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ABSTRACT

This paper shows that the level of deforestation in Indonesia is positively related to the degree of ethnic fractionalization at the district level. To identify a casual relation we exploit the exogenous timing of variations in the level of ethnic heterogeneity due to the creation of new jurisdictions. We provide evidence consistent with a lower control of politicians, through electoral punishment, in more ethnically fragmented districts. Our results bring a new perspective on the political economy of deforestation. They are consistent with the literature on (under) provision of public goods and social capital in ethnically diverse societies and suggest that when the underlying communities are ethnically fractionalized decentralisation can reduce deforestation by delegating powers to more homogeneous communities.

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1 Introduction

The Intergovernmental Panel on Climate Change attributes up to one-third of total anthropogenic carbon dioxide emissions to deforestation, mainly in tropical areas. Much of the latter can be attributed to illegal logging which is driven by the cooperation of corrupt politicians and agroforestry companies. In Indonesia for instance, where corruption is endemic, deforestation is mostly illegal with local politicians receiving bribes from the logging companies in exchange of logging licenses.

This paper investigates how the characteristics of local populations matter for illegal logging in Indonesia, focusing upon their level of ethnic heterogeneity. Forests are common goods which matter to local communities. Local populations have different preferences over the forests. Some may have a strong interest to preserve the forest if they use it for hunting, sheltering and gathering activities. Others may want to exploit it for energy or for the revenues from clear-cutting. Corruption leads to over exploitation of forests relative to the preferences of the local populations. We posit that local populations dislike corruption of their elected political representatives and are willing to punish their behaviour.

We show that ethnic diversity reduces the ability of locals to coordinate to achieve better control of politicians and punish them. As a result, ethnic fragmentation increases deforestation. It is difficult to identify causal effects of ethnic diversity since the latter is the result of geographic and political conditions (Michalopoulos 2012) and migration which are likely to have an impact on logging as well. We overcome these challenges using a quasi-experimental setting. Following the decentralisation process started in 1998, Indonesian forests became controlled by district-level elected governments that were in charge of allocating and enforcing logging licenses. The decentralisation of forest management duties was accompanied by an increase in the number of administrative jurisdictions through the proliferation of district splits which allowed for more homogeneous communities. We construct a time-varying measure of ethnic fractionalization by exploiting the proliferation of administrative jurisdictions occurred during the period 2000-2012. Most of the newly-formed districts were more ethnically homogeneous. The timing of the splitting was exogenous as the central government intervened in two points in time, halting the redistricting process and introducing idiosyncratic variation across districts. Also procedural and bureaucratic delays influenced the approval of new districts. Note that it is usually quite difficult to identify exogenous changes in ethnic fractionalization. The way in which redistricting happened in Indonesia gives us the possibility to use a quasi-experimental setting to study the association between ethnic diversity and deforestation. In particular, we exploit the exogenous timing of district splits to provide causal evidence on the relationship between these two variables.

There are a number of theoretical arguments that can justify a positive effect of ethnic diversity on deforestation. First, ethnic fractionalization is correlated with corruption of elected politicians, who are less controlled and less responsive to local needs in fragmented societies. This is because ethnic fractionalization has a detrimental effect on social capital, trust, participation in communal activities and protection of public goods.[1] For instance Nannicini et al. (2013) show that low levels of social capital are associated with a lower capacity to punish bad politicians. Second, forests are common (public) goods for local communities and may be subject to exploitation by logging companies. Low social capital interferes with the communities' capacity to organise and lowers their ability to extract compensations from the logging companies making it cheaper for the latter to increase deforestation.[2] This is consistent with Okten and Osili (2004) who find that ethnic diversity in Indonesia has a negative impact on the contributions and prevalence of community organizations.

[1] On the positive role of social capital in the development of localities and their ability to provide public goods, *see* Banfield (1958), Putnam et al. (1993), Guiso et al. (2013).

[2] For a survey of the literature on the effect of ethnic fractionalization on (among other things) public goods provision see Alesina and La Ferrara (2005).

