The Economic Impacts of Covid-19 on the Forestry Sector: A Case Study in Turkey

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The Covid 19 pandemic has led to considerable destruction of social and economic areas at a global level. This study aims to determine the economic impact of the Covid 19 pandemic on the Turkish forestry sector. In this context, 5 years (from 2017 to 2021) of wood-based product sales of an administrative unit, which carries out regional forestry activities in Turkey, were studied. The data concerning the product groups were subjected to a Laspeyres price index analysis based on the base period weight through the price and estimated price increase rate variables. In addition, correlation analysis was utilized to determine the relationships between the determined variables. The findings showed that the Covid 19 pandemic led to decreases in the Laspeyres price index values for the price and estimated price increase rates when compared with the pre-pandemic period, which was different on a product group's basis. As a result, it can be said that the Covid 19 pandemic process created a considerable potential for a loss of income in wood-based products, which is one of the primary outputs of the forestry sector, and as of 2021, a recovery process has started.

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INTRODUCTION

The forestry sector can be defined as a broad concept which is comprised of forest products industry management as well as forest resource management and other subsidiary forestry activities (Hajdúchová *et al.* 2012; European Commission 2013). Therefore, forest resources have a major economic potential with their indirect and direct usage values (Shackletona *et al.* 2007). In addition, industrial activity areas associated with forests play an essential role in rural development (Kara *et al.* 2019; Griffin *et al.* 2020). The forestry sector plays a considerable role in the raw material procurement for the forest products industry, due to its high forward connectivity rate (Kara *et al*. 2019; Türker 2020). The most important source of income for forestry managements is logs sale, which forms more than 78% of the total sales (Sujová *et al.* 2017). For fuelwood, the variability in demand also makes the total volume and income level of this product a variable (Parobek *et al*. 2014). In addition, it is reported that the financial value of the timber stock is taken into account from the traditional point of view for the evaluation of tropical forests (Mahapatraa and Tewarib 2005).

While approximately 0.2% of the forest areas in Turkey are privately owned, the rest of it is fully managed by the General Directorate of Forestry (GDF) under state ownership (Kara *et al*. 2019; GDF 2021a). The GDF uses the auction method for the

marketing of forest products according to the Forestry Law 6831 (Türker 2020). As of 2020, the total planted tree stock in Turkey is 1,697,055,000 m^3 (GDF 2021a). In addition, the annual wood consumption is 32 million m^3 in the country. While approximately 26.3 million m^3 of the total consumption amount is addressed by the GDF, 5 million m^3 is supplied by the private sector and 1.5 million m^3 to 2 million m^3 is supplied through imports (GDF 2021b). Within the scope of private sector production, there are special forests, title deed cuts made from places that are not considered forests because they are smaller than 3 ha, and productions made from fast-growing species plantations in agricultural areas (Kök 2009). As such, the GDF is in the position of being the most crucial supplier of the forest products industry (Gültekin *et al.* 2021). While the industrial wood production of GDF was 17,009,998 m^3 in 2016, it reached 24,751,066 m^3 in 2020 (GDF 2020). Despite an increase of approximately 46% in the industrial wood supply of GDF compared to 2016, there is still a supply gap in the sector (Ministry of Development 2014; Akkaya *et al.* 2020). In a further breakdown, 40% (9,790,637 m^3) of the total annual industrial wood production of GDF is logs, 37% is fiber chip wood (9,105,038 m^3), and 33% (9,799,742 m^3) is other industrial wood types. The total annual fuelwood production is 4,047,510 m^3 (GDF 2020).

Covid-19, which emerged from the city of Wuhan in China and has spread to the world, was declared as a global epidemic on March 11, 2020 (Sen and Singer 2020). With the emergence of Covid-19, economies and sources of income have been cut (Hilsenroth *et al.* 2021; Saxena *et al.* 2021). A dependence on certain services and products, including forest resources, has emerged (Hilsenroth *et al.* 2021). During the pandemic period, implementations have been carried out in order to restrict economic activities in many countries around the world (Zaremba *et al.* 2020; Zhang *et al.* 2020; Dong *et al.* 2021). In contrast with the restrictions in urban areas, a considerable increase has been observed in the demand for recreational services concerning forest resources (Derks *et al.* 2020). The US Fish and Wildlife Service reported that hunting licenses have increased by 8.2% during the pandemic period. The importance of forestry services makes measuring possible changes in Covid-19 necessary (Hilsenroth *et al.* 2021). In addition, it is reported that during the Covid-19 pandemic process, restrictions such as curfews negatively affect field work on research and development in the field of forestry (Bhandari *et al.* 2021).

