florida, Gainesville, FL

Email: aschmitz@ufl.edu

* Corresponding author

DRAFT: November 26, 2021

Abstract:

The Covid-19 pandemic led to an unprecedented increase in the U.S. price of softwood lumber by more than 300 percent. The reasons for this increase have been attributed to constraints on supply caused by pandemic-induced labor shortages, and increased demand for lumber caused by a Covid-19 related boom in domestic real estate and home improvements. In this paper, we examine the effect that these factors might have had on the increase in prices and the related changes in the welfare of U.S. lumber manufacturers and downstream users of lumber. We examine three cases where the demand function shifts outwards: (1) the lumber supply function remains unchanged; (2) the U.S. lumber supply function and that of its trading partners shifts inwards; and (3) U.S. lumber producers restrict output at its pre-Covid level. Overall, we find that U.S. producers gained between \$0.7 and \$8.0 billion per quarter as a result of the pandemic, while downstream processors gained \$639 million. We argue, however, that the ultimate consumer of the downstream products that require lumber as an input (housing construction, furniture) might well be worse off as surplus lost as a result of reduced expenditures on commodities and services restricted by Covid-19 are not quite recovered when spending switches to lumber-related commodities.

Key Words: lumber pricing; trade; vertical chain welfare measurement

Highlights:

- Best explanation for a pandemic-induced 300% increase in softwood lumber prices in North America is increased demand, not limited supply.
- An increase in consumer surplus occurs despite the rise in price due to outward shift in demand.
- Major gains in welfare accrue to softwood lumber producers or forestland owners.
- Gains in consumer surplus in the lumber market represent increased quasi-rents that accrue to downstream lumber users, mainly construction companies.
- Lumber producers and downstream processors of lumber gain at the expense of providers of goods and services restricted by Covid lockdowns.

1. INTRODUCTION

The Covid-19 pandemic created havoc with global lumber markets. With many people forced to work at home or otherwise remain near home, some decided to expand their living space by purchasing larger homes. With extremely low interest rates and unknown circumstances, others invested in first homes or purchased additional properties (e.g., recreational properties, second or third or more homes). The result was a booming property market. Yet others decided to invest in home improvements, or purchase new furniture. These decisions increased the demand for lumber and related wood products (plywood, OSB, etc.). Meanwhile, lumber producers were unable to increase supply fast enough to address growing demand.

The situation was recently summarized in a Canadian Forest Service (2021) science-policy note as follows:

Lumber prices in Canada and the United States have recently reached record highs. Prices are so high because builders and homeowners are buying up very large amounts of lumber, and producers have not been able to increase production quickly enough to meet the demand. Consumers are buying lumber for new home construction and residential repair and remodelling projects. These activities started ramping up after the early months of the COVID-19 pandemic and remain very strong today. Despite high prices, it is not easy for lumber companies to increase production rapidly. They must consider a variety of market factors (for example, availability of timber and labour), as well as plan and carry out expansion projects. Lumber production in Canada and the U.S. has not increased significantly from pre-pandemic levels, and is not expected to before early 2022.

The price of lumber sold in the U.S. increased from \$319.70 per thousand board-feet (mbf) in April 2020, as the pandemic began to look as if it would take some time to resolve, to a peak of \$1,500.50/mbf exactly one year later. Meanwhile, the composite framing construction price of lumber increased from \$354/mbf in April 2020 to a peak of \$1,479/mbf in May 2021. The monthly prices of U.S. lumber and the composite framing lumber price index are provided in Figure 1. Higher prices of lumber were touted as a contributing factor to rising rates of inflation in the U.S.

and elsewhere.

