

## Economic and financial crime in the forest industry: Internationally and in Romania

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### Abstract

With poor quantitative academic research on the topic, this study aims at presenting an accurate picture of how corruption and logging are interconnected, at the international level, as well as in Romania. Researchers need to have a wide and updated view on this phenomenon when trying to find efficient solutions. For this, the most recent available secondary data (2012-2020) from multiple well-known sources are used for statistical processing, taking into consideration 185 countries, but they are also used to analyse the situation in Romania, where illegal logging is escalating. We found a positive relation between corruption, shadow-economy and money laundering, on one hand, and deforestation, on the other hand, as well as identifying multiple determinants such as the wealth of the country, the efficiency of the government, the protection of the environment, and the public health. In Romania, northern forests are more exposed to illegal logging because of the quality of wood, and counties like Suceava are famous for the red-blooded crimes that happen to the ones who try to protect the woods from illegal exploitation. This analysis' purpose is to raise awareness upon economic and financial crime in the forest industry. These findings are relevant in understanding the phenomenon of illegal deforestation, and it contributes to the adoption of efficient countermeasures that contribute to a healthier environment for all of us.

**Keywords:** corruption, shadow economy, money laundering, forest, sustainability

**Jel Codes:** D73, Q01, Q23

### 1. Introduction

We find ourselves in a sustainability crisis. Most of our actions harm the environment and, in the end, our own health is put in danger. Green solutions and alternatives are arising, but it seems that we are not doing enough, as the earth temperature is still rising. There are multiple causes for climate change, from greenhouse gases to massive deforestation. The fact that trees are the only natural machine that converts carbon dioxide into oxygen and the fact that forestlands are shrinking in the times when we need them the most are the core reasons why this topic needs all the awareness it can get. Even if there is a doubt whether the legal level of deforestation exceeds the sustainable one, the real level is for sure much higher. Corruption and illegal deforestation often overlap, as one facilitates the other.

Nowadays, as everyone is searching for ways to stop the climate change, in order to protect life on Earth, and ensure the health of billions of individuals, trees unavoidably hold a major part of the solution. However, the mass exploitation of trees continues, relinquishing the long-term benefits of living trees for short-term gain. Forests still cover almost 30 percent of the world's surface, but they are vanishing at a disturbing rate. Since 1990, the world has lost 420 million hectares of timberland. Around 17 percent of the Amazonian rainforest has been cut only in the past 50 years, and the logging activity has been on the rise. There are many reasons for which we need trees, especially because they transform the carbon dioxide that we breathe out into oxygen, and also help with the greenhouse gases we excessively emit. As these gases enter the atmosphere, the global temperature rises, and the climate change increases. But tropical trees cover alone might give 23% of the climate mitigation required throughout the following ten years to meet objectives set in the Paris Agreement in 2015, studies say.

But there are several impediments due to economic reasons. Grazing of livestock, farming, drilling, and mining joint record for the most part of all deforestation, as wildfires, forestry practices, and urbanization account for the rest. In Malaysia and Indonesia, woodlands are chopped to produce palm oil, which is a valuable resource in manufacturing millions of goods. Logging activities are responsible for cutting enormous amounts of trees, which it is done in order to produce the world's wood and paper products. Because the wanted level of exploitation exceeds the sustainability and usually the legal level, forest workers illicitly create routes to access remote areas of forest and, therefore, the deforestation increases.

Deforestation has a significant impact on individuals and animals living in the forests, as it has on every one of us. People living in woods and savannah regions rely on them for ensuring their living and earning money, as many of them are citizens of the world's poorest countries. Also, more than 80% of the Earth's fauna and flora live in woodlands, and deforestation accounts responsible for endangering those species including the orangutan, Sumatran tiger, and numerous types of birds. Cutting trees results in destroying its canopy, which prevents the excessive sun waves in the daylight and preserve a warm temperature in the night. Damaging the canopy results in harm to plants and animals. But the consequences do not end here. The South American rainforest has an impact on regional and even global water cycles, and it is critical to the water supply in Brazilian towns and nearby countries. In terms of climate change, chopping trees contributes to the increase of carbon dioxide to the air while also diminishing the ability to absorb carbon dioxide already there. According to the World Resources Institute, if tropical deforestation were a country, it would rank third in carbon dioxide-equivalent emissions, behind China and the United States (Nunez, 2020).

Although the statistics are dismal, environmentalists believe there is grounds for optimism. Existing forest ecosystems are being preserved, and lost tree cover is being restored. Organizations and activists are striving to combat illicit mining and logging. But even with all the rules, laws and institutions trying to fight against massive deforestation, the penury on the wood market makes corruption in this field a reality, contributing to their lack of efficiency. Cold-blooded murders of rangers, environmental activists, and people trying to protect the forests are the red face of this white-collar crime.

In this paper, the connection between economic and financial crime and illegal logging is studied from a mondo-economic point of view, using the most recent available data, in order to have a wide perspective and understanding of this phenomenon, so efficient countermeasures can be found, adopted, and implemented. This analysis' purpose is to raise awareness upon corruption in the forest industry. By using linear regressions, this analysis shows that countries with intensive logging activities are more corrupt, have higher levels of shadow economy, and more intense money-laundering activities. Therefore, countries with high levels of economic and financial crimes are also countries that unsustainably exploit their forests. Also, in those countries, the GDP per capita is low, the governance is inefficient, the life expectancy is low and their results towards protecting the environment are missing.

To gain this holistic perspective on the subject, section 2 begins by summarizing the most important research on corruption in the forest industry, demonstrating that there are few proper analyses on how corruption and illegal deforestation interact, and thus very little understanding of this phenomenon, which can constitute an impediment in implementing effective countermeasures to reduce the negative effects of illegal logging. In section 3, dedicated to the methodology, the variables utilized are explained, as well as why they were chosen, and what kind of statistical analyses were performed. The process of obtaining the results is discussed in detail in section 4, to explain the relation between corruption and deforestation at both international level and in Romania. The conclusion formed in light of the findings, as well as the limitations of the study and future work, make up the final section.

