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Analysis

Rule of Law and Avoided Deforestation from Protected Areas☆

Ryan Abman

Department of Economics, San Diego State University, 5500 Campanile Drive, San Diego, CA 92182-4485, United States

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ABSTRACT

Global efforts to protect biodiversity and slow deforestation rely heavily on the establishment of protected areas; land set aside that cannot be deforested or developed. This paper studies the macro-level relationship between rule of law and variation in avoided deforestation from protected areas. Using recent global satellite data from 2000 to 2012, I estimate the country-level avoided deforestation of protected areas established in this period via nearest-neighbor matching. I then use weighted least-squares regressions to explain country-level variation in estimated avoided deforestation as a function of a country's governance characteristics as well as other country-level controls. Across 71 countries in this study period, protected areas were more effective in countries with higher levels of corruption control and protection of property rights, protected areas were more effective in more democratic countries, and there appears to be no relationship between political stability and avoided deforestation from protected areas.

1. Introduction

Global efforts to protect biodiversity and natural habitats rely heavily on the establishment of protected areas. As of 2016, protected areas covered more than 14% of the earth's terrestrial surface (UNEP-WCMC, 2016). The simple *de jure* establishment of a protected area, however, does not ensure effective protection of the natural environment inside its boundaries. Many protected areas around the world are ineffectively managed (Leverington et al., 2010) and offer little *de facto* protection (Joppa et al., 2008). For a protected area to offer *de facto* protection, it must be the case that there was pressure to convert protected land and the relevant governing body was able and willing to enforce the established land use rules. As much of the world's biodiversity lies in countries with high rates of corruption, low protection for private property rights, and persistent political instability, the degree to which terrestrial protected areas can offer *de facto* protection for sensitive habitats in these regions may be greatly affected by the country-level institutional and governance context of the countries in which they are created.

This paper studies the relationship between country-level governance and institutions and the effectiveness of protected areas at preventing deforestation. Using spatially-explicit global data on forest cover, deforestation, protected area boundaries, and land characteristics, I estimate the *de facto* effect of protected area status on deforestation for 2000–2012 across 71 countries around the world. To account for the nonrandom location of protected areas, I employ non-parametric, nearest-neighbor matching to match protected land with unprotected land with similar attributes (elevation, slope, distance to population center, etc.). I then examine the country-level avoided deforestation estimates as a function of measures of rule of law in a particular country. The results indicate significant variation in avoided deforestation between countries and I estimate deforestation in protected areas would have been 2.3% greater in 2001–2012 in the absence of protection (within areas protected in this time period). I find that protected areas avoided more deforestation in countries with better control of corruption and protection of property rights and countries with more democratic institutions. I find no relationship between political stability and avoided deforestation from protected areas.

Previous literature has established the connection between rule of law, corruption, political instability and deforestation at the country-level. Deacon (1994) and Koyuncu and Yilmaz (2009) demonstrate that country-level corruption is associated with higher deforestation. Both Barbier (2004) and Ferreira (2004) find that trade openness is associated with higher agricultural expansion and deforestation in corrupt countries. Barbier et al. (2005) and Bulte et al. (2007) find that corruption leads to more agricultural expansion. Ferreira and Vincent (2010) finds a nonmonotonic relationship between weak governance and timber production using a panel of timber exporting countries and Wendland et al. (2014) finds a nonmonotonic relationship between governance and deforestation examining trends in post-Soviet countries after the collapse of the USSR. Bohn and Deacon (2000) examine the role of government type and political instability on deforestation,

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E-mail address: rabman@mail.sdsu.edu.

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finding instability increases deforestation. Didia (1997) demonstrates a negative relationship between democracy and deforestation.[1] Collectively, this literature suggests that corruption, protection of private property rights, and political stability play an important role in the deforestation pressure, that is how likely unprotected land is to be deforested. These findings may lead policy makers to prioritize forests in corrupt and non-democratic states for protection as they seem to face the highest risk. However, it is likely that these same governance characteristics that put unprotected forests at risk may also have implications for the enforcement of protected areas.

Much of what is known about the relationship between corruption, property rights protections, political instability and protected areas comes from case studies. In the wake of Madagascar's 2009 coup d'état, deforestation inside the largest protected area in the country (Masoala National Park) increased dramatically after relative to surrounding, unprotected land (Allnutt et al., 2013). Anecdotal evidence suggests that corruption allowed for widespread logging from protected areas in Vietnam with the timber then smuggled through Cambodia (EIA, 2017). Illegal logging in Indonesian protected areas has been common and largely facilitated by both petty corruption (bribery of local authorities) and grand corruption (administrative officials redraw boundaries to provide access for timber companies) (ICG, 2001). These and other accounts indicate that corruption and absence of rule of law undermine the effectiveness of protected areas to slow deforestation within their boundaries. As *de facto* protection is the difference between what happens to forest cover inside a protected area and what would have happened in the absence of protection, corruption, rule of law, political stability and other governance characteristics of the host country have an empirically ambiguous relationship with protection, thus motivating the present study.