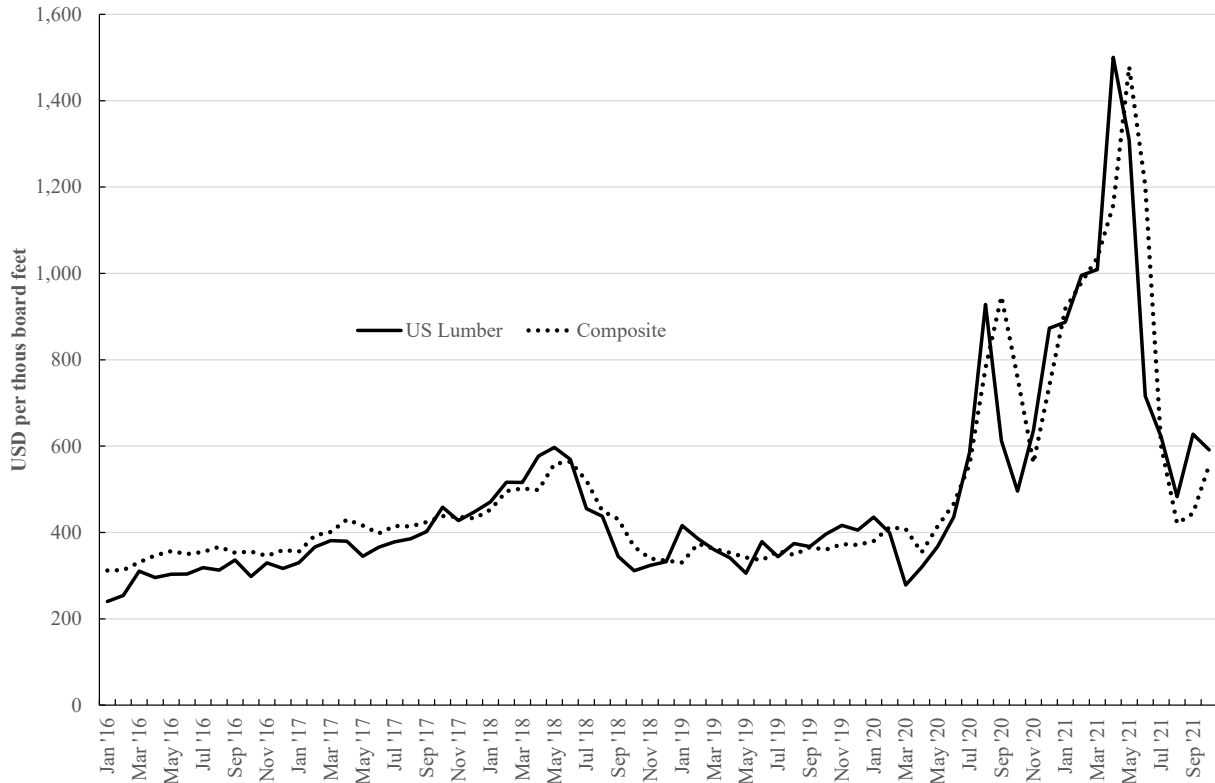


Figure 1: Monthly Prices of Lumber Sold in the U.S. and the Composite Framing Price Index, January 2016 through October 2021
Source: Statista (2021) and Random Lengths (2021)

The composite framing price index is important because it had been used in the latest Softwood Lumber Agreement (SLA) between Canada and the U.S. as a trigger for determining the export tax that Canada would apply to lumber exported to the U.S. Under the SLA that ran from 2006 to 2016, no export charge was levied if the composite price index rose about \$355/mbf (van Kooten et al. 2021, p.17). After the SLA expired and prior to the pandemic, the U.S. applied new combined countervailing (CV) and anti-dumping (AD) duties of 8.99 per cent, down from the 20% originally set. However, the U.S. Department of Commerce recently announced that it would raise the CV plus AD duty to 18.32% from 8.99%, despite the recent high lumber prices (Healing 2021).

The Covid pandemic resulted in a significant outward shift in the demand function, while

the supply function likely shifted inwards due to labor shortages.¹ Yet, there may have been some supply response as lumber manufacturers expanded output by sliding up the higher marginal cost function in response to higher lumber prices. With the exception of the U.S. South, few forestry jurisdictions have the ability to shift the supply curve out, rather responding only to the price increases by sliding up rather inelastic supply functions. For example, Canada is the world's largest exporter of lumber, but its wood supply is constrained by provincial government sustainability requirements through an annual allowable cut (AAC) as evident in Figure 2.² The Province of British Columbia accounts for about half of the country's lumber exports, most of which are to the U.S. However, the annual timber that can be harvested in BC is determined by the government's timber supply analyses, with the AAC seeking to balance the need for government revenue from the resource and environmental lobbying to prevent harvests, particularly of old growth. Indeed, as a result of revived controversy about logging old-growth timber and recent wildfires, the supply of logs may have declined somewhat. In that case, lumber manufacturers would have employed logs in their inventories.³

What is neglected in discussions regarding the effect of the rapid increase in the price of lumber has been their welfare impacts. Which parties have gained and which have experienced a loss as a result of the pandemic? In particular, we focus on the distribution of welfare gains and losses in the United States, although we also consider the Canadian market because some one-quarter or more of U.S. softwood lumber is imported from Canada. In this study, we employ standard welfare economics theory to examine this issue (Just et al. 2004). We begin in the next

¹ There is little evidence to suggest that the supply curve shifted inwards to a large extent. To account for the large increase in the price of lumber, therefore, the demand function must have shifted outwards to a degree that seem unreasonable and could, perhaps, be explained to some extent as the result of speculation. This is an issue for future research (see Schmitz et al. 2016).

² These data are the latest available.

³ Sawmills will harvest logs even if they cannot immediately use them, storing logs for future use.

section with a theoretical model of lumber markets and the potential welfare impacts. We conclude with some remarks concerning the implications of the research.