In this paper we set up a simple theoretical framework to provide the intuition behind the relationship between ethnic heterogeneity and illegal logging. Then we test the predictions of the model using a rich dataset on Indonesia districts. First, a simple cross sectional analysis supports our main hypothesis that ethnic fractionalized areas display more deforestation.[3] We then construct a time-varying measure of ethnic fractionalization by considering the changes in administrative borders over the period 2000-2012. By exploiting the exogenous timing of the creation of new jurisdictions, panel data evidence confirms our hypothesis and supports a casual relationship between ethnic diversity and deforestation. Finally, we provide an empirical test of the impact of ethnic fragmentation on the control of politicians and ultimately on deforestation, as outlined in the model.

This paper contributes to several strands of the literature. First, it speaks to the large body of works on the effect of ethnic fractionalization on public goods provision (Alesina et al. (1999) Alesina and La Ferrara (2005), Miguel and Gugerty (2005)), being the first study able to identify causal effects of ethnic diversity on a common natural resource. It is also generally related to the literature on the depletion of common resources such as water, fisheries and air (Lloyd (1833), Hardin (2009),Ostrom (1990)). This literature points out that in the absence of regulation or well defined property rights, common goods are subject to the so-called "tragedy of the commons" with individual actors that tend to overuse them, not internalising the social cost of an excessive exploitation of the resources. We contribute to this literature introducing a political economy explanation for the depletion of common natural resources, which focuses upon the interaction between the characteristics of local communities and the incentive of politicians to behave illegally. Third, this paper contributes to the literature on the political economy of deforestation by introducing a new perspective on the effect of decentralisation. Our results are related to those in Burgess et al. (2012) who show that greater political fragmentation is detrimental to deforestation

[3] This suggestive evidence is robust to the inclusion of a full set of potential confounding factors.

due to increased competition among districts for the provincial wood market. Our findings suggest, however, an additional and different effect of political fragmentation. In an ethnically heterogeneous environment, an increase in political jurisdictions can have beneficial effects on deforestation if it leads to lower ethnic fragmentation. The two effects, therefore, work in opposite directions. In doing so we also speak to the literature on the optimal size of local governments (Alesina and Spolaore, 2003; Alesina, 2003) that highlights the trade-off between the benefits of size versus the costs of heterogeneity of preferences, culture and attitudes of the population. In our context, the trade-off is between lower ethnic heterogeneity and increased competition in the natural resource market.

The remainder of the paper is organized as follows. Section 2 describes the institutional background in Indonesia with a particular emphasis on the process of political fragmentation. In section 3, we present a simple theoretical framework that highlights one of the possible link between ethnic heterogeneity and deforestation. Section 4 describes the data while Sections 5 discusses the empirical methodology. The main results and relative robustness checks are in Section 6. Section 7 provides evidence on the relationship between ethnic diversity, control of politicians and logging. The last section concludes.

2 Institutional Background

2.1 Political Fragmentation

Indonesia is very ethnically diverse. Its population includes more than 500 ethnic groups and 742 distinct languages and dialects. The majority of these groups are native to the country, and their presence on the islands predates written history. Indonesia is divided into provinces, subdivided into districts (Kabupaten), the administrative units considered in our analysis. Districts are further subdivided into subdistricts (Kecamantan), and finally into villages (Desa). Ethnic and religious cleavages are a salient characteristic of Indonesian population since precolonial times. When the Dutch established their colonial government they exploited the ethnic divisions to extend their political control over the arcipelago. In particular they privileged some ethnic groups assigning them crucial positions in the armed forces and in the local administration. This strategy gave the Dutch the ability to govern effectively the periphery, populated by an heterogenous population (Tajima, 2014). On the other hand, the same strategy exacerbated ethnic cleavages with some ethnic groups being disadvantaged compare to others. During the authoritarian regime of Sukarno (1945-1965) acts of violence perpetrated by the military and the police forces tapped into local ethno-religious relations. However, manifestations and claims of ethnic identities were suppressed since the regime had the objective to promote assimilation and a strong national identity. A similar approach was adopted during Suharto's New Order (1966-1998), a centralistic authoritarian political regime where all power was retained by the Army and the Suharto's affiliated elites.

