An Empirical Analysis of the Effects of Government Influence on Deforestation in Latin America

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Abstract:

This paper investigates government influence and factors that may increase the rate of deforestation in Latin American countries. An empirical analysis will be conducted to measure the change in deforestation rates based on several potential influences. The analysis will look specifically at countries in Latin America that have a high level of deforestation including Argentina, Bolivia, Brazil, Columbia, Paraguay, Peru, and Venezuela from 1996 until 2011. Variables studied include accessibility, suitability for agriculture production, corruption perception, government effectiveness, political stability, GDP per capita, foreign direct investment, and trade openness. The results show that as more forest cover is lost, and higher rates of deforestation occur, the government institution becomes more corrupt and less politically stable. Additionally, when there is less foreign direct investment, there is also lower rates of deforestation due to the recently diminished levels of natural resources in the area.

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1.0 INTRODUCTION

Climate change continues to become a more urgent matter for policymakers as well as leaders alike. Particularly in Latin America, climate issues are of great importance. Most agricultural production in this area relies on their vast rainforests. However, this region is seeing a rapid decrease in the amount of forest area, at a great rate than the rest of the world. This may be due to many factors, but one specific reason that can explain for this inconsistency is corruption amongst leaders within these countries. Bringing attention to this matter may help slow the destruction of the rainforests in these regions.

This study aims to enhance understanding of the high rate of deforestation in Latin American countries and the role that government influence plays on it. From a policy perspective, this analysis is important because if there is a strong direct relationship, by reforming government and corruption, then the rainforests can be saved, and therefore the effects of climate change can be slowed or even reversed in the coming years. The relevance of this study is that climate change is becoming an increasingly pressing problem with no immediate and easy solution. Therefore, any insight into this issue can help aid policymakers in future decisions and help stop the slow now.

As deforestation becomes a more pressing problem, not only is biodiversity decreasing and the environmental health taking a toll, but the citizens of these countries are also negatively affected. In both Latin America and the Caribbean, the increase in deforestation is leading to higher rates of outside agriculture and can in turn put those who depend on the forest land of their livelihood in a tough state. Not only do they no longer have access to resources they used to, but now there is more industry in their space leading to a potential increase in poverty and hardship for these individuals. Some specific areas can be investigated to help address the issues posed by deforestation of the rainforests are the strength of government in the country, amount of FDI, trade openness within the borders, and the amount of corruption that occurs. Various studies and papers have addressed this problem and have looked into the causes of the increased rate of deforestation.

This paper will look at Latin American countries from the years of 1996 to 2011. In this time period, Latin America faced a disproportionate amount of deforestation compared to other

regions in the world. Factors that may be escalating the amount of deforestation in these areas include the strength of the institutions and their ability to lead and govern a country. The stability as well as the intentions of those in power can greatly impact what foreign influences can enter the country as well as what is done with the country's natural resources.

