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Assessing the Role of Forest Certification and Macroeconomic Indicators on Croatian Wood Exports to the EU: A Panel Data Approach

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Abstract: In the wood industry, forest certification stands as a pivotal factor that supports the implementation of sustainability and market acceptance. Recognizing its significance for both the wood sector and exports, this study explores the impact of Forest Stewardship Council (FSC) Chain of Custody certificates on the export of Croatian wood to European Union (EU) countries. Through a dynamic panel data analysis using the system Generalized Method of Moments (GMM) estimator, our aim is to uncover the implications of this certification on wood industry exports. Additionally, the model assesses other determinants of wood exports, such as GDP, GDP per capita, remoteness, manufacturing value added, unemployment, and the real effective exchange rate. The results indicate that the number of FSC certificates during the observed period (2000–2021) have a positive and significant impact on wood exports from Croatia, suggesting that wood certification plays a predominant role in shaping such exports. Furthermore, the econometric analysis confirms the statistical significance of selected macroeconomic indicators, including nominal Gross Domestic Product (GDP), GDP per capita, unemployment, added value of manufacturing and real effective exchange rate, on wood exports. This study emphasizes the importance of forest certification in promoting wood exports and improving market competitiveness, offering a unique contribution to the literature by considering a range of macroeconomic factors in the analysis.

Keywords: Croatia; European Union; FSC; GMM; gravity model; international trade; sustainable forest management; wood exports; wood industry

1. Introduction

Wood-based industries, particularly those involved in the manufacture of wood and wood products, are of vital importance to the entire production sector. Eurostat data from 2020 [1] shows that in the European Union, wood-based industries accounted for 19.00% of all manufacturing enterprises.

Forest certification was introduced in the early 1990s to address concerns about deforestation, forest degradation, and the preservation of biodiversity, particularly in tropical regions. Initially championed by environmental organizations, it has since developed into a valuable tool for promoting Sustainable Forest Management (SFM) [2]. While various certification programs exist, the Forest Stewardship Council (FSC), the Programme for the Endorsement of Forest Certification (PEFC), and the Sustainable Forestry Initiative (SFI) are the most prominent. Although all three certification schemes are founded as a commitment to sustainable forest management, differences exist in their standards and certification criteria. The similarity of these three schemes is evident in their principles, but the following common points are worth highlighting: a focus on sustainable forest and resource management, preservation of biodiversity and ecosystem protection, advocacy

for the rights of indigenous peoples, respect for workers' rights and community rights, and adherence to business laws, promotion of transparency, and community participation. However, differences are evident in their distribution; FSC and PEFC have global distribution, while the influence of SFI is predominantly in North America. There are two types of SFM certifications: Forest Management (FM) certification, which assesses compliance with forest management standards, and Chain of Custody (CoC) certification, which ensures segregation of certified and non-certified materials throughout processing and trade [3,4].

As of now, 292 million hectares of global forests are PEFC certified [5], while nearly 160 million hectares of forest land are certified under the FSC scheme [6]. The certified area of PEFC certification also includes certification under the SFI scheme, because SFI is recognized by PEFC. According to research jointly conducted by PEFC and FSC, around 86 million hectares of the global forest area were double certified as of mid-2022 [7]. The decrease in the number of FSC and PEFC certificates took place when Russia invaded Ukraine. At that point, FSC and PEFC suspended all certificates from the Russian Federation, Belarus, and the occupied territories in Ukraine. This significantly impacted the availability of certified raw materials and, combined with sanctions on the import of timber products from Russia, profoundly disrupted supply chains [8].

In perspective, 39.00% of the total EU land area is forested [9], which represents approximately 5.00% of the world's forests [1]. In 2020, EU forests spanned roughly 160 million hectares, excluding other wooded land types [9]. Evaluating FSC certification within the EU based on the FSC Facts and Figures report from July 2023 [6], with a specific focus on the countries encompassed by this study, certified forests in the EU represent 27.70% of the total certified areas worldwide. Approximately 35.93% of global FSC CoC certificates have been issued within the EU. Similarly, PEFC certification [5] shows a comparable proportion of PEFC-certified forest areas to the total certified global forest area, standing at 26.18%. However, PEFC CoC certification has a significantly higher share within the EU, reaching 78.40%. Regardless that the proportions of FSC and PEFC certified forests in the EU relative to the global level are quite similar, the total certified area of PEFC in the EU (76 million ha) surpasses the total FSC certified area (44 million ha).

In the wood-based industry, 157,000 companies are engaged in the manufacture of wood and wood products, while 120,000 are involved in furniture manufacturing [1]. Despite being largely composed of small and medium enterprises (SMEs), these industries contribute significantly to the European economy, generating a total Gross Value Added (GVA) of 136 billion euros, representing about 7.20% of the overall manufacturing industry. Specifically, the wood and wood products sector contributes approximately 1.97% of the total manufacturing GVA, and the furniture manufacturing sector contributes approximately 1.65%. Furthermore, the wood-based sector plays a pivotal role in employment, providing jobs for 3.1 million people, which accounts for approximately 10.50% of the total manufacturing workforce in the EU. The sub-sector of wood and wood products manufacturing employs around 3.10% of the total manufacturing workforce [1].