## **2. Literature Review**

The qualitative studies on this topic are numerous, but the quantitative ones are very few. Most research uses interviews, focus groups, case studies, observations, or other academic papers as methodology, whilst only a handful of studies are using quantitative methods in order to statically prove a connection between an economic and financial crime and deforestation. Even so, deforestation is mostly used as a determinant and/or control variable for other relations and very old databases are used, most recent data being from 22 years ago.

**Table 1.** Academic research on deforestation in relation to corruption, money laundering and shadow economy

Keywords	Web of Science database	ACM Digital Library	Science Direct	Emerald Insight	IEEE Transactions	Springer-Link Journals
Deforestation, corruption	140 results	20 results	24 results	1 result	0 results	304 results
Deforestation, money laundering	6 results	54 results	3 results	0 results	0 results	24 results
Deforestation, Shadow economy	6 results	153 results	0 results	0 results	0 results	138 results

**Source:** own processing

Many articles tangentially discuss the problem of illegal deforestation, while others present it as a main subject from a theoretical and qualitative point of view. Likewise, most investigations on this subject spotlight on the Amazon woodlands, Indonesia, Ghana, Brazil, Tanzania, and very few analyse the more than 100 countries worldwide. No up-to-date quantitative-based study conducted at an international level was found on the topic of economic and financial crime and deforestation.

Firstly, the difference between these three types of economic and financial crime must be established. In their book, Achim and Borlea (2020) analyse all these crimes, as well as identifying significant determinants for each and one of them. If corruption refers to an abuse of power from a public servant or authority for personal gain, shadow economy includes illegal activities and unreported incomes, while money laundering is the illegal process of making money generated from illegal activities appear to have a legal source (cleaning dirty money).

Even if the literature is not very generous on the subject of illegal deforestation in respect with economic and financial crimes, there is a lot of valuable general knowledge in these qualitative studies. On the topic of corruption and illegal deforestation, Pellegrini (2011) notes that Pakistan forest officials overlook illegal logging in order to obtain a larger volume of timber than the legal limit. The study of Hoinaru et al (2020) conducted on a large cross-country database of 185 countries for the 2005–2015 time period finds the higher levels of corruption and shadow economy are correlated with low levels of economic and sustainable development.

The “wooden mafia” is politically infiltrated and pays big bribes to allow timber trafficking. Another study on this topic is conducted by Milledge, Gelvas and Ahrends (2007) in southern Tanzania, which main finding is that illegal timber exports are facilitated by corruption. Robbins (2000) had interviewed 162 Indian foresters and concludes that corrupt practices of some local barons are efficient in circumventing forest laws and exploiting wood beyond permitted levels. Miller (2011) analyses 15 interviews with various experts and concludes that the most common and efficient practice of forestry corruption is this: police officers take bribes to allow timber transportation without the mandatory legal documents. Another practice identified by Miller (2011) is that forestry servants issue permits that are not stamped, so an exploitation company can reuse this document several times. Teye (2013) conducted a study based on 102 interviews with employees of the Forest Service Division of Ghana, 105 interviews with the citizens of Amutu and Bami and 24 interviews with logging companies. He found out that the national good is sacrificed for the personal interests of both state officials and private companies that exploit wood. Sundstrom (2016) analyses 37 studies, from which 27 empirical, and observes that they suggest in unison that corruption at all levels allows illegal exploitation of the forests and that this is true, in both time and space. Maina (2018) uses previous research to point out that corruption can decimate a country's 74extremely74d and affirms that there is a great need for studies that can provide further explanations on the extent to which corruption affects the continuous decline of forestland, and also find multiple reforms for improving the performance of the forestry industry. Siebert and Elwert (2014) investigate deforestation in Benin, Africa, and find that corruption of public officers plays an important role in the illegalities that occur in public property forests. Also focusing their study on Africa, but this time on Guyana, Bulkan and Palmer (2008) consider corruption as the major factor in the lack of efficient control over long-term deforestation concessions by governmental institutions. They discover that there is a favourable contest for corruption due to low forest taxes and high profits obtained from undeclared wood exports. The state itself acts like a criminal enterprise, by ignoring technical solutions that can improve forest management, but selectively use the existing ones against loggers who do not have political influence. Young and senior forest officers have very good relationships with forest operators. Small-scale logging companies increase their incomes by excessively exceeding the cutting quota, for which they pay bribes to first-level government officials in the forest inspection field.

From a quantitative point of view, several studies show a great contribution to the topic of illegal deforestation. For instance, Lopez and Mitra (2000) came to a major conclusion: for any level of per capita income and regardless of the type of relation between the company and the government, pollution levels are always above the optimal and sustainable one. In another quantitative study, Mendes, Junior and Tourrucoo (2016) prove that a constant salary scheme in the public institution can increase the possibility of giving and taking bribes. They developed a mathematical model which they used to show how the salary in the public sector is an efficient tool in combating illegal deforestation in developing countries. Another mathematical model was developed by Amacher, Ollikainen, and Koskela (2012), which shows how bribery taken by corrupt forest inspectors significantly changes the concession policy government. The authors note that a government's efforts to punish forest crimes is not independent of bribery incentives. They also state that illegal logging and corruption are inseparable, one aggravated by the other. Godoy et al. (1997) focus their study on Honduras and use deforested area as a dependent variable, and length of residence and age of inhabitants, level of education, income from agricultural production, wealth of households, area of agricultural land, and demographic variables as independent variables, together with credit, morbidity, and rice production. They demonstrate that deforestation has a direct and significant relationship with income, length of residence, education, age, wealth, off-farm income, and rice yield. Moreover, Cole (2007) published a study on 94 countries, from 1987 to 2000, in which he analysed the relationship between sulfuric dioxide emissions per capita, as dependent variables, and corruption, GDP per capita, the percentage of imports and exports in gross domestic product, and the percentage of industrial production in gross domestic product, as explanatory variables. Thus, the author proves that corruption has a positive impact on sulfuric dioxide emissions per capita, but also on carbon dioxide emissions per capita. Another research by Wilson and Damania (2004) show that high levels of political competition would lead to stricter environmental legal framework and to higher fines for those who break the law. The authors also state that stricter regulations always mean fewer emissions, and they conclude that an important factor in reducing environmental damage is political competition. Damania (2002) completes that an effective judicial system involves policies that combine efforts to reduce emissions to the ones that reduce corruption.