In Turkey, the Covid-19 pandemic has led to critical problems in the economic system as well as disruptions in labor markets and commercial activities (UN Turkey 2020). Micro and small-sized enterprises were more negatively affected by the process when compared with medium and large-sized enterprises. Activities have come to a halt in 35% of micro enterprises and in 24% of small enterprises (UN Turkey 2020). In a similar manner, the forest products industry sector was negatively affected by the process. The priority issue for the new possible negative processes of the sector is raw material procurement (Bayram 2021). However, the first studies on the subject have shown that not every business in the sector is affected by the process in the same manner (Yücel and Durak 2021).

This study aims to reveal the economic effects of the Covid-19 pandemic on the Turkish forestry sector, based on wood-based products, in terms of sales amount and income level. The algorithm of the study is designed to obtain general inferences for the forestry sector, based on the economic activities of the unit selected as an example.

EXPERIMENTAL

Material

The Amasya Regional Directorate of Forestry (RDF), which is affiliated with the GDF in Turkey, was chosen as the study area (Fig. 1). In the selection of the sample area, the following parameters were used: (1) the presence of a high-capacity industrial management which processes fiber chip wood within its area of responsibility; and (2) the RDF with the largest forest assets (Komut and Santo 2020; GDF 2021a). A forest industry facility with an annual processing capacity of approximately 56,000 m^3 of fiber and chip wood is located in the region (Doğan and Akyıldız 2017). The total number of enterprises processing wood-based products in the Amasya RDF region is 1,386 (including forestry and logging industry, furniture industry, paper products manufacturing industry and other wood and wood products industry) (SSI 2020). The Black Sea Region, where the Amasya RDF is located, is the geographical region that contains the largest part (24.4%) of the forest assets of the country with 5,593,342 ha (GDF 2021a). Amasya RDF has the highest forest area (27%) in its geographical region, with 1,529,275 ha of forest area (GDF 2021a).

Fig. 1. The location of the study area (GDF 2021c)

Method

Data collection

The study data consists of the official sales data of wood-based product groups in a 5-year period between 2017 to 2021 of the selected sample unit (GDF 2021d). The time period of the research data was determined to cover the Covid-19 pandemic period, based on similar studies (Dikilitaş and Öztürk 2010; Coşgun 2017; Komut and Santo 2020). The sales data was analyzed by classifying based on the algorithm shown in Fig. 2. Under the title of log product class, all log batches in all diameter and length classes in the quality class 1, 2, and 3 were included in the analysis. The tree species discussed within the scope of the research were handled for two different sales methods: stumpage sales and traditional warehouse sales.