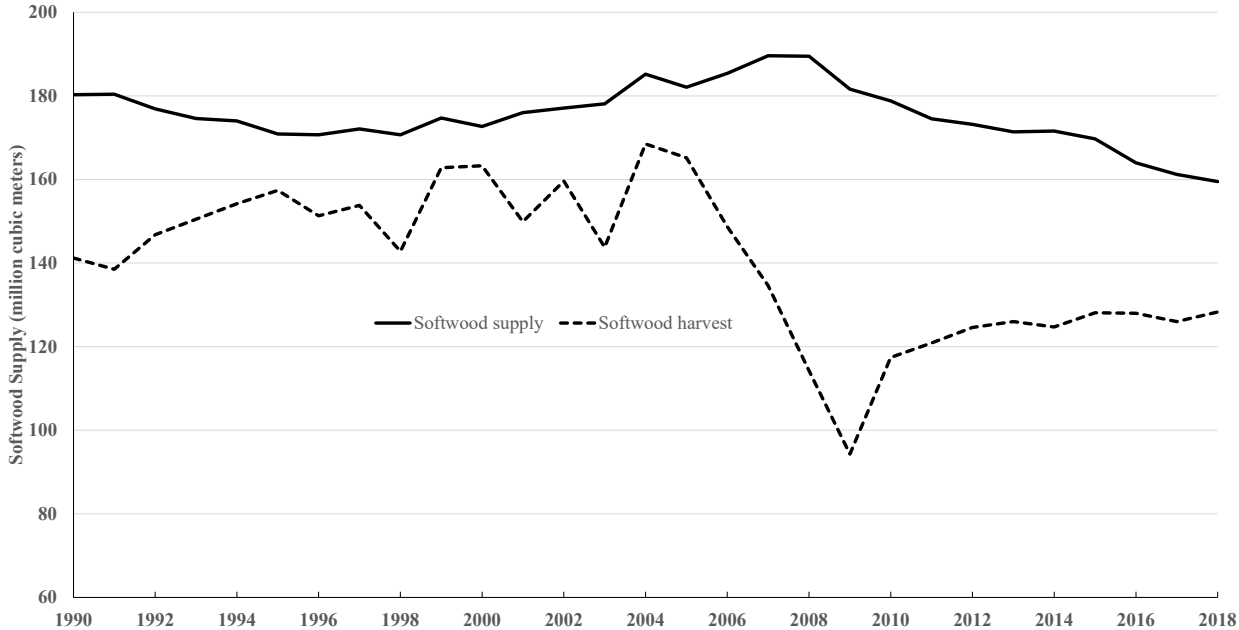


Figure 2: Softwood Timber Supply and Harvest, Canada, 1990-2018, '000s m³
 Source: Natural Resources Canada (2021)

2. MODELING WELFARE IMPACTS OF COVID-19

We examine the gains and losses in the welfare of consumers and producers resulting from an outward shift in the U.S. demand for lumber with the aid of Figure 3. In Figure 3(a), S and D refer to the respective U.S. domestic supply and demand schedules prior to the pandemic outbreak, while D' represents the Covid-induced increase in demand. If it is assumed that there is also a Covid-induced change in supply, the new supply schedule becomes S', perhaps reflecting a constraint on labor and the need to pay higher wages. We consider three cases: (1) demand shifts to D' with no shift in supply; (2) demand shifts to D' and supply shifts inward to S'; and (3) lumber producers exercise market power and fix supply at Q_s when demand shifts outward to D'.

The global export market for softwood lumber is modeled in Figure 3(b); it is dominated

by Canada, because it is the largest exporter of lumber to the U.S. Lumber exporting countries face an excess U.S. demand function ED, while their excess supply is denoted ES; we assume that ES includes shipping and handling costs. For simplicity and without loss of generality, it is further assumed that the demand for lumber in the rest of the world has also increased, but that this demand is offset by increased supply in the rest of the world so that the ES function remains unchanged. In the second and third cases, it is assumed that the ES function shifts inwards to ES', reflecting either a strong reduction in supply or, as indicated in the figure, an increase in the tariffs imposed by the U.S. Department of Commerce, or a combination of both.

Pre-Pandemic Situation

Consider first the situation prior to the pandemic. Market equilibrium occurs at point e in the right side panel, as determined by the intersection of ES and ED, which determines the world price (P). At that price, American lumber producers sell Q_S and domestic consumption equals Q_D , with the difference imported from abroad, mainly Canada. Global exports to the U.S. equal $X_E (= Q_D - Q_S)$. From panel (a), domestic consumers in the U.S. experience a surplus given by area ($\beta P\sigma$) and producers of lumber a surplus given by ($Pa\lambda$), while the rest of the world (panel b) earns an overall surplus of (Pue).

Post-Pandemic Cases

Shift in Demand Only

Now consider the situation after the pandemic occurred, where the U.S. demand function shifted outwards to D' . In the case where the supply function remains unchanged from its pre-pandemic level, equilibrium occurs at e' in panel (b). At price $P' > P$, $Q_{D'}$ is consumed in the U.S. Lumber producers in the U.S. now sell $Q'_S > Q_S$. The shift in U.S. domestic demand causes the excess demand function in panel (b) to shift to ED' (as shown by the arrow on the right). Then, in the rest

of the world (ROW), the price also rises from P to P' (minus shipping and handling costs that are implicitly taken into account in ES). ROW exports increase to X'_R from X_R ; the increase in ROW exports may come from a reduction in domestic consumption in regions outside the U.S. (due to the higher price consumers face) and/or from an increase in their supply.