As for the causes of corruption in the forestry industry, Saint-Paul and Palmer (2005) had identified cultural and historical heritage, as well as the nature of business transactions. They argue that all actions and initiatives that aim to minimize corruption are just for show, if the culture of giving and taking bribes still exists, and if it is not eradicated from the top to the bottom. However, it is unlikely that the leaders, given their personal interests, will legislate against them. Smith, Obrizinski, Subarudi, and Suramenggala (2003) have demonstrated that a weak and unstable governance, with power battles, conflict, anarchy, and conflicting laws, will blur the line between illegality and legality and, so, it facilitates the illegal deforestation. When transitioning from autocracy to democracy, countries are pretty vulnerable to corruption because, during these times, the essential democratic institutions are not well underdeveloped yet. In their research, Pellegrini and Gerlagh (2006) had taken into consideration 62 countries for the 1980-1985 period, trying to explain the link between gross domestic product per capita, the index of democracy, and the level of corruption, as independent variables, and the stringency index of environmental protection, as an explained variable, while education, urbanization rate, and the percentage of agricultural workers are used as control variables. The authors main finding is that corruption represents a significant determinant of environmental policies. Furthermore, Koyuncu and Yilmaz (2011) had selected a set of 128 countries for explaining the corruption variable, by using the explanatory variable forest privatization, and by using as control variables the economic openness, the political rights and civil liberties, and education. The study shows that between corruption and forest privatization is a significant negative correlation. Thus, it should be considered a possible countermeasure to fight against illegal deforestation, together with other measures. Golovko & Sahin (2021) published an extensive research study on foreign trade, using data from 1994 to 2018, and they found out that the Eurasian countries are less integrated in the global trade system by 35 percent than the projected potential amount, sustaining the idea that the quality of political regime is a potential determinant of forestry corruption.

If these articles are only tangential to the topic of interest of this paper, there are three articles that directly address the topic of corruption in the forestry industry, that are worth mentioning. Firstly, Ferreira (2004) considers over 90 countries between the years 1990-2000 in order to study the relationship between deforestation rate, as explained variable, and corruption, risk of expropriation, contract repudiation, the bureaucratic quality, and the rule of law, as explained variables, while the gross domestic product per capita, the intensity of trade, the price of wood, and the population density are used as control variables. The author had found out that, when corruption is widespread, trade liberalization has negative effects on forestland. Secondly, Cornelis van Kooten and Wang (2003) taken into consideration 117 countries to demonstrate the relation between the average annual deforestation rate, as the dependent variable, and gross domestic product, corruption, OECD membership, forest exports,

agricultural production, property rights, government size, capital market, currency diversity, literacy rate and rural population. One important finding of this study is that as the income per capita grows, so does environmental degradation, as an effect of economic growth, but after a certain level of income, citizens seek a higher environmental quality, so the natural environment improves. The results of this study show the need for institutional reforms, to stabilize economies and stimulate the demand for a greater quality of the natural environment. Lastly, Koyuncu and Yilmaz (2008) analysed a set of 100 countries, between 1980-2000, to identify the link between deforestation, as the dependent variable, and corruption, cropland area, rural population growth, and the growth of the gross domestic product, as independent variables. They reach to the conclusion that corruption has a positive influence on the level of deforestation. Thus, countermeasures and policies that aim to reduce corruption will also reduce illegal forestry.

After identifying the causes of deforestation, the next stage is to try to identify solutions and to make recommendations. For instance, Guertin (2003) thinks that even with no consensus on defining and measuring illegal logging activities, a rising number of experts are discussing this phenomenon on the international level, within NGOs, governments, and associations of producers of wooden goods. Given the scale of this problem and the impact it has on world trade, illegal deforestation activities represent a threat to the forest products industry, as well as to the pollution level and our own health. This is why Callister (1999) made several recommendations for the World Bank, including the creation of a specialised working group against illegal logging activities, as well as starting a collaboration in this regard with the World-Wide Fund for Nature. In addition, Leitao (2016) proposes a list of facts that are currently discussed at the international level: corruption and poor governance can accentuate social and environmental problems that do not allow communities and ecosystems to develop; when economic development is low, environmental corruption is higher; corruption is present in a wide range of political stages, but it is higher in weak democracies; vulnerabilities in governance structures diminish good governance and contributes to facilitating environmental corruption; monopolies, whether controlled by the state or by a corporation, are an opportunity for corruption, especially in the environmental economic sectors; countries that are dependent on exploiting their natural resources have higher levels of corruption and poor environmental governance; and, finally, corrupt exporting companies, that are partners of the political leaders, increase the volume of illegal activities, which endangers the environment, and that translates to an increasing in the demand of natural resources. However, to understand the link between corruption and deforestation, Amacher (2006) says that we need to firstly understand the forest management decisions, the process behind bribery, and government policy decisions, by considering various assumptions regarding different forms of corruption, markets, and bargaining power of every country. Brockington (2008) studies Tanzania's resource management activities and suggests that the focus should be on developing effective institutions such as the ministry of natural resources, and even this represents a long-term struggle, it is the core of the democratic culture. Another research by Fadli and Purnomo (2019) was concentrated on the laws in Indonesia, and they discovered that people with large sums of money have great influence in politics, which translates to a legislation created for individual interests of some, but in the detriment of the low-income population. The integrity of the leaders equals the degree of corruption in that area, so the authors' recommendation is that the government must ensure the integrity of leaders and should internally control all areas in order to minimize corruption. Moreover, Irland (2008) studies 46 vulnerable countries and proposes a short list of countermeasures against the wood mafia that deserve attention: legal timber labelling systems, ending the conspiracy of silence, institutional transparency, corporate responsibility, buyer commitments, and efficient planning of forest management programs and projects. Irland has drawn one important conclusion: whenever the government is dysfunctional or absent, forest management policies will not work. As a response to all the problems discussed, Gupta and Siebert (2004) had made some suggestions regarding the Forest Integrity Network (FIN). The main objective of this organization is to minimize forest corruption and to raise awareness of this phenomenon, in order to surpass this key obstacle to sustainable forest use and forest conservation. FIN has a rich database with a lot of information on forest corruption, including benchmarking and policy research. Its main role is to develop and implement innovative ideas that aim at combating forest corruption, as well as collaborating with other organizations preoccupied with sustainable use of natural resources. Another objective of this network is to build an efficient framework for the stakeholders to collaborate in the exchange of experiences and to identify together the best practices in reducing forest corruption. Therefore, institutions like FIN are an efficient response to the urgent need of studying the link between corruption and the misuse of natural resources.