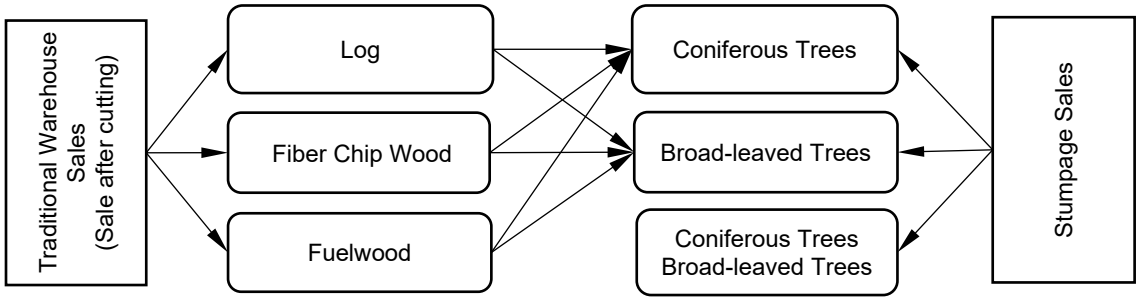

Fig. 2. Research data classification algorithm

Analysis of data

The price index is considered as an indicator of the average price movement of fixed goods and services baskets over time (Sivaram and Sandeep 2010; Tosovska 2010). In addition to the Paasche price index and the Fisher price index, one of the most widely used indexes is the Laspeyres price index, which utilizes the base period weight (Hlavackova *et al.* 2015). These indexes are used to compare changes in the weighted price and quantity over a time period and they require the reference year to be used throughout the analysis (Önder and Konuk 2018). In this study, the Laspeyre's price index (LPI) based on weighting was used in the analysis of the data due to the significant differences between the sales volumes of the product groups. The LPI index was calculated with Eq. 1,

$$LPI = \left[\frac{\sum_{i=1}^{n} P_{1i} \cdot Q_{0i}}{\sum_{i=1}^{n} P_{0i} \cdot Q_{0i}}\right] x100 \quad (1)$$

where P_{1i} is the period price given for the ith product (₺/m^3), P_{0i} is the basic period price of the ith product (₺/m^3), and Q_{0i} is the basic period weight of the ith product (Ahn 2005; Hlavackova *et al.* 2015; Önder and Konuk 2018).

The product basic circuit weight was calculated using Eq. 2,

$$Q_{0i} = \frac{Q_i}{\sum_{i=1}^{n} Q_i} \quad (2)$$

where Qi is the sales amount of the ith product.

The determination of the appraised value, the discount/upgrade rates that can be made in these prices are determined by GDF on the basis of product costs (Türker 2020). The change between the appraised value (AV) for batches of wood products offered for sale and the price formed as a result of the auction was calculated with Eq. 3,

$$AR_{ri}=(P_i-AV)/AV \quad (3)$$

where AR_{ri} is the rate of increase in an appraised value (%), P_i is the sales price (₺/m^3), and AV is the appraised value (₺/m^3) (Öztürk *et al.* 2008; Komut *et al.* 2013).

A correlation analysis was performed to determine the relationships between the year, wood species, sales price, and AR_{ri} variables in the 5-year period between 2017 and 2021(Kalaycı 2010). In this context, SPSS statistical analysis software (version 20, IBM Corp., Armonk, NY) was utilized. The calculations and graphical presentations concerning the data were made in Microsoft Office Excel 2013.

RESULTS AND DISCUSSION

The changes in the AV values of the wood products handled within the scope of the study were determined for each calculated year compared to the previous year. For the 5-year period between 2017 and 2021, the annual AR_{ri} average was 24% for the log product group, 15% for fiber chip wood, 14% for fuelwood, and 21% for stumpage sales (GDF 2021d). Sales prices for the product batches will be higher than the AV, regardless of different conditions (Öztürk *et al.* 2019). Therefore, in this study, the price-based LPI index values were analyzed through support with the AR_{ri}-based LPI index values.

Table 1 shows the distribution of the wood-based products sold in the 1st, 2nd, and 3rd quality classes of the Amasya GDF, a part of the Turkey GDF, between 2017 and 2021, according to the wood type. The total amount of industrial wood sales, which started to increase as of 2020, reached the highest value of 248,950 m^3 in 2021 (as shown in Table 1).

Table 1. The 5-Year Industrial Wood (1st, 2nd, and 3rd Quality Class) Sales Quantities according to Tree Species in Amasya RDF (GDF 2020; GDF 2021b)

Tree Species	Sales Quantities by Year (m^3)				
	2017	2018	2019	2020	2021
Fagus sp. L.	62,786	69,340	77,676	96,200	115,746
Populus spp.	780	200	442	418	474
Fraxinus sp.	336	314	1,097	27	441
Castanea sativa Mill.	34	28	-	-	-
Alnus spp.	1,164	-	42	21	1,146
Quercus sp.	250	473	346	114	611
Carpinus sp.	204	242	106	283	159
Pinus nigra Arnold.	23,962	22,511	31,132	33,788	53,543
Pinus sylvestris L.	48,399	22,106	18,678	29,893	45,865
Pinus brutia Ten.	574	1,455	1,148	2,282	2,234
Abies sp.	9,395	8,992	16,261	20,749	28,686
Pinus pinaster Ait.	105	-	14	-	45
Total	147,989	125,661	146,942	183,775	248,950