According to the latest available data from Statistical Office of the European Union, sawn wood production in the EU peaked in 2007 [10]. The global financial crisis in 2008 caused a sharp decline in production, which subsequently fell further in 2009. However, production gradually recovered and stabilized with fluctuations, witnessing significant growth from 2012 to 2021 when production reached a new peak [10].

The pandemic outbreak triggered substantial societal changes that impacted industries, including European sawmills [8,11]. Demand for sawn wood remained high until late 2021, then slowed [11]. Resurgent demand in early 2022 coincided with Ukraine conflict and sanctions on Russia and Belarus, leading to a decline in sawn softwood demand from mid-2022. According to the Forest Products Annual Market Review, 2011–2022 [8], production of sawn softwood in European member countries grew by 4.30% (3.7 million m^3) to 89.40 million m^3 in 2021, due to strong demand. However, trading was mostly conducted in local markets, which resulted in a 0.60% increase in interregional trade. Owing to strong demand of sawn wood in Europe and North America, sawn softwood remained at a high

cost throughout the second quarter of 2022, with a declining trend due to impact of the war in Ukraine [9,11]. European sawn hardwood production showed a notable decline in 2020 due to the COVID-19 crisis, particularly in France and Germany. However, a remarkable recovery occurred in 2021 with a double-digit increase (+11.00%), reaching the highest production value since 2015. In 2021, it grew across most EU member countries [9,11]. Among the largest producers, Croatia, Germany and Romania performed particularly well. Overall, the trading situation in Europe experienced fluctuations and changes in destination markets, with a shift towards intraregional trade and a decline in exports to overseas markets. The war in Ukraine also had a significant impact on the pulp and paper industry and trade in the region.

In general, sawn wood production in the EU has maintained a constant growth trend during last twenty years, with a minor decrease observed in 2020 [1]. This trend implies that the wood sector in the EU is inherently resilient and capable of rebounding from economic challenges. The aforementioned data highlights the noteworthy contributions of wood-based industries to the European economy. These sectors do not only sustain a significant number of businesses, but also yield substantial economic value and offer considerable employment opportunities. Consequently, the wood-based sector continues to be a crucial component of the broader manufacturing landscape within the EU.

Both PEFC and FSC certification bring forth diverse benefits and contribute to ecosystem services. However, challenges related to ensuring compliance and administrative complexities exist, whereby certified timber yielded minimal price premiums. The importance of locally developed certification systems for effective forest policy implementation is emphasized [12,13]. The effects of FSC CoC certification on international trade, as examined by Guan, Xu, and Ip Ping Sheong [14], have indicated that the application of FSC CoC certification positively impacts the net export of sawn wood, particle board, veneer, wooden furniture, and chipboard, while it has negative impact on the net export of roundwood. The results indicate a greater availability of FSC CoC certified sawn wood, particle board, veneer, wooden furniture, and chipboard compared to roundwood and veneer sheets in meeting the demand for legal products. On the other hand, Chen et al. [15] explored the impact of forest certification on international trade in timber products, aiming to provide a scientific basis for improving global forest certification systems and fostering the development of the forestry industry in different countries. The research has revealed several significant results. First, forest certification has an export competitive effect, where the effect of forest certification in developing countries is greater than that in developed countries. Furthermore, forest certification acts as a trade barrier in developing countries, serving as a non-tariff barrier in trade with developed countries. The export competitive effect of wood products is higher than that of furniture products. Forest certification constitutes a trade barrier effect on wood products in developing countries, while it manifests a trade barrier effect on furniture products in developed countries. Together, these two studies provide insight into the impact of CoC certification on international trade in timber products. While there is a positive impact on the export of certain products, it is also important to highlight the effects of forest certification as non-tariff trade barriers, particularly for developing countries.

In Croatia, sawn wood production exhibited relatively constant growth from 2004 to 2015, followed by a minor four-year decline caused by the 2008 crisis. During this period, production increased from 582.00 thousand m^3 in 2004 to 1488.35 thousand m^3 in 2015. However, after 2015, production decreased and stabilized at around 1300.00 thousand m^3, with minor annual fluctuations. In 2021, production reached 1298.15 thousand m^3, which is close to the level of 2012 [10]. Croatia holds a prominent position among the leading countries in the production and export of hardwood [9,11], as stated by the European Organization of Sawmill Industry (EOS). When analysing production, Croatia consistently ranks as one of the top producers among EU countries. In 2020, Croatia achieved a sawn hardwood production of 1066.88 thousand m^3. The subsequent year saw a slight decrease to 1041.61 thousand m^3. Nevertheless, Croatia maintained its status as one of

the largest producers in the EU, surpassing France and Germany. In terms of exports, Croatia demonstrated impressive performance. It emerged as the largest exporter of sawn hardwood among EU countries in 2020, shipping out 869.18 thousand m^3. This number rose to 1033.93 thousand m^3 in 2021, firmly establishing Croatia's position as the top exporter among EU countries. Based on the provided data, Croatia clearly maintains a robust presence in the sawn hardwood market within the EU.