As for the limitations of these studies, it can be observed that a part use very small or niched samples, while others use databases from 20 years ago. Some studies focus on broader and/or tangential topics to illegal deforestation and economic and financial crime, but not focus specifically on it. A large part of these studies lacks the control variables and, also, lacks demographic and qualitative indicators, such as the socio-cultural ones. (Cozma, Cotoc, Vaidean, & Achim, 2021)

Therefore, the subject of illegal deforestation is not very popular in the academic research field, with modest results regarding its relationship with the economic and financial crimes. There is a significant need for fact-based research, given by the massive loss of forestland in the last 30 years, which had a negative impact on the environment and, thus, our health. The present study aims to analyse the relation between deforestation and corruption, money laundering and shadow economy, as well as identifying the determinants, by using the most recent data available, in order to offer a quantitative approach that can serve in understanding this phenomenon and contributing to the fundament of the stakeholders' decisions regarding the protection of the environment.

Bearing all these in mind, in order to study the relation between economic and financial crimes and deforestation, three hypotheses can be now formulated:

*Hypothesis 1: An increase in the level of corruption results in an increase in the level of deforestation.*

*Hypothesis 2: An increase in the level of shadow economy results in an increase in the level of deforestation.*

*Hypothesis 3: An increase in the level of money laundering results in an increase in the level of deforestation.*

### **3. Data and Methodology**

This quantitative research uses secondary data from well-known sources. It offers an updated world-wide view, by analysing data from 2012 to 2020 for 185 countries. The list of countries can be found in Appendix A.

The dependent variable is deforestation, and because there is no other measurement for it, it is illustrated by using the Net Forest Conversion Rate (NFCR), an indicator obtained by dividing the Net Forest Conversion (NFC) to the Forestland (FL).

The second category of variables are the economic and financial crimes indicators: Corruption Perception Index (CPI), Shadow Economy (SE) and Anti-money-laundering Index (AML).

The influences of GDP per capita, Government Effectiveness (GE), Environmental Protection Index (EPI), and Life Expectancy (LE) are also analysed. These control variables are also used by different authors, as the literature review shows, including Cole (2007), Koyuncu and Yilmaz (2011), Pellegrini and Gerlagh (2006), Lopez and Mitra (2000), respectively Guertin (2003).

The estimation methods, the description, the unit measurement, and the sources for each variable can be found in Table 2, as the summary statistics can be found in Table 3.

**Table 2.** Variables used

Variables	Way of estimations	Description	Unit measure	Source
<b>Dependent variables</b>				
<i>Deforestation</i>	Net Forest Conversion Rate (NFCR)	The percentage of forest land added or subtracted in a country; $NFCR(t) = NFC(t) / FL(t-1)$ ; negative values reveal that logging exceeds planting activities, and positive values show that planting exceeds logging, where:	%	Food and Agricultural Organization (FAO) (2022)
	Forestland (FL)	Total forest land in a country	1000 ha	Food and Agricultural Organization (FAO) (2022)
	Net Forest Conversion (NFC)	The amount of forest land added or subtracted in a year, in a country; own formula: $NFC(t) = FL(t) - FL(t-1)$ ; negative values show that cutting trees exceeds planting, and positive values show that planting exceeds logging	1000 ha	Food and Agricultural Organization (FAO) (2022)
<b>Independent variables</b>				
<i>Economic and financial crime</i>	Corruption Perception Index (CPI)	The level of perceived corruption in a country	a scale from 0 (extremely corrupt) to 100 (not corrupt at all)	Transparency International (2022)
	Shadow Economy (SE)	Shadow economy as percentage from the total GDP in a country	%	Medina & Schneider (2022)
	Anti-money-laundering Index (AML)	The risk of money laundering and terrorist financing	a scale from 0 (not vulnerable) to 10 (very vulnerable to money laundering)	Basel Institute on Governance (2022)
<b>Control variables</b>				
Wealth of the country	Gross Domestic product (GDP)	GDP per capita in a country	current US dollars (\$)	World Bank (2022)
Political regime	Government Effectiveness (GE)	The perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies	a scale from -2.5 (not effective) to 2.5 (extremely effective)	World Bank (2022)
Pollution	Environmental Protection Index (EPI)	How close countries are to established environmental policy targets	a scale from 0 (not environmentally friendly) – 100 (extremely environmentally friendly)	Yale Center for Environmental Law & Policy (2022)
Health	Life Expectancy (LE)	the number of years a new-born infant would live if prevailing patterns of mortality at the time of its birth were to stay the same throughout its life	years	World Bank (2022)

**Source:** own processing

To test the hypotheses, linear regressions between the variables above were designed using STATA. The confidence level is 0.05. Table 3 describes the variables from the statistical point of view:

**Table 3.** Summary statistics

Variable	Observations	Mean	Standard Deviation	Minimum	Maximum
NFCR	1,593	-0.0016745	0.0113104	-0.2708764	0.0805687
CPI	1,574	43.10102	19.44574	8	92
SE	924	27.30833	11.20252	5.1	58.2
AML	1,298	5.670722	1.229314	1.778681	8.610344
GDP	1,571	1,4485.9	20,072	252.3589	118,823.6
GE	1,638	-0.0519586	1.001396	-2.475142	2.3353
EPI	830	55.06836	16.0141	15.47	90.68
LE	1,416	72.16613	7.619598	47.416	85.07805

**Source:** own processing

An important observation that needs to be emphasized is that NFCR has a negative mean of -0.1674%, which means that, in average, in just one year, 0.1674% of the total forestland on Earth is disappearing. The forests are still shrinking, even with all the efforts to protect them, as the pollution is rising exponentially. This double effect (less trees, more green gasses) has a huge impact on the quality of the environment and, in the end, on our health.