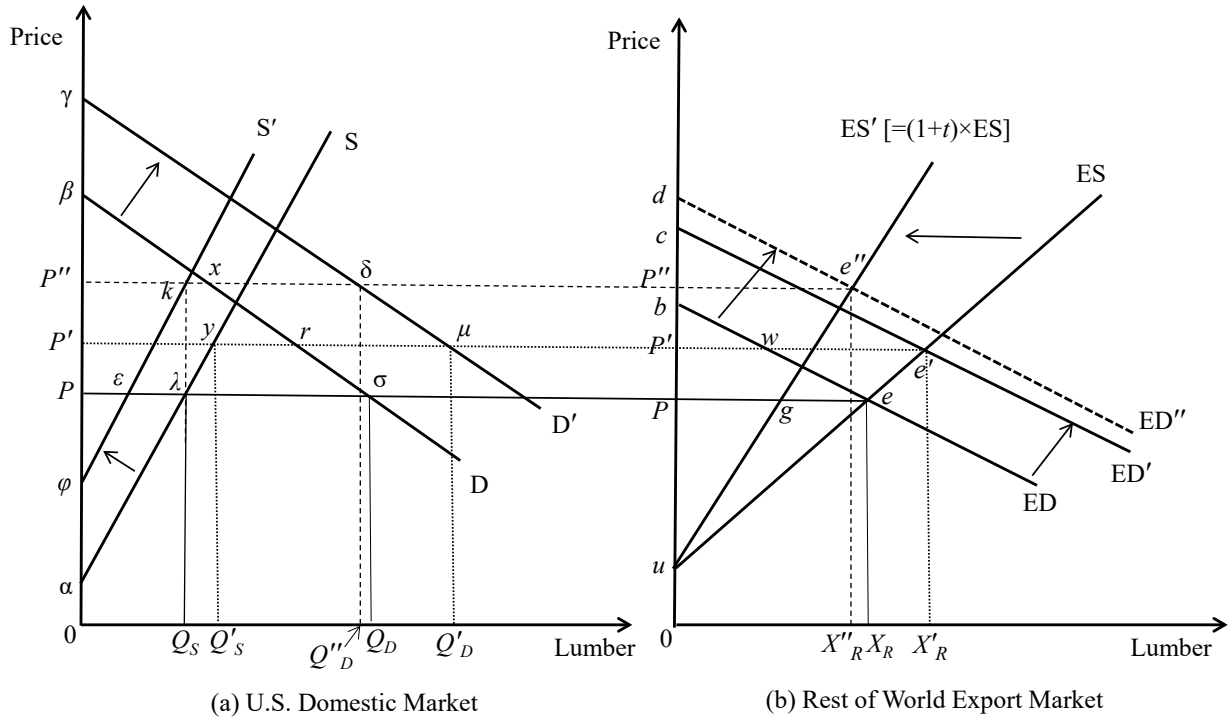


Figure 3: Expanded U.S. Demand for Lumber: Welfare Measures With and Without Supply Shifts in U.S. and Rest of World Markets

Demand and Supply Shifts

Now assume that, in addition to the outward shift in U.S. demand, there is an inward shift of the supply curve due to a pandemic-induced shortage of workers that increases the marginal costs of producing lumber. This causes the U.S. excess demand function to shift to ED'' (as indicated by the arrow on the left in panel b)—the dashed ED curve. In this case, we also assume that the U.S. increases the tariff (denoted t) imposed on Canadian imports of softwood lumber (as Canada is the largest source of imported lumber) and/or that Covid-induced labor shortfalls are experienced

elsewhere as well. That is, it is assumed that the ES schedule shifts to ES'. In that case, U.S. consumption declines to $Q''_D (\approx Q_D)$ and ROW world exports fall to $X''_R (= Q''_D - Q_S)$.⁴ Note that, depending on the shifts to excess supply and demand—the extent of the shifts in ES' and ED''—will determine whether ROW exports to the U.S. decrease or increase—whether $X''_R \leq X_R$ or $X''_R > X_R$. This will depend on the elasticities of domestic supply and demand in each of the countries involved in softwood lumber trade. With the inward shift of supply in both the U.S. and ROW markets, U.S. consumer surplus is given by area $(\gamma P''\delta)$ and producer surplus by $(P''\phi k)$.

Demand Shift and Vertical Supply

We also consider a constrained case where the U.S. supply function does not shift inwards as a result of increased input costs, but, rather, that lumber manufacturers take advantage of the increased demand by restricting output—thereby speculating that they can garner monopoly rents. It is assumed that U.S. production is fixed at Q_S , which would cause the U.S. excess demand function to shift and pivot (not shown in the figure). In this constrained case, we also assume that the ES supply function pivots to ES' in panel (b); for convenience and without loss of generality, we further assume the intersection between ES' and ED (not shown) occurs at point e'' .