After the fall of Suharto in 1998, Indonesia's democratic government embraced the policy of multiculturalism as a preferred approach to rebuilding the nation. As a consequence the process of democratization led to an uprise of identity politics, which in part culminated in the emergence of separatistic movements. The pattern in ethno-religious identities was accompanied by a vast decentralisation process, initiated after 1998, that was characterised by a significant transfer of power from the central government to the districts. Two laws (Law 22 and Law 25), both passed in 1999 established the devolution of a significant portion of government functions to district level governments such as education, healthcare and infrastructure. Only national defence, monetary and foreign policy remained under the responsibility of the central government authority. The country faced strong centrifugal forces and political instability marked by a rise in the number of separatist parties based on ethnic and religious identity trying to pursue self-determination (Ostwald et al., 2016). Between 2000 and 2010, the number of provinces increased from 27 to 34 and the number of districts from 341 to 497 due to the splitting of 98 original districts into 254 administrative units. Geographic dispersion, political and ethnic differences, natural resource wealth and bureaucratic rent seeking (Fitrani et al., 2005) were the key parameters that influenced this process. For instance, administrative units would split because of a desire by some ethnic groups to establish their own district where they would become the majority ethnic group. If a district wanted to split, it needed to go through a number of steps and satisfy several criteria, in some cases needing the approval from the parliament and the head of the original district and and in other cases needing the approval from the national parliament.[4] The approval procedure was subject to various bureaucratic delays. In addition the national government intervened twice to halt the proliferation of districts, first in 2004 and then in 2009, by approving two moratoria whcih halted the creation of new districts between 2004-2006 and 2009-2012, respectively. In practice the moratoria delayed the approval of new districts that were just about to complete the process and resulted in these districts being created at the same time of other districts that initiated the formal process years later. Overall both bureaucratic delays and the moratoria introduced idiosyncratic variation in the date of approval of new districts. This particular feature of the splitting process is crucial for the analysis performed in this paper, which relies on the exogeneity of the timing of the splitting.

2.2 Illegal logging

The devolution affected logging as well, with heads of districts being entitled to issue licenses to log. On the wave of decentralisation, logging activities increased significantly, partly because deforestation that was considered "illegal" by the central government was made "legal" by several localities (Casson and Obidzinski, 2002). In fact, there is a large gray area between "legal" and "illegal" permits. District governments frequently issued per-

[4]See Bazzi et al. (2015) for a detailed description of the redistricting process.

mits which overlap with those issued by neighbouring governments, exceeded caps imposed by the central government and allowed logging in customary forests that were reserved for use by indigenous people. Kasmita Widodo, the national coordinator of the Participatory Mapping Network (JPKK), an organization that supports efforts to map indigenous people, estimates that as much as 70% of forest area in Indonesia is covered by these overlapping permits.[5]

The decentralisation process allocated a significant portion of timber revenues to local jurisdictions, particularly if compared to their share of income tax and oil and gas revenues (Arnold, 2008); however it also empowered local public officials to issue logging permits beyond national control opening new opportunities for corruption and rent seeking (Martini, 2012). At its peak in 2000, some 75% of logging activity was illegal, falling to 40% by 2006, according to an estimate by the British think-tank Chatham House. The Environmental Investigation Agency, a non-profit organization, alleged in 2005 that $600 millions worth of Indonesian timber was being smuggled to China each month, with both the army and the police taking an active role. A more recent report by Transparency International Indonesia (2011) on the existing corruption risks in the forestry sector in three Indonesian provinces (Riau, Aceh and Papua) has identified bribery to obtain licenses and logging concessions as a major source of corruption. In Pelawan district the head of the district was arrested in 2008 for issuing illegal licenses to 15 logging companies. Throughout the decentralisation process, forest-dependent communities were empowered to exert property rights over customary forest. Heads of districts (*Bupatis*) were initially permitted to issue small-scale forest conversion licenses conditionally to a pre-negotiated agreement between a company and the community, which contributed to the proliferation of overlapping permits. In many cases this resulted in communities negotiating directly with logging companies in exchange for financial and social benefits (Engel and Palmer, 2006). Some communities were much