Net Forest Conversion Rate (NFCR) has the lowest value in Sudan, in 2012, with -27.09% of its total forestland being cut, while in the same year, Burundi expended its forestland by 8,06%. Corruption Perception Index (CPI) has the lowest values between 2012 and 2015, showing that Afghanistan, North Korea, and Somalia were the most corrupt countries, while Denmark, in 2014, has the highest value of CPI, meaning that it was the least corrupt country. Switzerland recorded the lowest level of shadow economy (SE) in 2014, with underground economic activities of only 5,1% of GDP, while Bolivia recorded the highest level in 2016, with underground economic activities of 58.2% of GDP. Burundi had the lowest value of Gross Domestic Product per capita (GDP), in 2012, as Norway had the highest, in 2013. The lowest value of the Governance Effectiveness indicator is recorded by Somalia, in 2014, while the highest by Singapore, in 2020. Somalia has the lowest value of the Environmental Protection Index, in 2014, while Finland the highest, in 2016. Lesotho registered the lowest life expectancy, of only 47,42 years, in 2012, while Hong Kong the highest, 85,08 years, in 2020. It can be observed that the Nordic countries are the examples of good practices in all these areas, with Finland leading the top, opposed by African countries, like Somalia.

As for Romania, the database used in this research contains information about the Romanian Police activity regarding forestry industry and economic and financial crime, between 2012 to 2020. It contains 3 indicators: the total number of solved economic and financial crimes, the number of corruption crimes, and the number of crimes regarding the Forestry Law (Law no. 46/2008).

#### 4. Results and Discussions

This research aims to identify the effects of financial and economic crime in relation with deforestation. In order to test the three hypotheses, Net Forest Conversion Rate (NFCR) is used as explained variable. The explanatory variables are Corruption Perception Index (CPI), Shadow Economy (SE), and AML (Anti-money laundering Index), on turn. The list of determinants includes the Gross Domestic Product per capita (GDP), Government Effectiveness (GE), Environmental Protection Index (EPI), and Life Expectancy (LE).

Table 4 reflects the correlation matrix of the variables listed above. It can be observed that there is a positive relation between NFCR and CPI, which means that a corrupt country exploits the forests more (negative values of NFCR show that logging is more intensive than planting trees, and the forests are shrinking, as low levels of CPI



show that people perceive that country as a corrupt one). However, there is a negative relationship between NFCR and SE, which means that a country with a high percentage of shadow economy is a country which intensively cuts trees. Also, a negative relationship is between NFCR and AML, which means that a country that is vulnerable to money-laundering activities is also a country that unsustainably exploits its forests. As for the other variables, there are only positive relations between them and NFCR, which means that a poor country, with inefficient governance, that is not environmentally friendly, and with low life expectancy is a country that does not manage its forests sustainably and cuts more wood than plants trees, shrinking its forestland.

**Table 4.** Correlation matrix

	NFCR	CPI	SE	AML	GDP	GE	EPI	LE
NFCR	1.0000							
CPI	0.3054	1.0000						
SE	-0.3191	-0.7037	1.0000					
AML	-0.3459	-0.6629	0.4854	1.0000				
GDP	0.2693	0.8309	-0.6992	-0.5338	1.0000			
GE	0.3721	0.9297	-0.7339	-0.7163	0.8239	1.0000		
EPI	0.3702	0.7749	-0.6330	-0.7376	0.7664	0.8556	1.0000	
LE	0.4672	0.6616	-0.6088	-0.6730	0.6562	0.7792	0.8545	1.0000

**Source:** own processing

#### 4.1. Economic and Financial Crime in the Forest Industry at the International Level

Firstly, several simple linear regressions have been made, in order to test the three hypotheses stated above. Table 5 shows the results of these regressions.

**Table 5.** Simple regressions of NFCR on CPI, SE, AML, GDP, GE, EPI, and LE

NFCR	Coef.	Std. Err.	T	P>t	[95% Conf. Interval]		Prob. > F	Adj. R-squared
CPI	0.0001189	0.0000331	3.59	0.000	0.0000535	0.0001842	0.0004	0.0662
(Constant)	-0.0068364	0.0015429	-4.43	0.000	-0.0098824	-0.0037904		
SE	-0.0002274	0.0000575	-3.95	0.000	-0.00341	-0.0001137	0.0001	0.0911
(Constant)	0.0045416	0.0017077	2.66	0.009	0.001664	0.0079168		
AML	-0.002059	0.000505	-4.08	0.000	-0.0030567	-0.0010614	0.0001	0.0916
(Constant)	0.0101479	0.0029918	3.39	0.001	0.0042276	0.0160481		
GDP	1.01e-07	3.27e-08	3.10	0.002	3.66e-08	1.66e-07	0.0023	0.0483
(Constant)	-0.003189	0.0007639	-4.17	0.000	-0.0046971	-0.001681		
GE	0.0027456	0.000606	4.53	0.000	0.0015494	0.0039419	0.0000	0.1019
(Constant)	-0.0015458	0.0005939	-2.60	0.010	-0.002718	-0.0003736		
EPI	0.000193	0.0000454	4.25	0.000	0.0001033	0.0002827	0.0000	0.0907
(Constant)	-0.0122742	0.0025377	-4.84	0.000	-0.0172837	-0.0072646		
LE	0.0004084	0.0000762	5.36	0.000	0.000258	0.0005587	0.000	0.1411
(Constant)	-0.031004	0.0055063	-5.63	0.000	-0.0418743	-0.0201336		

**Source:** own processing

The positive relationship between NFCR and CPI is confirmed, as it proves to be statistically significant, which means that a corrupt country is shrinking its forests more (negative values of NFCR show that logging is more intensive than planting trees, and the forests are shrinking, as low levels of CPI show that people perceive that country as a corrupt one). Therefore, the first hypothesis is accepted: deforestation increases as corruption increases.

The negative relationship between NFCR and SE is also statically significant, which means that a country with a high percentage of shadow economy is also a country which shrinks its forestland (high values of SE and negative values of NFCR). Thus, the second hypothesis is confirmed: deforestation increases as shadow economy increases.