In Croatia, out of 2,759,039 hectares, the total forest and forest land area amounts to 2,097,318 hectares, constituting approximately 76.06% of the total area. The majority of state-owned forests, approximately 2,024,461 hectares, is managed by The Croatian State Forest Enterprise [16]. This company stands as the largest supplier in the Croatian wood-based sector and has held an FSC certificate since 2002. Additionally, it occupies 98.80% of the FSC certified area in Croatia. This has opened up an opportunity for Croatian wood industry sector companies to enter the chain of custody, as most of them have been certified due to customer demands, or market needs [17]. As of now, there are no PEFC certified forests in Croatia, and the national standard for PEFC certification is currently undergoing public consultation. The trend of FSC CoC certification in the Republic of Croatia indicates a continuous increase in the number of CoC certificates, currently surpassing three hundred and fifty [6]. Only twenty four PEFC certificates have been issued in Croatia, primarily for companies engaged in trading or belonging to the paper industry [5].

Regarding the topic of Sustainable Forest Management (SFM), certification has predominantly delved into the motivations, disadvantages, and advantages of certification, with lesser emphasis on its economic impacts [13,17–19], as examined by Romania, noting minor certification costs but highlighting challenges like lack of locally certified materials and specific FSC standard requirements. In Slovakia, Paluš et al. [12] found that forest owners certified under FSC and PEFC appreciate certification benefits, but also mention their high costs. The research results from Croatia and Spain are quite similar [17,19], and identified a primary motivation for certification: enhancing corporate image and meeting customer demands. Despite varying findings across studies, high certification costs remain a consistent challenge, while motivations often revolve around improving corporate image and accessing green markets.

Reviewing the literature related to macroeconomic indicators and exports, several studies [20–24] have shown that traditional macroeconomic indicators (such as nominal GDP, GDP per capita, unemployment, manufacturing value added, real effective exchange rate, and distance between countries) have been identified as significant and crucial determinants that lead to higher export values and stimulate export activities. For instance, Brazil's GDP variable has demonstrated a positive influence on exports of wood product, illustrating that the higher economic growth in a country theoretically corresponds to higher production levels, and consequently, a greater quantity exported [22]. Furthermore, India has been shown to have stronger trade connections with its proximate neighbours than with countries further afield [23]. Felbermayr et al. indicated that enhanced trade openness can potentially reduce unemployment rates [24].

In the context of certification and its export's influence, recent studies [25,26] explored the effects of certification on exports using the gravity model. In their study, Tao et al. [25] found that the presence of a forest certification system in an importing country reflects the strength of its enterprises and government's awareness of sustainable forest management. This awareness leads to greater demand for high-quality imported forest products. Conversely, Sam and Song [26] focused on the ISO 14001 environmental protection system certification, highlighting its positive and significant influence on Korean exports. Their findings underscored the positive and significant impact of ISO 14001 certification on Korean exports.

The latest research in 2023 provides insights into the effects of forest certification on various economic aspects. Deniz's study [27] highlights the importance of certification as a tool to meet the demand for environmentally friendly products and to inform consumers about the environmental and ethical aspects of company operations. Similarly, N'Doua's [28]

investigation from France underscores a positive relationship between forest management certification and timber and wood product exports. However, while Zubizarreta et al. [19] recognize a trend among more prosperous companies to pursue certification, the direct benefits of certification on firms' financial performance are yet to be conclusively proven.

In reviewing Croatian research on FSC certification, Klarić et al. [17] explored the benefits of FSC Chain of Custody certification within Croatia's wood industry with a specific focus on customer retention as the primary advantage, despite the associated high certification costs. The study emphasized the significance of FSC certification in conveying commitment to traceability, ecological principles, and prevention of illegal timber trade. Additionally, the study explored the impact of FSC certification on financial performance in Croatia. The findings revealed slight positive correlations between certification duration, total equity efficiency, and asset returns. While the financial advantages were limited, FSC certification promotes sustainable practices and compliance with regulations such as the European Union Timber Regulation (EUTR 995/2010).

In contrast to prior research on SFM by Guan, Xu, and Ip Ping Sheong [14], which explored the effects of FSC CoC certification on international trade, the studies by Chen et al. [15] regarding the impact of forest certification on global timber product trade, and Klarić et al. [17] who delved deeply into the benefits, motives, and shortcomings of FSC Chain of Custody certification in the wood industry, this research offers a new perspective by analysing the link between FSC CoC certification in Croatia and its wood product exports to the EU over a 21-year period, employing a unique gravity data approach. Furthermore, it integrates findings from other studies [20–23,29–31] that identified key macroeconomic indicators as decisive factors for export values. The use of dynamic panel data analysis further deepens this examination, emphasizing the crucial relationship between forest certification, sustainability, and market acceptance.