[5]Link: http://www.thejakartaglobe.com/news/indigenous-peoples-vow-to-map-customary-forests/

more successful in appropriating these benefits from the issuing of permits than others, and the system resulted in a huge proliferation of small-scale licenses (Engel and Palmer, 2006). Although a restructuring of the licensing system in 2003 resulted in small-scale licenses being banned by the central government, many district officials continued issuing them contributing to increase the overall amount of "legal" logging. In addition heads of districts continue to be entitled to issue large logging concessions within their borders (Barr et al., 2006). Since 2003, forestry related revenues are shared between district and national governments and accrue through three main channels: a reforestation fund, harvest royalties, and land rents that are usually in the form of licensing fees. While the reforestation fund and harvest royalties are usually tariffs exacted on a per-cubic meter or per-ton harvested basis, the licensing fees are assessed by the hectare of the area. Though the national government has provided some benchmarks for the base tariffs for each channel, the taxation rates vary drastically between districts and even between permitted tracts, as some communities are more successful than others in claiming their share of the benefits.

3 A simple model

Our model of illegal logging shares some features with Burgess et al. (2012) but the important difference is that we focus upon ethnic heterogeneity. We assume a large number of logging firms which seek to obtain a permit to log in the representative district. Local governments (heads of districts) decide the number of permits to sell to firms taking the price of wood as given. Bribes are needed to obtain any permit which goes beyond the legal quota set for the district.[6] Ethnic diversity can influence deforestation by decreasing the cost of bribing sustained by politicians. The reason is that control of politicians, through electoral or legal punishment, is a public good typically under supplied in communities

[6] As we mentioned above, in reality the distinction between legal and illegal permit is a bit fuzzy, but for simplicity in the model we assume away this complication.

characterised by low social capital and low political participation which is the case of ethnically fragmented districts. Therefore politicians in fragmented districts facing a lower probability of being punished for being corrupted, have a greater incentive to increase the amount of illegal logging permits issued, thus their "price", the bribe, goes down.

The logging company solves the following problem:

$$\underset{f}{Max}\ \pi(f) \equiv f(p-c-b) \tag{1}$$

$$s.t.\ \pi(f) = 0 \tag{2}$$

where f is the amount of wood extracted by the company, p is the price that is determined at the province level, considered exogenous, c is the marginal cost of extraction and b is the bribe per unit of wood to be paid to the local politician (head of district). Given the free entry assumption, the company maximizes its profit under the zero profit condition. The maximum bribe the company is willing to pay is:

$$\pi(f) = 0\ \rightarrow b^{*} = (p-c) \tag{3}$$

The equilibrium bribe per unit of wood extracted equals the marginal benefit of extraction.

The local politician decides how many permits to allocate and faces the risk of being punished for exceeding the amount of logging permitted by the national government. The probability of punishment, $\phi(f-\bar{f}, EF)$, is a convex function of the difference between the number of illegal permits issued and the legal quota, $\bar{f}$, set for the district. It is also a decreasing function of the level of ethnic fractionalization EF, i.e. $\phi_{EF}(f-\bar{f}, EF) < 0$ and $\phi_{f,EF}(f-\bar{f}, EF) < 0$. This assumption captures the idea discussed above that legal or electoral punishment of political corruption is lower in more ethnically fragmented districts. The loss for being caught corresponds to all future rents from holding office, r, or, more generally, to a penalty of size r. The local politician solves the following problem:

$$\underset{f}{Max}\ V \equiv bf - \phi(f - \bar{f}, EF)r \tag{4}$$

Substituting 3) into the above equation, we obtain:

$$\underset{f}{Max}\ V \equiv f(p - c) - \phi(f - \bar{f}, EF)r \tag{5}$$

Hence the first order condition is:

$$p - c = \phi_f(f - \bar{f}, EF)r \tag{6}$$

In equilibrium the politician issues an amount of logging permits such that the net marginal benefit of issuing an additional permit is equal to the marginal cost. From equation (6) we can easily derive the effect of an increase in ethnic diversity on the equilibrium number of logging permits as:

$$f_{EF}(EF) = -\frac{\phi_{f,EF}(f - \bar{f}, EF)}{\phi_{ff}(f - \bar{f}, EF)} \tag{7}$$

Recalling that ϕ is convex in f and decreasing in EF, the following proposition holds:

Proposition 1 *In equilibrium* $f_{EF}(EF) > 0$.