Also, the negative relationship is between NFCR and AML proves to be statistically significant, which means that the third hypothesis is confirmed: deforestation increases as the money-laundering activities increase.

As for the other variables, they all prove to have positive and significant relationships with NFCR, from the statistical point of view. This means that a poor country, with inefficient governance, that is not environmentally friendly, and with low life expectancy is also a country that does not manage its forests sustainably and cuts more wood than plants trees, shrinking its forestland. Thus, it seems that the way in which we treat the environment shows a lot about our community.

Same conclusions can be drawn by analysing the results obtained through designing multiple regressions that introduce the control variables on turns, in order to avoid multicollinearity, as shown in Tables 6, 7, and 8.

**Table 6.** Multiple regressions of NFCR on CPI and control variables

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
<b>Regression of NFCR on CPI, using GDP as control variable</b>						
1	(Constant)	-.007	.002		-3.490	.001
	GDP	1.449E-8	.000	.033	.269	.788
	CPI	.000	.000	.250	2.028	.044
<b>Regression of NFCR on CPI, using GE as control variable</b>						
2	(Constant)	.000	.003		.132	.895
	GE	.003	.001	.415	2.628	.009
	CPI	-4.438E-5	.000	-.100	-633	.528
<b>Regression of NFCR on CPI, using EPI as control variable</b>						
3	(Constant)	-.012	.003		-4.360	.000
	EPI	.000	.000	.246	2.130	.035
	CPI	3.770E-5	.000	.084	.729	.467
<b>Regression of NFCR on CPI, using LE as control variable</b>						
4	(Constant)	-.031	.006		-4.884	.000
	LE	.000	.000	.381	3.985	.000
	CPI	2.794E-6	.000	.006	.067	.947

Source: own processing

**Table 7.** Multiple regressions of NFCR on SE and control variables

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
<b>Regression of NFCR on SE, using GDP as control variable</b>						
1	(Constant)	.003	.003		1.153	.251
	GDP	2.499E-8	.000	.061	.553	.581
	SE	.000	.000	-.266	-2.407	.017
<b>Regression of NFCR on SE, using GE as control variable</b>						
2	(Constant)	.002	.002		.787	.432
	GE	.002	.001	.190	1.688	.094
	SE	.000	.000	-.176	-1.567	.119
<b>Regression of NFCR on SE, using EPI as control variable</b>						
3	(Constant)	-.004	.005		-.852	.396
	EPI	.000	.000	.189	1.879	.062
	SE	.000	.000	-.193	-1.911	.058
<b>Regression of NFCR on SE, using LE as control variable</b>						
4	(Constant)	-.022	.008		-2.539	.012

	LE	.000	.000	.303	3.117	.002
	SE	-8.697E-5	.000	-.122	-1.256	.211

Source: own processing

Table 8. Multiple regressions of NFCR on AML and control variables

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
<i>Regression of NFCR on AML, using GDP as control variable</i>						
1	(Constant)	.007	.004		1.801	.074
	GDP	5.467E-8	.000	.137	1.547	.124
	AML	-.002	.001	-.245	-2.761	.006
<i>Regression of NFCR on AML, using GE as control variable</i>						
2	GE	.003	.001	.308	3.061	.003
	AML	-.001	.001	-.107	-1.061	.290
<i>Regression of NFCR on AML, using EPI as control variable</i>						
3	(Constant)	-.006	.007		-.930	.354
	EPI	.000	.000	.277	2.669	.008
	AML	-.001	.001	-.121	-1.169	.244
<i>Regression of NFCR on AML, using LE as control variable</i>						
4	(Constant)	-.025	.010		-2.503	.013
	LE	.000	.000	.370	3.818	.000
	AML	-.001	.001	-.108	-1.111	.268

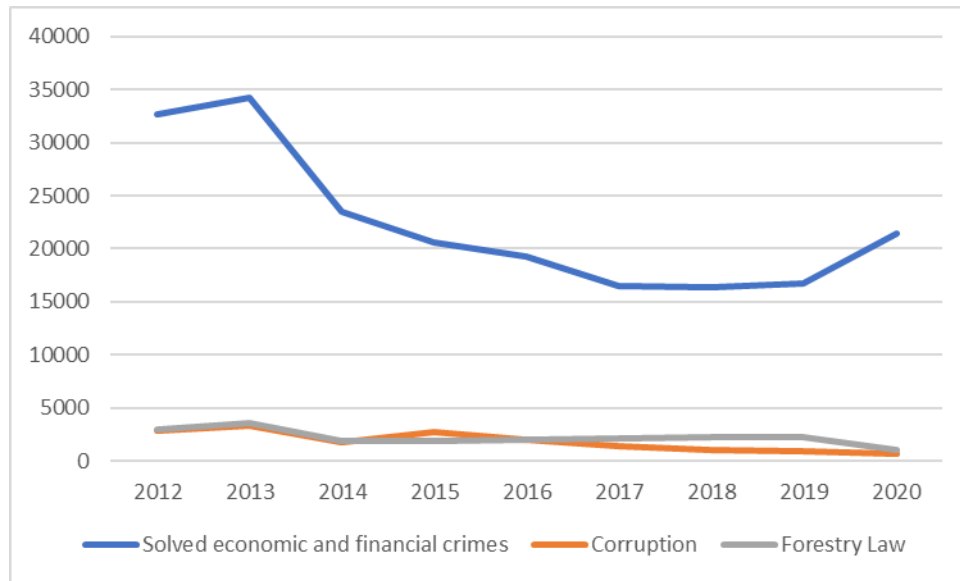
Source: own processing

Mostly, the type of relationships and their significance remain the same. More exactly, in the case of CPI and AML, the only significant variable is GDP, in the case of SE, not only GDP, but also EPI proves to be significant. However, the signs correspond and confirm the type of relationships for each. It can also be observed that GDP is significant for all three types of relationships tested.

Therefore, there is enough evidence to sustain that deforestation is linked with corruption, shadow economy, and money-laundering, as its determinants include the wealth of the country, the efficiency of the government, the protection of the environment, and the public health. Economic and financial crime determines, in part, the deforestation level, and determines, in total, the level of illegal deforestation, which would not be possible without corrupt officers, rangers, and public servants.