Based on prior research, the substantial impact of CoC certification on international trade in timber products holds significant importance and should not be disregarded. The primary objective of this research was to explore the relationship between FSC CoC certification in Croatia and Croatian wood-based sector exports to European Union (EU27) countries, employing the gravity data approach for years 2000–2021. For the purpose of this research, the FSC certification scheme was chosen due to its extensive global acceptance and significant presence in Europe. It stands out as the most widely adopted among all certification schemes in Croatia, which is the focal point of this study. The study uses the system GMM estimator to probe how certification affects Croatian wood exports. Originated by Arellano and Bond [32] and refined using the system-GMM estimator by Arellano and Bover [33] and Blundell and Bond [34], this approach ensures precise and consistent estimates. We adopt the two-step system GMM estimator, corroborating instrument validity through the Sargan test and consistency via the Arellano-Bond AR(2) tests. The data used spans from 2000 to 2021, capturing significant milestones such as Croatia's accession to the WTO and the EU. Various economic indicators like GDP per capita, manufacturing, and unemployment are considered. The study melds advanced econometric tools and diverse data sources to provide comprehensive insights into Croatian wood exports. This research not only delves deeper into Croatian wood export dynamics but also enriches econometric analysis by fusing innovative methodologies with classic ones, offering a thorough investigation of the subject.

Furthermore, to provide a comprehensive analysis, we have placed additional emphasis on assessing the impact of selected macroeconomic indicators (nominal Gross Domestic Product (GDP), GDP per capita, unemployment, added value of manufacturing and real effective exchange rate on wood export. These factors were examined to enhance our understanding of their potential influence on the performance of the Croatian wood-based sector in international markets. By considering both CoC certification and macroeconomic factors, this study strived to offer valuable insights into the driving forces behind the wood export dynamics in Croatia during the specified period.

This research significantly contributes to comprehending the link between FSC Chain of Custody certificates and Croatian wood exports to the EU. Utilizing dynamic panel data analysis, the study highlights the role of forest certification in sustainability and market acceptance. Through the examination of macroeconomic factors, the research offers insights into wood export dynamics. The positive correlation between GDP and wood exports accentuates economic influence, while identifying production value as a driving force provides practical guidance. Moreover, the contribution of this research provides a deeper understanding of the relationship between SFM certification and the export of timber products, thus contributing to global efforts towards comprehending and achieving the Sustainable Development Goals (SDGs). This study contributes to the SDGs in various ways: by promoting sustainable forest management, emphasizing the significance of the wood industry and trade for sustainable infrastructure, linking economic prosperity and exports, and fostering partnerships for sustainable timber trade. As such, this research contributes to global endeavours in realizing sustainable development objectives.

2. Materials and Methods

2.1. Econometric Analysis

2.1.1. Model

Half a century ago, the gravity model was first applied by Tinbergen [35] and Pöyhönen [36] who proposed that bilateral trade flows between two countries are positively related to their national income and negatively related to the bilateral (geographical) distance between them. Specifically, the gravity equation in international trade is one of the most robust empirical findings in economics: bilateral trade between two countries is proportional to their respective sizes, measured by their GDP, and inversely proportional to the geographic distance between them [37]. Hence, the gravity model often serves as a practical tool for estimating trade flows and examining explanatory factors and policy implications on them; the latter could include the potential of adding novel parameters and factors to the model or investigating the effects of already known parameters to trade flows [38]. Indeed, early justifications on the gravity model performance were provided by Linnermann [39], while Anderson [40] was the first to derive a theoretical explanation based on economic theory [38].

The core gravity model considers only the size of economies, measured by home and host GDP (GDP per capita) and the geographical distance, which serves as a proxy of transport costs and other barriers. However, the choice of GDP measure (in current prices, in constant prices, or in purchasing power parity) for gravity models remains debatable [41,42].

Our empirical settings that rely on the theoretical background adopt a somewhat modified (augmented) version. The so-called "gravity equation" in international trade has remained remarkably stable over time and across different country samples and methodologies [37]. Our analysis is based on bilateral data regarding the export of Croatia's wood sector (as the home country) and all member states of the European Union (plus United Kingdom). To assess the determinants of Croatian wood exports, we adopted the following econometric specification of a dynamic panel:

$$lnX_{it} = \alpha_i + \beta_1 lnX_{it-1} + \beta_2 lnGDP_{it} + \beta_3 lnRem_i + \theta_t + \varepsilon_i$$
$$i = 1, \ldots, N \ t = 1, \ldots, T_i$$

(1)

where N is the number of units of observation, T is the number of periods, X_{it} stands for the value of the dependent variable (in this case, the Croatian wood export) i in the period t, the parameter α is the constant, β is the scalar, X_{it-1} is the one-period lagged (one year) dependent variable, θ_t is the fixed element or random error for the unit of observation, and ε_i the error term in the model. There are also independent variables influencing the structure of exports: number of FSC certificates and selected macroeconomic factors (nominal GDP, GDP per capita, the distance between the analysed pairs of countries, manufacturing value added, unemployment, and real effective exchange rate, which will

be described in the next subsection. The dependent oe-period-lagged variable will be used as an instrumental variable.

Hence, to investigate whether certification is affecting Croatian wood export, this paper utilizes the dynamic panel system GMM model. Namely, the panel GMM estimator discussed in Arellano and Bond [32] is probably the most popular alternative for estimating dynamic panels with unobserved heterogeneity and predetermined regressors [43]. The beauty of the Arellano and Bond [32] estimator is that relies on minimal assumptions and provides consistent estimates even in panels with few time series observations per individual [43]. However, in order to overcome the few weaknesses with a difference in GMM (linear GMM estimator obtained after first differencing has been found to have large finite sample bias and poor precision in simulation studies; lagged levels of the series provide weak instruments for first differences in this case [34]), our analysis is based on the so-called system-GMM estimator by Arellano and Bover [33] and Blundell and Bond [34].