In Appendix A we describe two additional channels whcih may link ethnic fractionalization and deforestation. The first is the ability of local communities to fight against logging companies. For instance, Collier and Hoeffler (2004) have established that ethnically diverse communities can coordinate less, hence are less effective in organising a political battle. In addition ethnic diverse communities have a lower social capital and individuals tend to participate less in social and political activities (Alesina and La Ferrara, 2000) which can be the case also for protests against logging companies. The second channel is that more diverse communities, which are less able to negotiate because of coordination issues, receive a lower compensation from logging companies. As a result, deforestation is higher in more ethnically fragmented communities, since it becomes relatively cheaper for logging companies.

4 Data

We measure deforestation at the district level over the period 2000-2012 using satellite forest cover data as provided by Hansen et al. (2013). The data are originally constructed from Landsat images at 30-meter spatial resolution. Forest cover loss is recorded as a binary variable and each pixel is assigned value 1, i.e. deforested, if it experienced a stand-replacement disturbance or the complete removal of tree canopy cover over the year.[7] The data are measured in square meters for both forest cover in 2000 and annual deforestation over the period 2000-2012.

Table 1 shows the amount of logging, in thousands hectares, occurred during the period 2000-2012 in each province. About 12% of the initial forest area was deforested over the 12-years period. Most deforestation occurred in the island of Kalimantan and several provinces of Sumatra. Lower levels of deforestation are instead recorded in the island of Papua.

We measure ethnic fractionalization at the district level using the 2010 Indonesian Census provided by the Indonesian National institute of statistics (BPS) and construct the

[7]For a detailed description of the methodology followed to collect deforestation data see Hansen et al. (2008).

Table 1: Deforestation and Ethnic fractionalization by province

Province	Area	Forest Area	Logging (2000-2012)	EF (mean)	EF (sd)
Sumatra					
Nanggroe Aceh Darussalam	5,737	4,556	379	0.35	0.27
Sumatera Utara	7,161	5,088	884	0.48	0.28
Sumatera Barat	3,931	3,217	311	0.20	0.18
Riau	9,865	7,626	2,943	0.72	0.12
Jambi	4,929	3,958	1,031	0.62	0.15
Sumatera Selatan	8,761	5,856	1,738	0.73	0.13
Bengkulu	2,000	1,617	224	0.66	0.18
Lampung	3,392	1,486	179	0.52	0.18
Bangka Belitung	1,689	1,114	305	0.51	0.08
Java					
DKI Jakarta	66	2	0	0.76	0.02
Jawa Barat	3,752	1,608	45	0.27	0.23
Jawa Tengah	3,490	1,191	29	0.04	0.06
DI. Yogyakarta	323	99	1	0.07	0.07
Jawa Timur	4,707	1,466	55	0.10	0.12
Banten	947	480	19	0.51	0.21
Nusa Tenggara					
Bali	569	312	4	0.20	0.18
Nusa Tenggara Barat	2,002	1,013	30	0.32	0.24
Nusa Tenggara Timur	4,737	1,913	61	0.37	0.28
Kalimantan					
Kalimantan Barat	14,794	12,272	1,957	0.79	0.18
Kalimantan Tengah	15,483	12,965	2,070	0.71	0.13
Kalimantan Selatan	3,768	2,383	444	0.36	0.24
Kalimantan Timur	19,477	16,939	1,778	0.82	0.06
Sulawesi					
Sulawesi Utara	1,461	1,191	50	0.52	0.27
Sulawesi Tengah	6,159	5,222	338	0.72	0.19
Sulawesi Selatan	6,245	4,000	286	0.35	0.30
Sulawesi Tenggara	3,698	2,894	254	0.54	0.22
Gorontalo	995	808	47	0.25	0.06
Maluku					
Maluku	4,684	3,881	96	0.69	0.24
Maluku Utara	3,173	2,920	120	0.77	0.15
Papua					
Papua Barat	8,491	7,746	95	0.85	0.12
Papua	23,643	19,900	190	0.50	0.33