Summary of Welfare Effects

What interests us are the welfare effects of the pandemic as viewed in the lumber market. The welfare effects are summarized in Table 1. ROW producers of lumber gain, while ROW consumers lose as a result of the Covid-induced increased demand for lumber. The reason is that the shift in U.S. demand causes an increase in ROW lumber prices that is exacerbated when the U.S. supply function and/or ROW excess supply shifts inwards (or U.S. supply is constrained when ES shifts

⁴ For convenience of presentation, we assume that the intersection of S' and P'' occurs at the same consumption level as the intersection of S and P, namely, Q_S .

inwards). Overall, however, the losses to ROW consumers can be compensated for by the gains to its lumber producers.

The situation in the U.S.—the net importing country—is somewhat different. First, if the demand function remains fixed, and suppliers slide up their existing supply functions, U.S. consumers would lose the area bounded by points ($P'P\sigma r$), while U.S. producers gain ($P'P\lambda y$). Overall, there is a loss given by $(P' - P) \times (Q''_D - Q_S)$, where the gain to U.S. producers is less than the loss to U.S. consumers; in essence, U.S. consumers bear the brunt of the costs. If welfare is measured under the Covid-induced U.S. demand function, then there is an additional gain to U.S. consumers given by the area between the pre-pandemic and pandemic-induced demand functions, namely, area ($\gamma\beta r\mu$). In that case, there is an overall net change in U.S. wellbeing attributable to the pandemic, which is measured by $(\gamma\beta r\mu - P'P\sigma r + P'P\lambda y)$ in Figure 3(a) or by $(cbee' - P'Pew)$ in Figure 3(b).

Table 1: Welfare Effects from a Covid-19 Shift in Demand for Lumber, Various Scenarios

Item	Pre-Covid	No Supply Shifts	With Domestic and International Supply Shift	Constrained Domestic Supply and International Supply Shift
United States Domestic Market – Figure 3(a)				
Consumer surplus	$\beta P\sigma$	$\gamma P'\mu$	$\gamma P''\delta$	$\gamma P''\delta$
Δ CS	–	$\gamma\beta r\mu - P'P\sigma r$	$\gamma\beta x\delta - P''P\sigma x$	$\gamma\beta x\delta - P''P\sigma x$
Quasi-rent ^a	$P\alpha\lambda$	$P'\alpha y$	$P''\phi k$	$P\alpha\lambda + P''P\lambda k$
Δ QR	–	$P'P\lambda y$	$P''\phi k - \phi\alpha\lambda\epsilon$	$P''P\lambda k$
United States Import Market – Figure 3(b)				
Surplus	$\underline{b}Pe$	$cP'e'$	$dP''e''$	$dP''e''$
Δ Surplus	–	$cbee' - P'Pew$	$dP''e'' - bPe$	$dP''e'' - bPe$
Rest of World Export Market – Figure 3(b)				
Surplus	Pue	$P'ue'$	$P''ue''$	$P''ue''$
Δ Surplus	–	$P'Pee'$	$P''Pge'' - ueg$	$P''Pge'' - ueg$

^a In the case of constrained supply, the quasi-rent includes a scarcity or monopoly rent,

Source: Authors' analysis

A similar analysis shows that the change in U.S. welfare, when domestic demand increases while supply shifts inwards, is given by $(\gamma\beta x\delta - P''P\sigma x + P''P\lambda k)$ in Figure 3(a) that is equivalent to $(P''Pge'' - ueg)$ in Figure 3(b). The same is true if supply is simply constrained to Q_s , where the supply function is vertical at that point. In that case, the gain to producers is $(P''P\lambda k)$, which is a pure scarcity or monopoly rent rather than a producer surplus.

Finally, and importantly, we note that the demand for softwood lumber is principally a derived demand. This implies that the consumer surplus measures in Figure 3 consist of producer surpluses that accrue to downstream producers of commodities that employ lumber as an input (e.g., home builders, furniture makers) plus consumer surplus that accrues to those who purchase these downstream products (e.g., home buyers). The extent to which these surpluses in the downstream market are shared between suppliers and consumers depends on the elasticities of demand and supply in the various downstream commodity markets (see van Kooten and Johnston 2021, pp.28-33).

3. MEASURING WELFARE GAINS AND LOSSES

Measurement Model

In this section, we develop a model that helps identify the gains and losses due to Covid impacts on the lumber sector. The derivation of the excess demand (ED) and excess supply (ES) functions for lumber in any given region is straightforward (van Kooten et al. 2021, pp.22-24). In the absence of trade, domestic consumption, production and price are determined by the intersection of the domestic supply (S) and demand (D) schedules. According to the law of one price, a country will engage in trade if the world price of lumber is greater or less than the domestic autarkic price plus (if exporting) or minus (if importing) the shipping and handling (S&H) costs. If the world price is higher than the domestic price, the country will export lumber; if the world price is lower, it will

import lumber even if it produces more than that produced in the exporting country. How much will it supply or demand?