Further, we use the two-step system GMM estimator. The validity of instruments is tested using the Sargan test of overidentifying restrictions. Consistency of estimates requires that error terms are not second-order serially correlated, so we report the p-values of Arellano–Bond AR(2) tests.

2.1.2. Data Description

Based on the previous theoretical consideration, data were collected, and this subchapter provides a more detailed explanation of the calculation of the value of each individual variable used in the analysis. The analysis covers the period from 2000 to 2021, which includes Croatia's entry into the WTO and EU membership. To calculate the value of bilateral trade between Croatia and EU member states, data on exports of wood products (category 44 according to the HS methodology: Product 44 Wood and articles of wood; wood charcoal) were used. These data were taken from the database of the International Trade Centre, whose calculations are based on UN COMTRADE and ITC statistics [44]. Export values were initially expressed in thousands of euros. In order to exclude the impact of the effect of price changes, the values were deflated by the consumer price index (2010 = 100; source: World Development Indicators), and real values were used in the analysis. Further, certification was approximated by the number of FSC Chain of Custody certificates, and the data were taken from the websites listed in Table 1. The GDP variable (current prices, expressed in million euro) was taken from the Eurostat, as a proxy for economic size. Furthermore, GDP per capita growth (annual %) was taken form World Development Indicators (WDI). According to Shepherd, Doytchinova, and Kravchenko [45], our GDP data used in the model are in nominal, not real, terms. The expected sign is positive since higher output growth leads to higher trade (export). Manufacturing, value added (% of GDP) was taken from WDI, and a positive impact was expected.

Second, trade costs or multilateral resistance terms were proxied by the variable called "remoteness". Namely, it was calculated according to Head [46] as a country's averaged weighted distance from its trading partners, where weights are the partner countries' shares of EU GDP [47], which refers to the natural logarithm of the distance (in kilometres) between two capital cities of the two trading partner i and j. The higher the increase in distance, the higher the costs of transportation. An increase in the transportation cost leads to increase in the unit price of final goods for selling, thus decreasing its demand. Hence, a negative effect on bilateral trade for this variable is expected, and remoteness was calculated according to [47].

Data on total unemployment (% of total labour force) were taken from the WDI database. However, when it comes to the impact of unemployment on trade (exports), the theoretical trade literature stresses various channels through which trade liberalization affects (un)employment [48]. Theoretically, the effects of trade liberalization on (un)employment are ambiguous, but Dutt et al. [49], as well as Felbermayr et al. [50], provide reduced-form evidence that push more open economies to have lower unemployment rates on average [48].

Table 1. Data description and sources.

Type of Variable	Variable	Source [1]
Dependent variable	Bilateral trade between Croatia and EU member states for a product (44 Wood and articles of wood; wood charcoal) exported by Croatia; Euro thousand	ITC calculations based on UN COMTRADE and ITC statistics
Independent variable	Number of FSC certificates	https://fsc.org/en/facts-figures, accessed on 29 April 2022
Independent variable	GDP per capita growth (annual %)	World Development Indicators
Independent variable	GDP (current USD)	World Development Indicators
Independent variable	Remoteness (Distance; GDP (constant 2015 USD))	https://www.distancecalculator.net/, accessed on 1 October 2022. World Bank
Independent variable	Unemployment, total (% of total labour force) (national estimate)	World Development Indicators
Independent variable	Manufacturing, value added (% of GDP)	World Development Indicators
Independent variable	Real effective exchange rate (deflator: unit labour costs in the total economy − 27 trading partners − European Union from 2020) Index 2010 = 100	Eurostat

[1] Source: ITC, FSC, WDI, World Bank, Eurostat.

The last explanatory variable is the real effective exchange rate (deflator: unit labour costs in the total economy − 27 trading partners, index 2010 = 100) taken from Eurostat. The expected sign is negative. Namely, according to Eurostat methodology, a rise in the index means a loss of competitiveness.

All variables that are not expressed as a percentage (except unemployment rate, manufacturing value added and GDP per capita) were logarithmically transformed. Finally, an unbalanced panel data was analysed because not all data are available for all countries in the analysed time period.

Table 2 provides pair-wise correlations matrix with correlation coefficients. Correlation coefficients between independent variables ranging from 0.0053 to 0.5001 indicate a weak intensity of correlation. As a result of weak correlation between independent variables, one can assume that multi-collinearity will not affect the parameter's estimation.

Table 2. Correlation matrix of variables.

Variable	BTr	NGDP	Rem	GDPpc	FSC	Unemp	Manuf	REER
BTr	1.000							
NGDP	0.3834	1.000						
Rem	−0.3090	−0.0053	1.000					
GDPpc	−0.1394	−0.1974	−0.0400	1.000				
FSC	0.3159	0.5001	−0.280	−0.0816	1.000			
Unemp	−0.0583	−0.0653	0.0617	−0.0271	−0.1423	1.000		
Manuf	0.1268	−0.0550	−0.2535	0.2972	0.0169	−0.1062	1.000	
REER	0.0243	0.1570	0.0483	−0.2815	0.1535	−0.3157	−0.2250	1.000

Legend: BTr—Bilateral trade and EU member states for a product (44); NGDP—Nominal GDP; Rem—Remoteness; GDPpc—GDP per capita; FSC—FSC certificates; Unemp—Unemployment; Manuf—Manufacturing value added; REER—Real effective exchange rate. Source: authors' calculations.