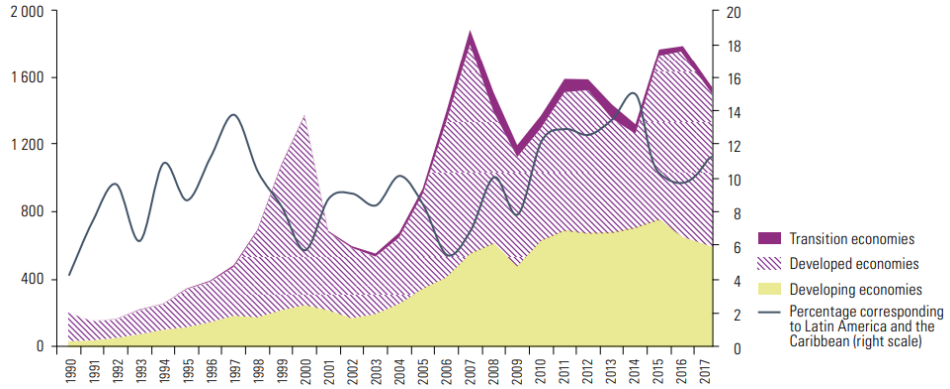
2.0 FOREST COVER AND FDI TRENDS

Figure 1: Forest Cover in Latin American and the Caribbean

Source: United Nations ECLAC

Figure 1 shows the amount of forest cover in Latin America and the Caribbean. The figure shows the years 1990-2020 and displays both the actual coverage in millions of hectares as well as the percentage of cover for this region. It also depicts how much of the coverage is natural forest and forest plantations. Natural forests are forests that are naturally occurring, whereas forest plantations are forests that are planted usually of a singular tree variety for the purposes of timber and other sources of production. The diagram shows that since 1990, the forest cover percentage has been decreasing steadily at around 2-3% every 5 years. Since 1990, the total percentage of forest cover has decreased by 7%. Similarly, the amount of natural forest has also decreased whereas the among of forest plantations has increased. Although that indicates an increase in trees, these trees are being planted with the intent of cutting them down, so they are not addressing the problem at hand.

Figure 2: Global FDI Flows in Latin America and the Caribbean



Source: ECLAC and UNCTAD

Figure 2 shows the Global FDI flows for Latin America and the Caribbean from the years 1990 to 2017. It shows the flows in both billions of dollars on the left, and the percentage of investment on the right. In addition, it breaks down the amount of investment for each type of economy: transition, developed, and developing. Since 1990, the amount of FDI for all types of economies has increased. In 2001, there was a large dip in the amount of FDI for developed countries due to the global slow of economic growth (UNCTAD, 2002). Another notable trend is the emergence of transition economies and investment in them. Starting in 2002, a level of investment occurs in this type of economy, indicating expansion, growth, and positive expectations by foreign investors. Although foreign direct investment is still occurring, it is not increasing at the same rate that it has been in years prior.

3.0 LITERATURE REVIEW

Deforestation is continuing to become a larger problem across the globe. Hit particularly hard by this epidemic is Latin America and the Caribbean. In this area, there is a high density of trees and rainforests. In addition, the industry and economies in these countries depend heavily on the rainforests for production and an inflow of funds. Deforestation is bad for the environment and disrupts the natural ecosystems that exist there, but it also leads to an increase in global warming effects which is becoming an increasingly larger problem within the world. The damaging of forests disrupts soil stabilization, water conservation, and may lead to more

desertification (Assa, 2020). This can also interrupt already in place agricultural processes which are necessary to sustain life as well as for economic stabilization. Although deforestation is the issue at hand, there are many factors that can be studied to see the effects that they have on the issue. For example, the strength of government in the country, amount of FDI, trade openness within the borders, and the amount of corruption that occurs. Various studies and papers have addressed this problem and looked into the causes of the increased rate in deforestation.

First, foreign direct investment plays a large role in the amount of deforestation that occurs in a country. Foreign direct investment, or FDI, is the amount of funding that comes from investors outside of the home country. They provide funds from a foreign country into a business venture within the home country. With this investment, they in turn get control of the good or resource within the country. Over the past 25 years, the amount of foreign direct investment in Latin America and the Caribbean has been increasing steadily (ECLAC, 2018). With this inflow of money into the economy, outside factors now have a say in resources like rainforests. More of this land is being converted into forest plantations as well as just being destroyed for the purposes of increasing the amount of agricultural land (ECLAC, 2021). These are more of cash cow ventures than the natural forests are, and therefore are more attractive than the natural forests that stand there. Therefore, foreign direct investment is having a negative effect on the forests. A variable that ties into this is trade openness as well. Being tied into trade arrangements like NAFTA (North American Free Trade Agreement) and other more localized trade agreements, it makes FDI in these countries that much more attractive for it is easier to get resources across borders and increase the flow of funds (Congressional Research Service, 2020).