It is a simple matter to derive the ED and ES schedules mathematically if one assumes linear (inverse) demand and supply functions as:

$$(1) \quad P^D = \alpha - \beta q, \alpha, \beta \geq 0, \text{ and}$$

$$(2) \quad P^S = a + bq, a, b \geq 0.$$

The excess demand and supply curves are then given by:

$$(3) \quad ED = \gamma - \delta q, \text{ and}$$

$$(4) \quad ES = \gamma + mq,$$

where $\gamma = P^* = \frac{a\beta + b\alpha}{\beta + b} \geq 0$ and $m = \delta = \frac{b\beta}{\beta + b} \geq 0$. Notice that γ is the equilibrium domestic price,

so that, in the absence of S&H costs and tariffs, the excess supply and demand curves start at the same point on the vertical (price) axis. Further, the absolute slopes of the ED and ES curves are identical, although ED slopes down and ES slopes up.

In the case where supply is restricted in Figure 3, the U.S. excess supply function in panel (b) has an intercept, d , determined by the equilibrium price at which D' and S' intersect in panel (a), and a slope equivalent to the slope of the demand function D' , becoming steeper only when price falls below P (not shown).

Data

The most recent data on U.S. production, consumption, imports and prices are found in Table 2. These indicate that U.S. softwood lumber consumption went up by 3.1% from 1stQ 2020 to 1stQ 2021, while U.S. lumber production went up slightly over that period. Since estimates of

elasticities of demand and supply of softwood lumber vary considerably, we employ Monte Carlo simulation over elasticities to estimate the welfare gains and losses in our model.

Table 2: Changes in U.S. Consumption, Production, Net Imports and Prices, Softwood Lumber, 1st Q 2020 to 1st Q 2021 ('000s mbf)

	2020	2021
Production	9,142	9,201
U.S. West	3,599	3,768
U.S. South	5,141	5,029
U.S. Other	402	404
Consumption	12,316	12,702
Imports	3,174	3,501
Price (US\$/mbf)^a	\$400	\$978 / \$1,280

^a For 2021, the lower price is the average for Q1 while the higher is for Q2.

Source: BC Council of Forest Industries, Western Wood Products Association (pers. communication)

Johnston et al. (2021, p.58) provide estimates of the elasticities of demand and supply for the U.S. and other regions. Elasticities of supply for the U.S. range from 0.2 to 1.0, with a mode of 0.65, while elasticities of demand range from -0.6 to -0.1, with mode of -0.16. These values are used to establish triangular distributions from which we sample in our Monte Carlo simulations. Once domestic demand and supply curves are determined from the elasticity values, we are able to determine the excess demand functions in Figure 3(b). To establish excess supply functions, we employ a triangular distribution over elasticities of ES; using information from Johnston et al. (2021), we construct a triangular distribution with elasticity bounds of 0.800 to 0.999, with a mode of 0.9. The simulation employs 10,000 distinct values for the three elasticities to determine the welfare measures.

We employ the composite framing construction price index because our consumption and production data are linked to this index. Lumber prices averaged \$400/mbf over the first quarter of 2020, rising to an average of \$978/mbf in the first quarter of 2021 and \$1,280/mbf in the second

quarter of 2021 (Table 2), after which a three-month moving average of the prices begins to decline (see Figure 1). Hence, we employ a pre-pandemic composite lumber price of \$400/mbf and pandemic-induced prices of \$978/mbf and \$1,280/mbf. That is, in order to calibrate the various functions in Figure 3, P' and P'' in panel (b) are set to \$978/mbf and \$1,280/mbf, respectively—this enables us to compare three explanations of the pandemic-induced price increase. In Table 3, we provide the estimated welfare effects for the U.S. domestic market as well as a summary of the welfare impacts on global suppliers of softwood lumber.

U.S. Domestic Market

If we examine what happens in the domestic U.S. market, we find that consumers actually gain welfare of about \$639 million if the domestic (derived) demand function shifts outward but the supply function remains fixed. That is, as explained below, it is the downstream companies that use lumber to produce other goods gain a quasi-rent (producer surplus) of \$639 million. Assuming that the outward shift of the (derived) demand function remains the same when supply shifts occur (Figure 3), consumer wellbeing will be affected. If supply shifts inward as a result, say, of higher costs due to labor shortages, the domestic price will increase—from \$978/mbf to \$1,280/mbf in our model. In that case, the Covid-induced consumer surplus (i.e., the quasi-rent in downstream markets) falls by some \$324 million compared to the case where there is no Covid-induced supply response. However, this surplus is still some \$315 million above what it would have been in the absence of pandemic. The consumer impact is the same if lumber producers exercise market power to fix supply at the pre-Covid level.