3. Results and Discussion

This section provides estimates within the system GMM model. Table 3 presents the results of the estimated impact of the wood certification on wood exports in Croatia, as well as the diagnostic tests of dynamic panel data analysis. The model has three variations depending on the variables used. In Table 3, the results reveal a positive and statistically significant impact of the number of FSC certificates (at the 1% level).

Table 3. Generalized Method of Moments (GMM) Model of Croatian Export with EU Member Countries in wood products (HS 44) product category.

Variable	Model 1	Model 2	Model 3	Model 4*
Bilateral trade between Croatia and EU member states for a product (44), exported by Croatia	0.7745 *** [0.000]	0.6914 *** [0.000]	0.7840 *** [0.000]	0.6414 *** [0.000]
Nominal GDP	0.2142 * [0.004]	0.2445 ** [0.015]	0.2482 *** [0.004]	0.3167 *** [0.000]
Remoteness	−0.1442 [0.647]	0.2977 [0.436]	−0.0170 [0.946]	−0.6120 *** [0.000]
FSC certificates	0.0326 *** [0.001]	0.0621 *** [0.009]	0.0373 ** [0.027]	
GDP per capita	0.0174 *** [0.000]	0.0062 * [0.077]	0.0142 *** [0.000]	
Unemployment	−0.0253 ** [0.032]	−0.0319 *** [0.008]	2.1637 *** [0.000]	
Manufacturing value added		0.0560 *** [0.000]		
Real effective exchange rate			−1.2580 ** [0.021]	
C	−2.7922 [0.058]	−6.8806 [0.143]	1.1697 [0.741]	−2.4922 *** [0.000]
Number of observations	436	417	436	539
m^2 test (*p*-value)	0.7234	0.6609	0.7192	0.2141
Sargan test (*p*-value)	0.9114	0.9555	0.9167	0.9062
Wald (chi2) statistics	2962.38 [0.000]	3209.20 [0.000]	5857.63 [0.000]	15,075.79 [0.000]

Notes: *, **, *** indicate statistical significance at levels of 10, 5 and 1%; standard errors are in brackets. 4* The dependent variable measures bilateral trade (export) between Croatia and other EU members plus UK. Source: Authors' calculations.

Furthermore, Model 1 analyses the influence of the basic gravity variables—nominal GDP, remoteness and FSC certificates, along with GDP per capita, and unemployment. According to the results of the first model of bilateral trade, the coefficients were consistent with study expectations and are in line with the predictions of the theoretical model. The econometric results related to the influence of the number of FSC certificates clearly show that this variable is positive and statistically significant in the model. The aforementioned demonstrates the positive impact of the growth of the FSC certificate on the export of the wood sector. Specifically, the coefficient of GDP is positive and statistically significant, suggesting the positive impact of GDP growth on wood exports in Croatia at the 1% level. Moreover, the results also reveal a positive and statistically significant impact of GDP per capita growth (at the 1% level). Concerning the unemployment variable, our results confirm that the variable is statistically significant and of the appropriate sign. Hence, it suggests the link between export growth and lower unemployment, which is consistent with economic theory. However, the remoteness variable did not prove to be significant, indicating that geographical distances are not an important indicator of transport costs.

The second model extends the analysis by including the manufacturing value added variable. The results suggest that the coefficient is in line with the expectations of the study and consistent with the predictions of the theoretical model. Specifically, the coefficient of manufacturing value added is positive and statistically significant, indicating a positive impact of manufacturing on wood exports. Other variables in the model have the same signs as in the first model. In Model 3, instead of the manufacturing variable, the variable of the real effective exchange rate is included in the analysis, which is also one of the ways of checking robustness. This additional variable has appropriate sign and is significant. Other variables in the model have the same signs and significance as in the previous Models 1 and 2. Hence, we confirm the robustness of the estimated models presented;

regardless of whether the model includes the unemployment rate, manufacturing value added or the real effective exchange rate, the main conclusion remains. More precisely, in terms of the control variables, results are qualitatively similar to those for the baseline model, although there are some differences in the magnitudes of some coefficients. In order to additionally check the constructed remoteness variable, a basic gravity model was analysed with the dependent variable of total Croatian exports to EU member states (Model 4). More precisely, the dependent variable measures bilateral trade (export (The variable of international trade is deflated by the Harmonised Index of Consumer Prices and logarithmically transformed. Source: IMF—Direction of Trade Statistics)) between Croatia and other EU members and UK. According to the results of the analysis, when the sectoral (timber) export is replaced by total export, the remoteness variable has a corresponding negative sign and is statistically significant in the model. Therefore, it can be concluded that the insignificance of the remoteness variable is related to the sectoral characteristics (because such a conclusion obviously cannot be made for total Croatian exports).