There are two notable papers studying the relationship between governance and protected areas at an international-scale. Kashwan (2017) studies the creation of protected areas and finds a relationship between democracy and inequality in their establishment, greater inequality is associated with more protected area in autocratic governments and lower inequality is associated with more protected area in democratic governments. The closest paper to the current study is Wright et al. (2007) which examines forest fires as a proxy for protected area effectiveness. Comparing fires within reserves to fires in surrounding buffer areas, they find that reserves do reduce the incidence of fires, but that the ratio of forest fires in buffer areas to forest fires inside protected areas is negatively correlated with both poverty and corruption. The current paper furthers this work in a number of ways. First, it explicitly estimates avoided deforestation using satellite data rather than using a proxy of forest fires. Second, by using nearest-neighbor matching to estimate avoided deforestation from protection, this paper avoids problems associated with using buffer area outside of a reserve as the counterfactual. Often times, borders of protected areas follow changes in the landscape, so that land inside the protected area may be very different than land immediately outside (Joppa and Pfaff, 2009). Furthermore, estimates of avoided deforestation can be overstated if the creation of the protected area displaces land clearing activity to the buffer. Lastly, this study examines political stability and democracy in addition to corruption control and income while controlling for a number of potential confounding characteristics.

While the underlying relationship between rule of law and protected area effectiveness has not been systematically studied, there has been a large literature on estimating avoided deforestation from the establishment of protected areas. A complete review of this literature is beyond the scope of this paper, however two important points emerge. First, protected areas are often created on land that would likely not have been deforested in the absence of protection.[2] This fact motivates the use of within-country matching estimation to estimate the avoided deforestation from protection status as explained in Section 3. The second insight from the existing protected area impact literature is that estimates of avoided deforestation vary across countries. It is this fact that motivates the underlying research question posed in this paper. To what degree can the rule of law explain protected area effectiveness? What is the relationship between a country's prevalence of corruption, instability and democratic accountability with the effectiveness of protected areas to slow deforestation?

This paper proceeds as follows. Section 2 provides some background on protected areas and a conceptual framework for analyzing their impact on deforestation. Section 3 describes the data used for estimation of protected area effectiveness, discusses the matching estimator for the country-level protection estimates and presents the country-level estimates of protected area effectiveness. Section 4 describes the governance data, explains the weighted-least-squares estimation model to examine the relationship between rule of law and protected area effectiveness and presents the results. The paper then concludes with final remarks.

2. Background

The International Union for the Conservation of Nature defines a protected area as "a clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values." Within this broad definition, the IUCN provides six sub-categories by which to classify protected areas, each allowing varying degrees of human interaction with the preserved habitat. The most strict of these classifications, Strict Nature Reserve, bar all but light human use only for scientific study or environmental monitoring. Other designations – Wilderness Area, National Park, Natural Monument and Habitat Management Area – allow for more human use, but prohibit land conversion.

While the overall aim of protected area status is to conserve biodiversity and natural habitat, this paper focuses specifically on deforestation (land change from forest to non forest). As greenhouse gas emissions from deforestation comprise roughly one fifth of global emissions, deforestation is an important contributor to global climate change. Protected areas have been proposed as an important tool to slow green house gas emissions. It should be acknowledged that this is an imperfect measure of protected area performance. Focusing only on deforestation misses important aims of protected areas such as protecting biodiversity (which could be lost due to poaching, but would not be measured by deforestation) or protecting important cultural/heritage sites.[3] Furthermore, only measuring deforestation will also miss selective logging of valuable tree species that does not involve clear-cutting and other forms of small-scale degradation. However, deforestation does allow for a consistent outcome which can be measured

[1] There is also an emerging literature examining within-country variation in corruption and institutions on deforestation. Notable examples include Burgess et al. (2012) and Alesina et al. (2014) for Indonesia and Araujo et al. (2009) and Cisneros et al. (2013) for Brazil. Sundström (2016) provides a review of corruption and forest governance at the international, national and local levels.

[2] DeFries et al. (2005) compared protected areas to surrounding land (buffers) around the world and found that 70% of buffers experienced forest loss while only 20% of protected areas experienced loss from 1980 to 2000. However, buffer areas may not provide a sufficient control for protected land. Joppa and Pfaff (2009) explicitly study location biases of protected areas in 147 nations and find biases in elevation, slope, distances to roads and cities and suitability for agriculture. They note that protected area borders often follow natural contours and are not randomly assigned, so buffer area comparisons may be comparing dissimilar land. Joppa and Pfaff (2010) also point out that spatial spillovers can be problematic for using buffer area comparisons, and other studies of protected area effectiveness have found smaller effects while explicitly controlling for land characteristics such as Andam et al. (2010), Ferraro et al. (2011), Joppa and Pfaff (2011), and Pfaff et al. (2009).

[3] The focus in this paper is solely on forested protected areas. This implies that the relationships found in this paper may not extend to effectiveness of protected areas in grasslands or marine protected areas.