The data obtained from the fiber chip wood, log, fuelwood, and stumpage sales implementations, and the data obtained from the AR_{ri} values occurring from the AV between the years 2017 and 2021 can be seen in Fig. 3. In 2019, it was determined that there were decreases in the AR_{ri} for coniferous tree (CT) and broad-leaved tree (BLT) batches in fiber chip wood, fuelwood, and stumpage sales (Fig. 3). An upward tendency in the AR_{ri} values again has been observed for these product groups since 2020. The decrease in the AR_{ri} for log products, which is the most important output of the forestry sector for wood-based product groups was found to have considerably decreased in 2020. However, the AR_{ri} values in this product group considerably increased in 2021 (as shown in Fig. 3). This situation can be seen as an important indicator of the economic recovery that started with the end of 2020 (Hilsenroth *et al.* 2021; Riddle 2021; UNECE/FAO 2021). However, in this process, the community vaccination rate and the re-emergence of the virus will have a major impact on the pace of the economic recovery process (Hardcastle and Zabel 2021).

Average AR and P_i values of product groups in Amasya RDF for the years 2017-2021 are given in Table 2.

Table 2. Average AR_{ri} and P_i values of product groups in Amasya RDF in 2017-2021 (GDF 2020; GDF 2021b)

Year	Log		Fiber Chip Wood		Fuelwood		Stumpage Sales	
	Average AV (₺)	Average P_i (₺)	Average AV (₺)	Average P_i (₺)	Average AV (₺)	Average P_i (₺)	Average AV (₺)	Average P_i (₺)
2017	195.51	264.80	96.29	98.03	74.51	85.84	104.58	118.35
2018	238.95	305.88	112.57	119.27	75.52	81.16	119.43	141.35
2019	298.59	336.37	108.80	110.18	88.97	93.50	126.16	141.72
2020	338.71	385.44	117.26	124.17	104.39	124.85	142.36	173.73
2021	428.41	814.78	162.79	195.59	111.49	143.37	209.61	348.46

Table 3 shows the LPI calculated through the prices of log, fiber chip wood, fuelwood and stumpage sales and AR_{ri} values between 2017 and 2021. LPI values are calculated by considering the years 2017, 2018, 2019 and 2020 are as the reference year for each product group in the table.