All analysed variables in all three variations are statistically significant and have appropriate signs. The only exception is the remoteness variable in Model 3, which has the appropriate sign, but is not statistically significant. Namely, while distance has traditionally been an important factor in the gravity model, recent studies, such as those by Brun et al. [51] and Coe et al. [52], increasingly question its role and significance. More precisely, the distance between trading partners does not play a significant role in trade, as it used to be in the past, because transport costs are far lower [53]. Of course, numerous variables other than distance influence transportation costs [54]. In our specific case, the question of the price competitiveness of Croatian wood exports in relation to transport costs and logistics itself arises here. Given that this is an analysis that is primarily based on sectoral data, the interpretation of the results should be approached with a dose of caution and provides the possibility of further questioning the significance of other potential variables such as common borders, entry/membership in Schengen, common language, etc. Additionally it should also be noted that the main export markets for Croatia are Italy, Germany, and Slovenia—countries that are neighbouring or in close proximity to Croatia.

The lower part of Table 3 presents the results of the diagnostic check (e.g., Arellano-Bond tests for autocorrelation of second order (AR2) and Sargan test). There was no autocorrelation between residuals of the second order in any of the analysed system GMM models, meaning that the models were valid. The validity of the instruments selected for the evaluation of the model was tested with a Sargan test. Hence, based on the Sargan test, the hypothesis that there is no correlation between the residuals and the instruments was accepted. The dependent lagged variable was statistically significant and had a positive algebraic sign.

In 2021, according to Eurostat, the total export of Croatian wood products (product 44: wood and articles of wood; wood charcoal) amounted to 975 million euros, of which 678 million euros (70%) were exported to EU member states [10]. The significance of Croatian exports to the EU is further supported by this research. The impact of sustainable forest management certificates on wood product exports is clearly visible through the research results. Our analysis of the Croatian wood sector data indicates a robust positive impact of FSC CoC certification on wood exports from Croatia. These findings align with earlier research that demonstrated how the number of FSC certificates can enhance the establishment of strong export relationships [28,55]. Additionally, this confirms that implementing environmental preservation systems, closely related to sustainable forest management, also positively impacts exports, as evidenced by Sam and Song [26]. Additionally, Van Kooten et al. [29] highlighted that higher export levels motivate firms and forest landowners to pursue certification, contributing to export-oriented behaviour. However, the study by Marx and Wouters [30] indicates a relatively weak correlation between exports and FSC certification, implying that the level of exports might have a limited influence on the adoption of FSC certification. Similarly, Tao et al. [25] found that the presence of forest certification schemes within an importing country was negatively correlated with wood product quality.

Conversely, the analysis conducted by Da Silva et al. [31] showed that FSC certification has a positive and statistically significant impact on the export of certain products, such as paper and paperboard, while negatively affecting the export of fuelwood and charcoal. These findings highlight the complexity and variability of the relationship between forest certification and trade in forest products, emphasizing the need for further research that delves into specific products and their ties to certification.

According to our results, the GDP coefficient is positive and statistically significant, indicating the positive impact of GDP growth on wood exports in Croatia. Furthermore, the results demonstrated a positive and statistically significant impact of GDP per capita growth and the number of FSC certificates. These results are consistent with similar studies, such as Lovrić et al. [55], which noted that an increase in exports might not predict the dispersion of future exports, but higher values of the production of wood-based products can contribute to the formation of export relationships. Our results from the first model of bilateral trade align with the theoretical model's expectations, and are consistent with relevant studies' predictions. Furthermore, the results also reveal a positive and statistically significant impact of GDP per capita growth and the number of FSC certificates. This trend is supported by the research of Van Kooten et al. [29]. They investigated the certification of sustainable forest management practices from a global perspective and found an inverse correlation between GDP per capita and the likelihood of countries certifying their forest practices under the FSC scheme. According to their findings, countries with higher GDP per capita are more likely to adopt FSC certification for their forest practices. This corroborates our findings about the positive impact of GDP per capita growth on wood exports in Croatia. Similarly, the research conducted by Marx and Wouters [30] also supports our results. They examined voluntary sustainability standards and green restructuring and found a positive correlation between GDP per capita (GDPpc) and FSC certification, suggesting that higher income levels contribute to a greater adoption of FSC certification. This aligns with our finding of a positive and statistically significant impact of GDP per capita growth on wood exports in Croatia. Furthermore, the study by Da Silva et al. [31], which focused on FSC standards as a trade facilitation strategy, emphasized that countries with higher GDP in both importing and exporting nations tend to have increased trade. This also supports our conclusions regarding GDP's positive impact on wood exports from Croatia. Foreign trade is recognized as a key driver of economic growth, particularly in the wood industry sectors that generate varying levels of added value, as highlighted by Janáková Sujová et al. [56], with exports being crucial for achieving sustainable economic development [57]. In line with this research, in the context of Croatia, a positive impact on the sector's economy is evident because exports exceed imports. Overall, the observed positive influence of GDP and GDP per capita growth on wood exports, as well as the association with an increased number of FSC certificates, underscores the importance of economic factors in fostering sustainable forest management and international timber products trade. These findings hold valuable insights for policymakers and stakeholders in Croatia's forestry and wood-based sectors, aiding the development of future policies that prioritize sustainability and wood product trade.