Table 3: Estimated Quarterly Welfare Effects from the Covid-19 Pandemic, USD millions

	Pre-pandemic	No supply shifts	Excess supply shift: ES → ES'	
			S → S'	Domestic supply= Q_S
1. U.S. Consumer Surplus				
Surplus measure	10,035.73	10,674.66	10,350.27	10,350.27
Standard deviation	4,046.90	4,304.54	4173.73	4173.73
Change from pre-Covid	–	638.92	314.53	314.53
2. U.S. Quasi-rent				
Surplus measure	2,530.14	10,166.71	3,226.75	10,575.10
Standard deviation	298.37	324.63	1,055.56	298.37
Change from pre-Covid	–	7,636.56	696.60	8,044.96
3. Rest of World (ROW) surplus				
Surplus measure	1,566.62	6,915.35	7,149.91	7,149.91
Standard deviation	71.35	314.96	806.73	806.73
Change from pre-Covid	–	5,348.73	5,583.28	5,583.28

Source: Authors' calculations based on areas identified in Figure 3 and values in Table 1.

Not surprisingly, producers benefit more if they find that their marginal costs are not affected by the pandemic and they voluntarily restrict supply. This might make sense if lumber manufacturers are able to produce the same lumber as they did prior to the pandemic, but that any attempt to expand output results in a higher marginal cost function. This might be the case if labor shortages do not affect sawmilling but do affect seasonal employment related to harvesting and trucking, thereby restricting the availability of logs. While consumer welfare is not impacted, the rents accruing to lumber manufacturers increase from \$3.2 billion to \$10.6 billion, simply because their costs are unaffected while the price they receive has increased from \$400/mbf to \$1,280/mbf. U.S. lumber producers gain an average scarcity (monopoly) rent of some \$8.0 billion.

What does beg explanation is the \$315-\$639 million increase in consumer surplus that the pandemic induces. As noted at the end of section 2, it is important to recognize that the demand functions in Figure 3(a) are derived demands. Thus, the consumer surplus calculations do not necessarily measure the welfare effects experienced by eventual consumers. Rather, they measure the welfare changes that suppliers of furniture, housing and other downstream products experience.

That is, much of which is measured as consumer surplus in the market for softwood lumber constitutes quasi rent or producer surplus in downstream markets, because the area under the derived demand function in the lumber market equals the producer surplus attributable to the input lumber in downstream markets. What we do not, and cannot, measure in the current model is the consumer surplus that accrues to purchasers of furniture, housing and other downstream products.

The major beneficiaries from the Covid-19 changes affecting softwood lumber markets are clearly the lumber manufacturers. Lumber producers could gain some \$0.7 to \$8.0 billion in rents as a result of the pandemic compared to pre-pandemic conditions (Table 3), although this depends greatly on impact that Covid has on their cost structure. Not surprisingly, the largest gains occur if costs are not impacted and, in addition, the lumber companies restrict output (say, to prevent costs from rising). The resulting divergence between the Covid-induced price of lumber and the sector's marginal cost (i.e., the supply price) constitutes a windfall; but if producers slide up their original or shifted supply functions, the gain constitutes no more than producer surplus. However, if the supply function has shifted upwards, the increased costs to produce the same amount of lumber must be subtracted from the producer surplus triangle associated with the higher lumber price. In that case, producers only benefit by less than \$700 million.

Finally, it should be pointed out that the gains in surplus we identified as accruing to lumber producers as a result of Covid-induced shifts in demand might not have materialized. Rather, many of the gains might have been scooped up by forestland owners who, realizing that demand for lumber increased, required higher stumpage fees for selling logs.⁵ This is likely the case given many forestlands in the U.S. South, the region producing the most lumber, are owned by pension funds and vertically-integrated forest companies.

⁵ In June 2021, for example, the Government of British Columbia moved to increase stumpage fees by more than 70 percent (Nicholson 2021).

Welfare of Foreign Suppliers

It is clear that producers of lumber outside the U.S. will gain, while consumers in the rest of the world (ROW) will lose. The reason is simply that the shift in U.S. demand causes an increase in global lumber prices. Overall, losses to ROW consumers can be compensated from the gains to its lumber producers, although only those ROW jurisdictions that are net exporters will gain. Compared to pre-Covid welfare, the ROW gains some \$5.35 to \$5.60 billion per quarter, depending on the extent to which the U.S. restricts supply and/or imposes additional import tariffs on softwood lumber.

The top six exporters to gain from the increase in U.S. demand should be Russia, Canada, Sweden, Finland, Germany and Austria (van Kooten 2021, p.3). Canada should gain the most as it is by far the largest exporter of softwood lumber to the U.S. Russia exports lumber primarily to China, but European countries have made inroads into the U.S. market, partly as a result of countervail and anti-dumping duties imposed on Canadian softwood lumber imports (see van Kooten et al. 2021).