Another variable that is playing a large role in deforestation is the role political institutions play in each respective country. Whether there is a strong government or not makes a big difference. Within Latin American countries there has been high rates of corruption, low rates of political stability, and low to moderate rates of government effectiveness rates. Looking at these variables can help form a good view into how each country's economy operates and where their priorities lay. In corrupt government situations, money and power rule. When this occurs, it is much more likely that environmental endeavors take a back seat, and this is becoming apparent as the rate of deforestation in these regions continues to increase at an

alarming rate (Moreira-Dantas and Soder, 2021). With the decrease of trees and the increase of agricultural practices and other increasing industries, the climate becomes more polluted due to the rising rates of damaging carbon dioxide emissions according to Galinato and Galinato in 2011. Although this may be a global concern, when there is weak political control, it is difficult to create any legislation or change the way that these natural resources can be protected and therefore benefit the environment and world as a whole.

4.0 DATA AND EMPIRICAL METHODOLOGY

4.1 Data

The study uses panel data from 1995 to 2011. Data were obtained from the World Development Indicators from the World Bank.

Table 1 Summary Statistics

Variable	Observation	Mean	Std. Dev.	Min	Max
LOGCHANGE	112	-0.00623	.00447	-0.02186	-0.00152
CPI	112	-0.54433	.40584	-1.4454	.1457
STABLE	112	-0.77669	.59392	-2.39011	.286
GOVEFF	112	-0.43704	.38725	-1.145	.329
LOGSUIT	112	13.0162	.92103	11.8962	14.65947
LOGGDP	112	8.13319	.697076	6.7892	9.524633
LOGFDI	112	1.269	.5792	-1.387	2.5799
LOGTRADE	112	3.7349	.41947	2.7481	4.4516

4.2 Empirical Model

Following Moreira-Dantas and Soder (2022) this study adapted and modified their empirical model. Influences from Galinato and Galinato (2011) like corruption control and political stability, were added to this model as well.

The model could be written as follow, where t represents time, and i indexes countries:

$$LnChangeForestArea_{i,t} = \beta 0 + \beta 1CPI_{i,t} + \beta 2Stability_{i,t} + \beta 3GovEffect_{i,t} + \beta 4LnSuitability_{i,t} + \beta 5LnGDP_{i,t} + \beta 6LnFDI_{i,t} + \beta 7LnTrade_{i,t} + \varepsilon$$

The dependent variable of the model is natural log change in forest area. Log Change in Forest $Area_{i,t,}$ from country i at year t, measures the change in forest area cover from year to year. Starting in 1995 until 2011, the change in forest cover is reported for each of the 7 countries in Latin America. The log was taken of this variable so that the data better fit the model. A negative value for all data points, shows that regardless of the country, over time, the amount of forest cover is decreasing.

Independent variables consist of seven variables obtained from the World Bank. Appendix A and B provide data source, acronyms, descriptions, expected signs, and justifications for using the variables. First, CPI (size of country i at year$t$) represents the Corruption Perception Index. This variable asks citizens how corrupt they view their own country's government system. STABILITY represents Political Stability. This also asks citizens how politically stable their country's government seems. GOVEFFECT represents government effectiveness, and how effective the home government seems in creating policy and functioning as a whole as viewed by their citizens. LOGSUITABILITY, takes the natural log of Agriculture Land Suitability. This variable measures the land's ability to reach potential yields in a variety of different crops. LOGGDP, takes the natural log of GDP per Capita in USD. This is measured by taking the GDP and dividing it by the total number of citizens in each respective country. LOGFDI takes the natural log of Foreign Direct Investment. This is the total level of direct investment from foreign entities in each country. The last independent variable is LOGTRADE.

This is measured by taking the natural log of Trade Openness. Trade Openness is measured by taking a country's total exports and imports and dividing the total by the country's GDP.