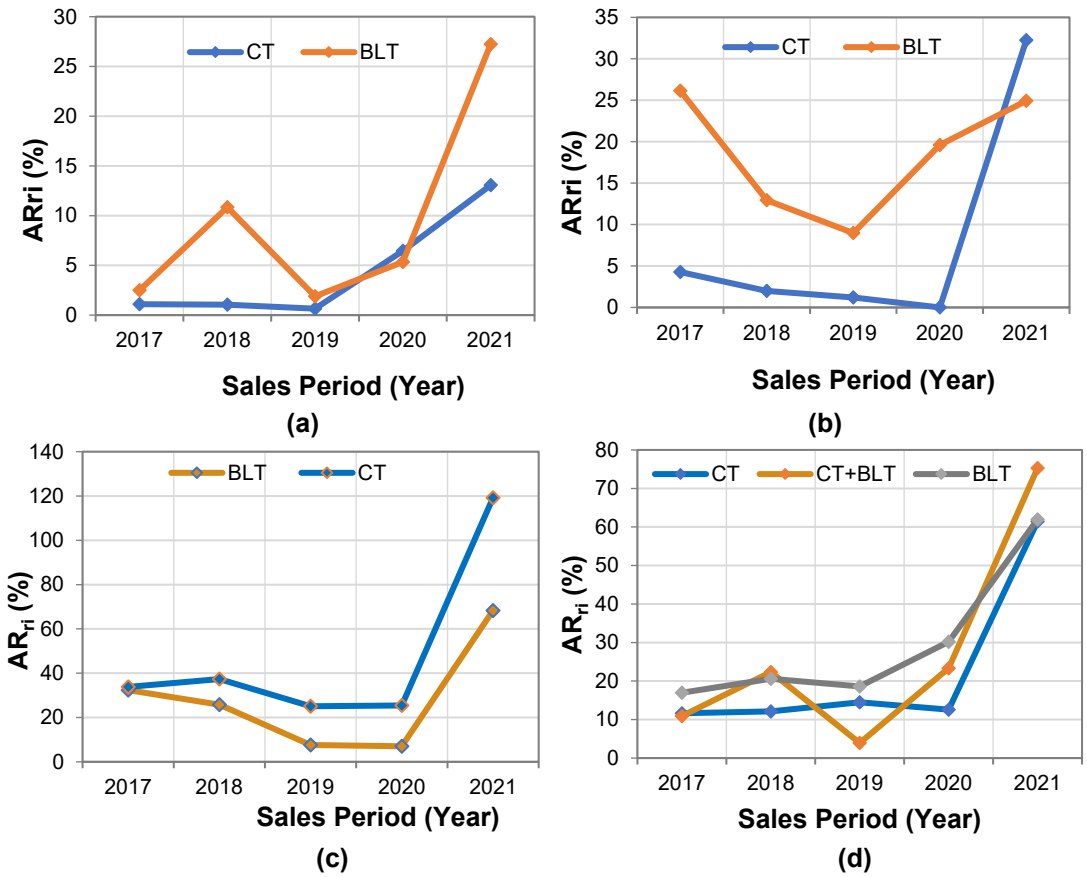

Fig. 3. Product group comparisons according to the AR_{ri}: (a) Fiber chip wood; (b) Fuelwood; (c) Logs; and (d) Stumpage sales

The reference year 2017 and the price based LPI values show a price increase of 37% for the log product group in 2020. However, the AR_{ri} -based LPI index values for the same period indicate a 30% decrease in the AR_{ri}. A similar relationship is also valid for the LPI index values with reference year 2018. Similarly, while the LPI price index for the fuelwood product group showed an increase of 18% for 2020 when compared with 2017, the LPI AR_{ri} index showed a decrease of 28%. In the stumpage product group, similar results were obtained for both indexes in terms of the decrease/increase direction and index values of the LPI price and LPI AR_{ri} index values for the reference years, unlike other product groups (as shown in Table 3). Considerable increases were observed in the 2021 LPI price and LPI AR_{ri} index values for all product groups (as shown in Table 3, Fig. 3, and Fig. 4).

Table 3. 5-Year Sale Price of Product Groups and AR_{ri} -based Laspeyres Index Values

Base Year	Log LPI (Price)					Log LPI (AR_{ri})				
	2017	2018	2019	2020	2021	2017	2018	2019	2020	2021
2017	1.00	1.10	1.24	1.37	3.00	1.00	1.05	0.62	0.70	3.46
2018	0.91	1.00	1.11	1.22	2.66	0.96	1.00	0.57	0.61	3.24
2019	0.81	0.90	1.00	1.10	2.40	1.62	1.76	1.00	1.09	5.77
2020	0.73	0.82	0.91	1.00	2.17	1.43	1.64	0.92	1.00	5.20
2021	0.33	0.38	0.42	0.46	1.00	0.29	0.31	0.17	0.19	1.00
Base Year	Fiber Chip Wood LPI (Price)					Fiber Chip Wood (AR_{ri})				
	2017	2018	2019	2020	2021	2017	2018	2019	2020	2021
2017	1.00	1.31	1.18	1.28	2.20	1.00	4.28	0.75	2.20	10.9
2018	0.76	1.00	0.93	1.07	1.62	0.23	1.00	0.24	1.39	4.08
2019	0.84	1.07	1.00	1.09	1.85	1.33	4.09	1.00	3.06	14.5
2020	0.78	0.94	0.92	1.00	1.66	0.45	0.72	0.33	1.00	4.23
2021	0.45	0.62	0.54	0.60	1.00	0.09	0.25	0.07	0.24	1.00
Base Year	Fuelwood LPI (Price)					Fuelwood (AR_{ri})				
	2017	2018	2019	2020	2021	2017	2018	2019	2020	2021
2017	1.00	1.01	1.18	1.18	1.75	1.00	0.49	0.34	0.72	1.23
2018	0.99	1.00	1.15	0.81	1.76	2.02	1.00	0.68	1.33	3.66
2019	0.85	0.87	1.00	1.17	1.45	2.93	1.47	1.00	2.17	2.93
2020	0.85	1.24	0.86	1.00	1.19	1.39	0.75	0.46	1.00	1.27
2021	0.57	0.57	0.69	0.84	1.00	0.81	0.27	0.34	0.79	1.00
Base Year	Stumpage Sales LPI (Price)					Stumpage Sales (AR_{ri})				
	2017	2018	2019	2020	2021	2017	2018	2019	2020	2021
2017	1.00	1.20	1.19	1.47	3.10	1.00	1.28	1.08	1.58	4.22
2018	0.85	1.00	0.97	1.24	2.60	0.78	1.00	0.84	1.24	3.30
2019	0.84	1.03	1.00	1.22	2.56	0.93	1.19	1.00	1.47	3.92
2020	0.68	0.81	0.82	1.00	1.22	0.63	0.81	0.68	1.00	2.66
2021	0.32	0.38	0.39	0.82	1.00	0.24	0.30	0.25	0.38	1.00