4. CONCLUDING DISCUSSION

Much has been made of the increase in lumber prices resulting from pandemic-induced lockdowns. This has increased the demand for lumber is not only the result of increased ‘do-it-yourself’ demand as buyers shifted expenditures from restricted activities to home improvements. It is also a result of highly inelastic supply and increased demand for other commodities that employ lumber as an input, such as housing (e.g., more people working at home and desiring more space). In this study, we employed a theoretical spatial price equilibrium model and Monte Carlo simulation to examine the potential welfare impacts of these shifts, particularly as they impacted the U.S. lumber market. Overall, we found that lumber producers and perhaps even producers of downstream final

commodities gained large surpluses, especially if lumber processors acted to minimize cost increases (avoid a shift in the supply function) by restricting supply at the pre-Covid level.

U.S. buyers of softwood lumber also appeared to gain from Covid-19 restrictions. However, many buyers employ lumber as an input into construction, furniture, et cetera, so that the changes in consumer surplus are really changes in the producer surplus accruing to these downstream processors. Ultimate consumers of lumber or products made from lumber gained little if anything because much of the gain reported here was offset by losses in surplus in sectors (especially the hospitality and events sector) where Covid-19 restricted their ability to spend money.

Acknowledgements: The authors wish to thank Kurt Niquidet for guidance regarding data sources and Alyssa Russell for research support.

Declaration of Funding and Conflict: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors

5. REFERENCES

- Canadian Forest Service, 2021. Why are Lumber Prices so High? *Science-Policy Note*, June. 2pp. Ottawa: Natural Resources Canada. At <https://cfs.nrcan.gc.ca/publications?id=40376> [accessed August 12, 2021].
- Healing, D., 2021. U.S. moves to double tariffs on Canadian softwood lumber imports, *CBC News*. May 21. At <https://www.cbc.ca/news/canada/calgary/tariffs-softwood-lumber-may-2021-us-canada-1.6037224> [accessed June 17, 2021].
- Johnston, C.M.T. and van Kooten, G.C. 2017. Impact of Inefficient Quota Allocation under the Canada-U.S. Softwood Lumber Dispute: A Calibrated Mixed Complementarity Approach, *Forest Policy and Economics* 74: 71-80.

- Johnston, C.M.T., Stennes, B., and van Kooten, G.C. 2021. Modelling Bilateral Forest Products Trade. Chapter 4 in *International Trade in Forest Products: Lumber Trade Disputes, Models and Examples* (pp.43-82) edited by G.C. van Kooten and L. Voss. Wallingford, UK: CAB International.
- Just, R.E., Hueth, D.L., and Schmitz, A. 2004. *The Welfare Economics of Public Policy. A Practical Approach to Project and Policy Evaluation*. Cheltenham, UK: Edward Elgar.
- Natural Resources Canada, 2021. Indicator: Volume harvested relative to the sustainable wood supply. August 9. <https://www.nrcan.gc.ca/our-natural-resources/forests/state-canadas-forests-report/timber-being-harvested-sustainably/indicator-volume-harvested-relative-sustainable-wood-supply/16550> [accessed September 27, 2021].
- Nicholson, M., 2021. British Columbia Tree Costs Surge as Lumber Makers Move South, Bloomberg News. June 30. At <https://www.bnnbloomberg.ca/british-columbia-tree-costs-surge-as-lumber-makers-move-south-1.1623825> [accessed November 22, 2021].
- Niquidet, K. and Tang, J. 2013. Elasticity of Demand for Canadian Logs and Lumber in China and Japan, *Canadian Journal of Forest Research* 43(12): 1196-1202.
- Random Lengths, 2021. *Forest Product Market Prices and Statistics Yearbook*. Published by J.P. Anderson, N. West, A. Fitzgerald and D. Guzman. Eugene, OR: Random Lengths Publications Ltd.
- Schmitz, A., D. Haynes and T.G. Schmitz, 2016. The Not so Simply Analytics of Production Quotas, *Journal of Agricultural and Applied Economics* 48(2): 119-147. <https://doi.org/10.1017/aae.2016.5>.
- Statista, 2021. Monthly Price of Lumber in the United States from January 2019 to October 2021. At <https://www.statista.com/statistics/1239728/monthly-lumber-price-usa/> [accessed November 22, 2021]
- van Kooten, G.C. 2021. Introduction. Chapter 1 in *International Trade in Forest Products: Lumber Trade Disputes, Models and Examples* (pp.1-9) edited by G.C. van Kooten and L. Voss. Wallingford, UK: CAB International.
- van Kooten, G.C. and Johnston, C.M.T. 2021. Spatial Price Equilibrium Trade Modeling: Theory. Chapter 3 in *International Trade in Forest Products: Lumber Trade Disputes, Models and Examples* (pp.27-42) edited by G.C. van Kooten and L. Voss. Wallingford, UK: CAB International.
- van Kooten, G.C., Nelson, H., and Mokhtarzadeh, F. 2021. Canada-U.S. Softwood Lumber Dispute: Background. Chapter 2 in *International Trade in Forest Products: Lumber Trade Disputes, Models and Examples* (pp.10-26) edited by G.C. van Kooten and L. Voss. Wallingford, UK: CAB International.