5.0 EMPIRICAL RESULTS

Table 2: Regression results for Latin American Countries

	Log of Forest Change	
	I (FE)	II (RE)
CONSTANT	.391*** (.086)	0.43*** (0.121)
CPI	-.00125 (.0008)	-.00313** (.0013)
STABILITY	-.00047 (.0007)	-.00152** (.00067)
GOVEFFECT	-.00185* (.001)	-.0001 (.0016)
LNSUITABILITY	-.0305*** (.0066)	-.00273*** (.0006)
LNGDP	-.00059* (.00033)	.00022 (.00052)
LNFDI	0.00047 (.00032)	.0024*** (.000648)
LNTRADE	-0.002** (.0007)	-.00483*** (.00133)
R^2	0.0311	0.7162
F-statistic/Chi	6.02***	116.71***
Number of obs.	112	112

Note: *** , **, and * denotes significance at the 1%, 5%, and 10% respectively. Standard errors in parentheses

The empirical estimation results are presented in Table 2. The empirical estimation shows both the fixed effects and random effects of the regression. The fixed effects regression has a very low R_2, 0.0311, indicating that the model does not account for a lot of the variations in data. The random effects regression has a much higher R_2, 0.7162, indicating that the model accounts for a much higher percentage of the data. The random effects model measures the effect of time over the regression. In this case, the random effects regression indicates that over time the relationship between the dependent and independent variables is changing and is significant. Random effects assumes that unobserved variables are uncorrelated with the model. This can be problematic and lead to potential biases.

Looking specifically at the random effects model, there were 5 significant variables in addition to the constant variable also being significant. This implies that this model produces results that are meaningful and can be interpreted and applied to prior research. Some of the independent variables do have a relationship that can be interpreted and have significance when compared to the dependent variable, log of area of forest change.

First, CPI, or the corruption perception index, is significant at the 5% level. It has a coefficient of -0.00313. This implies that for every 1% change in log of forest area, there is a 0.00313 decrease in CPI. Therefore, as the amount of forest area decreases, the more corrupt an institution is perceived to be by its citizens. Similarly, Stability is also significant at the 5% level and has a coefficient of -0.00152. This implies that for every 1% change in log of forest area, there is a 0.00152 decrease in Stability. As forest cover decreases, the government is perceived as being less stable by its citizens.

Next, the log suitability variable is significant at the 1% level and has a coefficient of -.00273. This implies that for every 1% change in the forest area, the land suitability amount decreases by 0.00273%. Therefore, as there is less forest area, the land becomes more suitable for agricultural processes. This may be because now that forests are cleared so there are more fields available for farming, increasing the suitability level of the land.

Log FDI is another significant variable at the 1% level. It has a coefficient of 0.0024. This implies that as Log change in forest area changes by 1%, the log of FDI will increase by 0.0024%. The two variables have a positive relationship showing that as the amount of forest

area increases, so does the amount of FDI. This is consistent with research (ECLAC, 2018). FDI inflows have been gradually declining from their 2011 peak. 90% of this decline has occurred in the natural resources sector (ECLAC, 2018). Therefore, this finding is consistent with the regression because as the amount of forest area decreases, so does the number of natural resources. Therefore, FDI should also be diminishing.

The last significant variable in the random effects model is the log of openness to trade. This is statistically significant at the 1% level and has a coefficient of -0.00483. This implies that as forest area cover changes by 1%, the openness of a country to trade decreases by -0.00483%. Therefore, as there are less trees, countries are more willing to trade. This can be due to a better running economy due to more opportunities and places to expand production with the less forested areas.

Interpreting these results from the relative changes of the independent variables, it is clear that the weaker the government institution is in a country, the more susceptible the area is to outside factors and therefore the amount of forest area is at risk. With outside interest looking to capitalize from the land, they are more likely to come in and use the land for its resources and make money, rather than looking to preserve the nature that is already there. Likewise, weaker institutions that are potentially more corrupt, are more likely to allow this business ventures to enter and use the land for they are potentially receiving kickbacks from the ventures. They may not have the people's best interest in mind, but rather are looking out for what will further their desires.

Limitations of the study include sample size and data available. There was limited data available making it difficult to extrapolate results. In addition, the variables CPI, Stability, and Government Effectiveness, are all based on a subjective scale. They are measured using current citizens' perceptions. It is uncertain how large the sample size is and whether or not it is comprehensive of the whole population. Likewise, if it is a more unstable and corrupt area, citizens may not want to share their true feelings due to the possibility of their being dangerous consequences. Specifically looking at the model, there may be omitted variables making it difficult to tell how accurate it is and whether or not the findings can be expanded to other countries and regions.