This case can be explained with the reduction in Covid 19 restrictions as of 2021 and the re-activation of economic activities. However, it is known that some of the price differences that occur over the years are due to the AV (Türker, 2020). An increase in log prices has been predicted to occur during Covid 19 in the USA and an increase is also predicted in the production amount depending on this increase in the continuation of the process (Timber Mart-South 2021). The 36% increase in the total production amount in

Amasya RDF in 2021 compared to the previous year (Table 1) and the 217% increase in the LPI index in the timber product group (Table 3) indicate similar results. Differentiations have been reported for the influence of Covid 19 for forest products sub-sectors (ILO 2020; Størdal *et al.* 2021). Therefore, it can be said that the results in the same direction were obtained for the 4 primary product groups selected for this study. In the timber industry, there has been a decrease in demand during the Covid 19 period, and there has been a decrease in the supply prices of raw materials for the market (Riddle 2021). Similar declines in demand for wood products have been reported in China (Chen and Yang 2021). On the other hand, it can be said that the increase in logging prices in 2021 is a reflection of the increasing demand in sectors related to forest runes (Stanturf and Mansuy 2021).

As of the end of 2020, the recovery process in the sector has begun, and the record price formations were observed in some economic product groups (Hilsenroth *et al.* 2021; Riddle 2021; UNECE/FAO 2021).

The LPI price index values, which were calculated based on 2018, have shown that the increases in prices remained limited in 2020, when restrictions occurred during the Covid-19 period. However, the LPI AR_{ri} index of all the product groups have shown that the AR_{ri}s considerably decreased in 2020 when compared with 2018 (as shown in Fig. 4). The findings imply considerable income losses in 2020 for the forestry organization, which is the most important raw material supplier for the Turkish forest products industry (Gültekin *et al.* 2009).

It has been determined that this income loss is at the level of 28% for log, 1% for fiber chip wood and 6% for stumpage sales, according to the average of years excluding the Covid-19 pandemic period (Table 2). Ratnasingam *et al.* (2020) reported that the furniture industry in Malaysia, which largely falls into the small and medium-sized business classes, has been critically affected by the supply chain inconveniences occurring because of the restrictions during the Covid 19 pandemic.

In the Turkish domestic markets, sales have decreased by 30% due to the Covid-19 restrictions and problems that occurred in the supply of wood-based forest products raw materials (Bayram 2021). In the continuation of the process, it is foreseen that the uncertainty in the supply and demand in the markets will persevere (Ozenc 2020).