#### 4.2 Corruption in the Forest Industry in Romania

With more and more cases of violence and murders, Romania's wood mafia rapidly gains international attention. Romania's forests occupy approximately 30% of its total surface, and it has the biggest surface of virgin forests in Europe. However, it is in top 3 most corrupt countries in EU. A database with information about the Romanian Police activity regarding forestry industry and economic and financial crime is used in order to draw some conclusions. The database contains 5 indicators: the total number of solved economic and financial crimes, the number of corruption crimes, and the number of crimes regarding the Forestry Law (Law no. 46/2008). Figure 1 reflects their evolution in time.

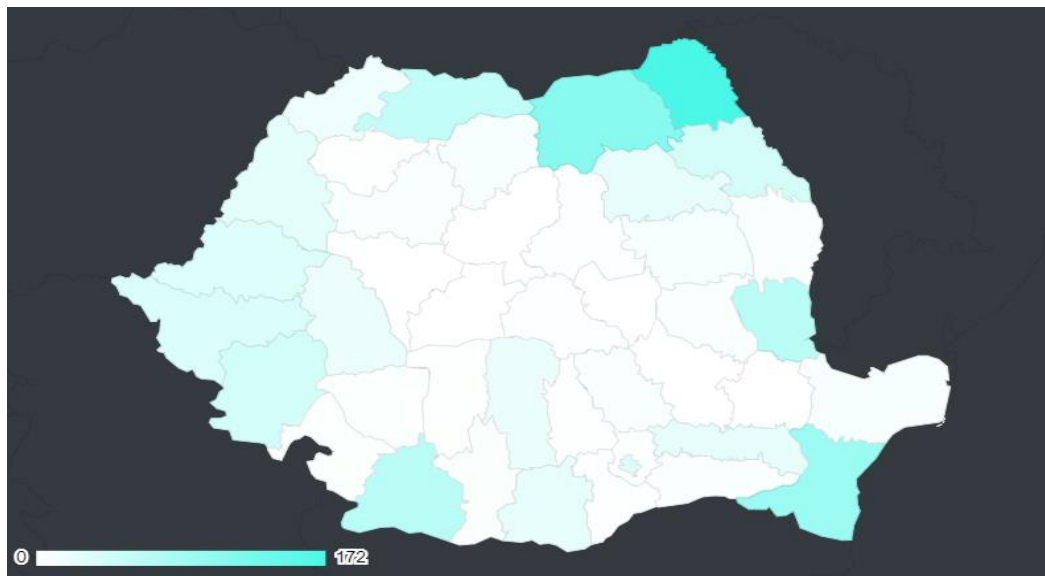


**Figure 1.** Crimes investigated by the Romanian Police between 2012 and 2020

**Source:** own processing

It can be observed that between 2012 and 2014, their evolution was similar, but from 2016, more and more forestry crimes were investigated, leading to the presumption that, maybe, Romanians became more aware of the importance to protect their forests. However, in the last couple of years, the number of investigated crimes regarding the Forestry Law decreased. As for the economic and financial crime, the evolution is unpredictable, with no clear trend.

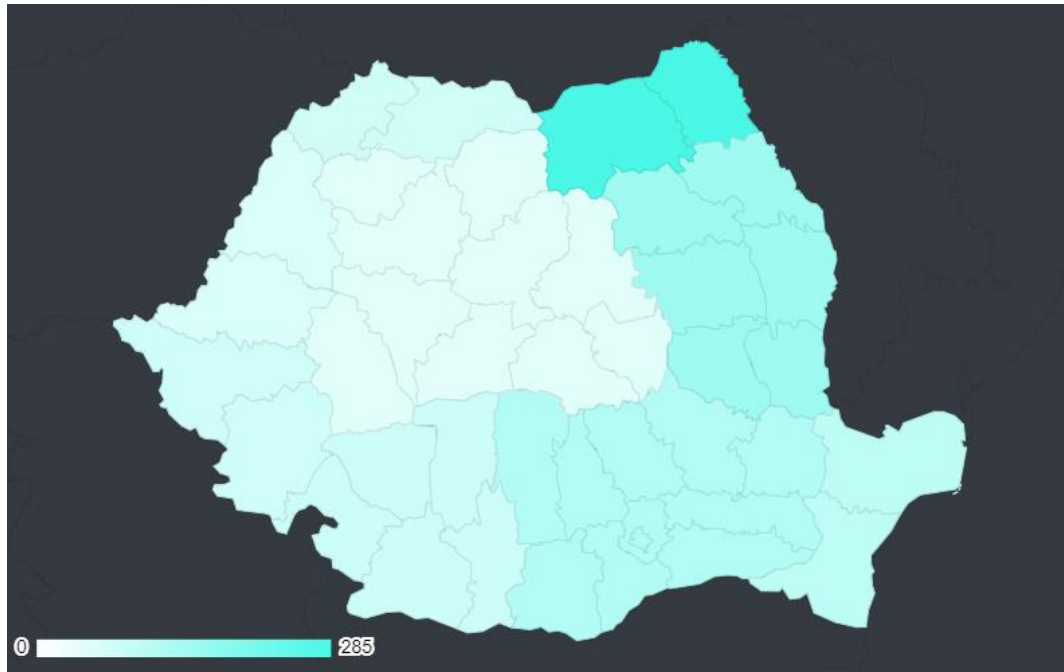
Regarding the Forestry Law, in 2020, the county with 0 crimes is Brăila, while only two counties exceed 100 crimes: Suceava (113) and Botoșani (172). Suceava is famous for the scandalous forestry illegalities exposed by the press and the environment activists. Thus, the quantitative data confirms the qualitative presumptions. In Figure 2, Romanian counties are coloured according to the number of crimes regarding the Forestry Law.