The study also has policy implications that can be addressed. There is an overall trend of decreased forest area over time regardless of country and the government system that they have. Global warming is becoming a more urgent matter and the amount of decreasing forest cover is only adding to the issue. Looking at the model, areas with a higher level of corruption, more suitable land, and more FDI tend to lose land at a quicker rate compared to areas that have less agriculturally productive land, and therefore less foreign interest. This finding has policy implications for a stronger government presence can help slow or stop the growing rate of deforestation. Areas with nutrient-rich land need to be protected for there is more interest in using and developing them. Therefore, stronger government programs or more environmentally focused programs can help form legislation that can protect this land from being developed, and let it continue to be natural and help the environment sustain itself.

6.0 CONCLUSION

In summary, over time the amount of forest cover is decreasing in Latin American countries. There are ties between the rate of deforestation being higher when there are more corrupt institutions in control. This can be looked at for policy implications and the future of forests. Climate change is becoming an increasing problem across the world and one step that can be taken to slow the issue is controlling institutions and looking at the role that they are playing.

Overall, those that care purely about economic expansion may be targeting areas like Latin America for their robust natural resources and potential ease of entry due to their weak institutions. However, identifying the reasons behind increased deforestation can hopefully curb the rate at which it is occurring. From this model, the argument for the need of stronger institutions can be made. In order to save the rainforests, slow the rate of global warming, and stop more harmful emissions from entering the atmosphere, there needs to be more regulations and a stronger presence of the government within industrial practices. In addition, having stricter practices and screening of potential investors before allowing business within the country could help slow this process and understand what they are necessarily interested in.

Although the growing of the economy in developing countries is very important, in this instance growing them for the sake of growing them may not be the answer. Destroying natural resources and polluting the environment may not be the best course of action. It may help in the short run, but in the long run depleted natural resources and a strong dependence on foreign investment may ultimately hurt these countries.

Appendix A: Variable Description and Data Source

Acronym	Description	Data source
LNFORESTAREA	By how much the forest area changed in a year, calculated by taking the percentage change.	World Bank
CPI	Rated on a scale of -2.5-2.5, how corrupt gov't seems to citizens.	World Bank
STABILITY	Rated on a scale of -2.5-2.5, how stable the gov't seems to citizens.	World Bank
GOVEFFECT	Rated on a scale of -2.5-2.5, how effective gov't seems to citizens.	World Bank
LNSUITABILITY	Land's ability to reach potential yields in a variety of crops.	World Bank
LNGDP	The GDP divided by number of citizens, measured in USD.	World Bank
LNFDI	Total amount of direct investment from foreign entities into the home country's economy.	World Bank
LNTRADE	Measure of exports and imports divided by the country's GDP.	World Bank

Appendix B: Variables and Expected Signs

Acronym	Variable Description	What it captures	Expected sign
LNCHANGE	By how much the forest area changed in a year, calculated by taking the percentage change.	Decrease in size of forests	-
CPI	Rated on a scale of -2.5-2.5, how corrupt gov't seems to citizens.	Corruption in Governments	-
STABILITY	Rated on a scale of -2.5-2.5, how stable the gov't seems to citizens.	Stability in Governments	-
GOVEFFECT	Rated on a scale of -2.5-2.5, how effective gov't seems to citizens.	Effectiveness of Governments	-
LNSUITABILITY	Land's ability to reach potential yields in a variety of crops.	How suitable the land is for agricultural production	+
LNGDP	The GDP divided by number of citizens, measured in USD.	GDP per capita	+/-
LNGFDI	Total amount of direct investment from foreign entities into the home country's economy.	The amount of FDI that a country is receiving. Helps gauge other countries and investor's interest	+/-
LNTRADE	Measure of exports and imports divided by the country's GDP.	A country's openness to trade with other nations	-

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