In our study, Model 2 is expanded to encompass the variable of added production value, revealing a noteworthy positive and significant impact within the model. This result indicates that an increase in production value correlates with higher exports, aligning with the literature [55,58]. The positive relationship between production value and exports underscores the critical role of production capacity and efficiency in driving wood product exports from Croatia, further bolstering the economic aspect of sustainable forest management and trade dynamics in the country.

According to our results, FSC COC certification, GDP, and GDP per capita have a significant positive impact on timber exports in Croatia. However, geographical distance does not emerge as a significant indicator of transportation costs. Our findings align with Da Silva et al.'s [31] assertion that distance between countries negatively impacts trade, while factors like common borders, language, and regional trade agreements are positively

correlated with higher levels of forest product trade. In the three models analysed, a significant correlation between unemployment and export growth was found. All models consistently showed that lower unemployment rates have a negative impact on export growth. This implies that reducing unemployment could boost export performance, especially when considering future analyses of the wood industry labour market dynamics and implications of this relationship. Our research highlights a negative correlation between the real effective exchange rate (REER) and exports. This observation aligns with other studies conducted in Croatia, demonstrating that changes in REER adversely affect the trade balance in European transition countries due to high import reliance and low competitiveness. Similarly, their analysis indicates a negative impact of exchange rate movements on exports in Croatia [59,60].

In light of future research, it is evident that social capital, in addition to economic factors, holds significant influence over whether countries will adopt forest certification practices. The findings from Van Kooten, Nelson, and Vertinsky [29] emphasize the importance of considering social capital alongside economic indicators in understanding the adoption of forest management certifications. This social dimension is further supported by the work of Marx and Wouters [30], who reveal a positive and meaningful correlation between FSC certification and aspects such as regulatory quality, government effectiveness, and the rule of law.

Overall, these research findings clearly indicate the significance of the wood sector in the European economy and the influence of FSC certification on the export of wood products, while also opening new perspectives for future research.

4. Conclusions

This research employed the system GMM model to estimate the impact of wood certification on wood exports in Croatia. The results were presented in Table 3, encompassing three variations of the model based on different variables. The main conclusions drawn from the results are as follows:

- Wood certification, as represented by the number of FSC certificates, demonstrated a significant positive influence on wood exports from Croatia. These findings support the idea that sustainable forest management practices contribute to increased wood product exports.
- Economic factors, including Gross Domestic Product (GDP) and Gross Domestic Product per capita (GDP per capita), were found to be crucial in driving wood exports. An increase in GDP and GDP per capita positively impacted wood exports, emphasizing the importance of economic prosperity in promoting trade in wood products.
- The value of production was identified as a significant driver of wood product exports. A higher production value was associated with increased wood exports, highlighting the role of production capacity and efficiency in driving the export of wood products from Croatia.
- Geographical distance did not emerge as a significant indicator of transportation costs, contrary to expectations. However, when analysing total Croatian exports as a dependent variable, the remoteness had a corresponding negative sign and was statistically significant in the model.
- Unemployment rates exhibited a significant negative correlation with export growth, implying potential benefits for export performance and their relevance for future analyses of the wood industry labour market dynamics.
- A negative correlation between the real effective exchange rate (REER) and wood exports was found, indicating that the rise of index means a loss of competitiveness.

This study introduces a new dimension to the analysis of the manufacturing sector by examining timber exports from Croatia through econometric analysis using advanced tools and diverse data sources that span from 2000 to 2021, capturing significant milestones such as Croatia's accession to the WTO and the EU. Considering the growing importance of sustainability in global trade, this study represents a significant contribution to under-

standing how certification impacts timber exports. Overall, this research sheds light on the significance of the wood sector in the European economy and highlights the positive influence of FSC certification on wood product exports from Croatia, emphasizing the role of forest certification in sustainability and market acceptance. The results provide valuable insights for policymakers and stakeholders in the forestry sector, offering opportunities for promoting sustainability and trade in wood products. Further research should focus on specific products and their associations with certification to obtain a more comprehensive understanding of the dynamics influencing the wood sector. Furthermore, this research contributes significantly to global efforts in comprehending and achieving the Sustainable Development Goals (SDGs) by promoting sustainable forest management, linking economic prosperity and exports, and fostering partnerships for sustainable timber trade. Additionally, in future research, it will be important to monitor how Croatia's recent accession to the Schengen Area and the Eurozone (as of 1 January 2023) will simplify and potentially further increase wood sector exports to EU member states, as well as reduce exchange rate risks.

The applied quantitative methodology provided crucial insights into forest certification and timber product trade, but there is area for improvement through qualitative analysis. It is particularly important to consider the social and cultural factors that can influence the certification process and trade. Moreover, the study was limited to the use of only the FSC certificate, excluding other certification schemes. Furthermore, the results of this study have highlighted the need for targeted research that not only delves deeper into specific products and their association with FSC certification, but also adopts a sectoral approach, focusing on individual wood products such as particleboard or timber, to gain a better understanding of the complexity of this interaction.

In conclusion, this study contributes new insights to understanding sustainable forest management and its implications for wood trade. The findings underscore the importance of promoting responsible forest practices and improving the competitiveness of wood products in global markets.

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