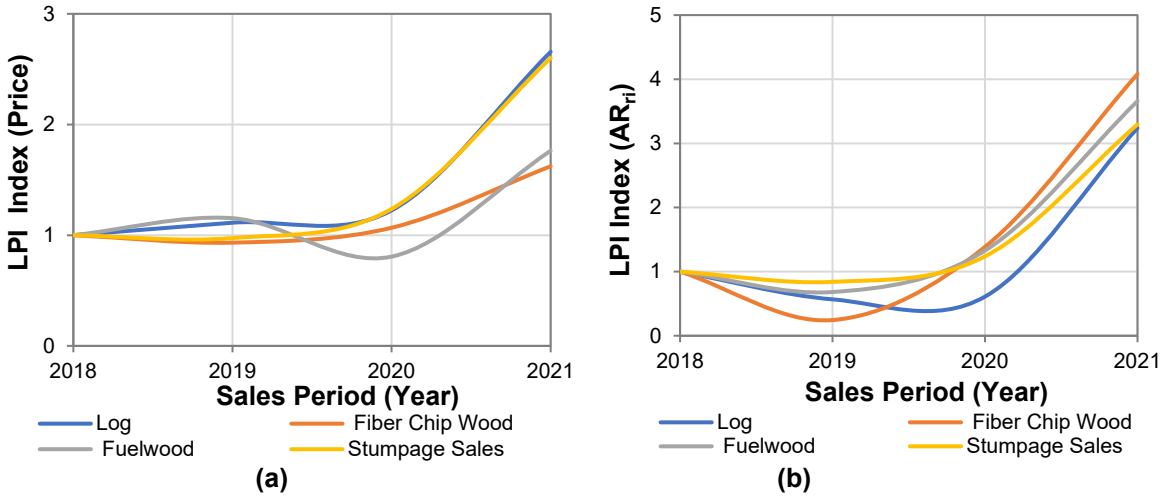

Fig. 4. The Covid-19 period and the: LPI price (a); and LPI AR_{ri} indexes (b)

Correlation analysis is used to test the linear relationship between two variables and to determine the degree of the relationship (Kalaycı 2010). A strong and positive correlation was detected between the sales year and the sales price in the log product group, which was affected most during the Covid 19 pandemic period.

A weak and positive correlation was detected between the wood species (CT/BLT) and the sales price. In addition, it was comprehended that there was a strong positive correlation between the sales price and the AR_{ri} (Table 4). These findings showed that the sales price increased with increasing years and accordingly AR_{ri} tended to increase. A similar relationship was also emphasized in previous studies (Öztürk *et al.* 2011).

Table 4. The Results of the Correlation Analysis between the Variables Determined for the Log Product Group

			Year	Tree Species (CT/BLT)	Sale Price	AR_{ri}
Spearman's rho	Year	Correlation Coefficient	1.000	0.000	0.794**	0.207
		Sig. (2-tailed)	.	1.000	0.000	0.133
		N	60	60	54	54
	Tree Species (CT/BLT)	Correlation Coefficient	0.000	1.000	0.288*	0.336*
		Sig. (2-tailed)	1.000	.	0.034	0.013
		N	60	60	54	54
	Sale Price	Correlation Coefficient	0.794**	0.288*	1.000	0.526**
		Sig. (2-tailed)	0.000	0.034	.	0.000
		N	54	54	54	54
	AR_{ri}	Correlation Coefficient	0.207	0.336*	0.526**	1.000
		Sig. (2-tailed)	0.133	0.013	0.000	.
		N	54	54	54	54
Note: ** Correlation is significant at the 0.01 level (2-tailed); and * Correlation is significant at the 0.05 level (2-tailed)						

CONCLUSIONS

1. During the Covid 19 pandemic process, there was no significant potential loss of income regarding the products offered to the market with the application of stumpage sales in the forestry sector. On the other hand, potential income decreased in wood products offered to the market with warehouse sales.
2. In the forestry sector during the Covid 19 pandemic, among the log, fiber chip, and fuelwood product groups offered to the market within the scope of warehouse sales, the log group, which is the most important wood product output of the sector, was the product that was most adversely affected.
3. The resumption of economic activities at the end of 2020, when the Covid 19 restrictions started to be lifted, led to considerable income increases in the forestry sector as of 2021. However, the variability in the demand for the forestry sector outputs for the last 5 years and the concerns about the development of the pandemic creates uncertainty.

4. The changes in the demand for wood-based product outputs of the forestry sector during the Covid 19 pandemic process have led to considerable economic losses in the sector.

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