**Figure 2.** Crimes regarding Forestry Law, in Romania, by counties, in 2020

**Source:** FinCrime (<https://fincrime.net/ro/platform/romania-map>)

Moreover, Figure 3 shows the Romanian regions coloured according to the number of crimes regarding the Forestry Law. It can be seen that the N-E region, Moldova, has the highest criminality in the forestry industry, followed by Muntenia, Dobrogea, Oltenia, Banat, Crişana, Maramureş, and lastly Transylvania. It can be observed that this is the exact order of regions with the largest forestland of softwood. It is generally used as a resistance structure in construction, in the manufacture of doors, windows, and furniture, and also in the manufacture of paper. The most widely used wood in production worldwide is pine wood, and in Romania, the most used is spruce wood, which represents 20% of the entire forest area of the country. This might explain the correlation between the forestry crimes and the forestland of softwood.



**Figure 3.** Crimes regarding Forestry Law, in Romania, by regions, in 2020

**Source:** FinCrime (<https://fincrime.net/ro/platform/romania-map>)

## 5. Conclusions

This quantitative research provides updated information to decision makers preoccupied with environmental issues, by contributing to a fact-based understating of the illegal deforestation phenomenon.

The simple linear regressions show that economic and financial crime is positively liked with deforestation, as the control variables such as the wealth of the country, the wealth of the country (GDP), the efficiency of the government (GE), the protection of the environment (EPI), and the public health (LE), prove to be significant. In the case of multiple regressions, the type of relationships and their significance remain the same. More exactly, in the case of CPI and AML, the only significant variable is GDP, in the case of SE, not only GDP, but also EPI proves to be significant. However, the signs correspond and confirm the type of relationships for each. It can also be observed that GDP is significant for all three types of relationships tested. Therefore, this analysis shows that countries with intensive logging activities are more corrupt, have higher levels of shadow economy, and more intense money-laundering activities. Therefore, countries with high levels of economic and financial crimes are also countries that unsustainably exploit their forests. Also, in those countries, the GDP per capita is low, the governance is inefficient, the life expectancy is low and their results towards protecting the environment are missing. As for Romania, the quantitative data proves that Suceava and Botoşani are the areas that need the greatest forest protection, and they are also the counties where the bloodiest forestry crimes are committed. The N-E region, Moldova, has the highest criminality in the forestry industry, followed by Muntenia, Dobrogea, Oltenia, Banat, Crişana, Maramureş, and lastly Transylvania, which is the exact order of the forestland of softwood, the most used

type of wood in Romania, as well as worldwide. These findings are relevant in understanding the phenomenon of illegal deforestation, and it contributes to the adoption of efficient countermeasures that contribute to a healthier environment for all of us.

The limitations of this study include the availability of data, the differences in the structure of the datasets, the methodology changes, which all results in a lower number of observations and a lower accuracy. Further research might consider ways to increase the adjusted R-squared, by adding new significant variables, so the relation between economic and financial crimes can be analysed and understood better.

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**Appendix A – List of countries**

1. Afghanistan	2. Albania	3. Algeria
4. Angola	5. Argentina	6. Armenia
7. Australia	8. Austria	9. Azerbaijan
10. Bahamas	11. Bahrain	12. Bangladesh
13. Barbados	14. Belarus	15. Belgium
16. Belize	17. Benin	18. Bhutan
19. Bolivia	20. Bosnia and Herzegovina	21. Botswana
22. Brazil	23. Brunei	24. Bulgaria
25. Burkina Faso	26. Burundi	27. Cambodia
28. Cameroon	29. Canada	30. Cape Verde
31. Central African Republic	32. Chad	33. Chile
34. China	35. Colombia	36. Comoros
37. Congo Democratic Republic	38. Congo Republic	39. Costa Rica
40. Côte d'Ivoire	41. Croatia	42. Cuba
43. Cyprus	44. Czech Republic	45. Denmark
46. Djibouti	47. Dominica	48. Dominican Republic
49. Ecuador	50. Egypt	51. El Salvador
52. Equatorial Guinea	53. Eritrea	54. Estonia
55. Ethiopia	56. Finland	57. France
58. Gabon	59. Gambia	60. Georgia
61. Germany	62. Ghana	63. Greece
64. Grenada	65. Guatemala	66. Guinea
67. Guinea-Bissau	68. Guyana	69. Haiti
70. Honduras	71. Hong Kong	72. Hungary
73. Iceland	74. India	75. Indonesia
76. Iran	77. Iraq	78. Ireland
79. Israel	80. Italy	81. Jamaica
82. Japan	83. Jordan	84. Kazakhstan
85. Kenya	86. Kiribati	87. Korea (North)
88. Kosovo	89. Kuwait	90. Kyrgyzstan
91. Laos	92. Latvia	93. Lebanon
94. Lesotho	95. Liberia	96. Libya
97. Lithuania	98. Luxembourg	99. Macao
100. Macedonia	101. Madagascar	102. Malawi
103. Malaysia	104. Maldives	105. Mali
106. Malta	107. Mauritania	108. Mauritius
109. Mexico	110. Moldova	111. Mongolia
112. Montenegro	113. Morocco	114. Mozambique
115. Myanmar	116. Namibia	117. Nepal
118. Netherlands	119. New Zealand	120. Nicaragua
121. Niger	122. Nigeria	123. Norway
124. Oman	125. Pakistan	126. Panama
127. Papua New Guinea	128. Paraguay	129. Peru
130. Philippines	131. Poland	132. Portugal
133. Puerto Rico	134. Qatar	135. Romania
136. Russia	137. Rwanda	138. Saint Lucia
139. Saint Vincent and the Grenadines	140. Samoa	141. Sao Tome and Principe
142. Saudi Arabia	143. Senegal	144. Serbia
145. Seychelles	146. Sierra Leone	147. Singapore
148. Slovakia	149. Slovenia	150. Somalia
151. South Africa	152. South Korea	153. South Sudan
154. Spain	155. Sri Lanka	156. Sudan
157. Suriname	158. Swaziland	159. Sweden
160. Switzerland	161. Syria	162. Taiwan
163. Tajikistan	164. Tanzania	165. Thailand
166. Timor-Leste	167. Togo	168. Tonga
169. Trinidad and Tobago	170. Tunisia	171. Turkey
172. Turkmenistan	173. Uganda	174. Ukraine
175. United Arab Emirates	176. United Kingdom	177. United States
178. Uruguay	179. Uzbekistan	180. Vanuatu
181. Venezuela	182. Vietnam	183. Yemen
184. Zambia	185. Zimbabwe	