Total logging, area and forest cover are in thousand hectares from a cross-section of 365 districts based on 2010 administrative borders.

Herfindahl index:

$$EF_i = 1 - \sum s_j^2, \tag{8}$$

where s is the share of ethnic group j over the total population of the district i. This is a broadly used measure of ethnic fractionalization which is the probability that two individuals randomly drawn from the population belong to two different ethnic groups.

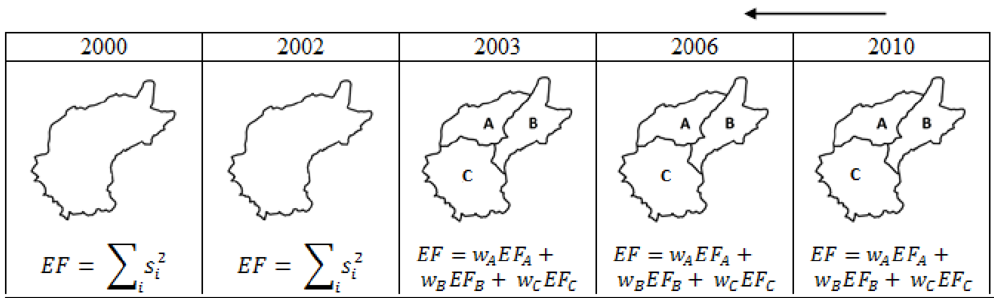
Our analysis uses two different units of analysis. The cross section analysis compares deforestation and EF across 465 districts as defined by the 2010 administrative borders for which data are available. Of the 497 districts in 2010 we excluded 6 districts that first merged and subsequently split again during the period. In addition we were unable to match 8 districts across the multiple sources of data and excluded 18 districts with missing population data. Average levels of ethnic fractionalization by province are shown in table 1 while overall average diversity is shown in table 2, first row. There is no discernible pattern of ethnic fractionalization across islands but there is significant heterogeneity across districts as shown in the map in Figure 4 of the Appendix.

The longitudinal analysis, instead, is based on 337 districts, as defined by the original administrative borders in 2000 (pre-splitting), and uses a time-varying measure of ethnic fragmentation. Of the 341 original districts, 4 districts could not be matched across data sources. The splitting of districts offers a unique opportunity to observe changes in ethnic fragmentation (EF) over time due to the redrawing of administrative borders. In particular, 75 districts experienced one splitting event while 20 districts experienced two splitting events over the period 2000-2012. The last split in our sample occurred in 2009. We consider the time of splitting as the date in which the formal law to create the new district is passed (de jure). Because our unit of observation is the district according to pre-splitting boundaries we do not distinguish between parent district, which retains the original capital, and child district, which establishes a new capital. While in theory child and parent districts could experience differences in institutional capacity, e.g. enforcement and access to financial resources[8], after splitting that could also influence deforestation, pre-splitting

[8] In the context of deforestation Burgess et al. (2012) show that there is no temporary decline in enforcement by comparing the parent and the child district after splitting. On the other hand, Bazzi et al. (2015) find that ethnic fractionalization matters relatively less for conflict and crime in child districts and

borders remain our preferred unit of observation as it will be extensively discussed in Section 5.

Figure 1: Construction of the time-variant EF measure



This is based on the district Ogan Komering Ulu that split in 2003 to form the following three districts: Ogan Komering Ulu, Ogan Komering Ulu Timur and Ogan Komering Ulu Selatan.

Figures 1 illustrates the construction of our time-varying measure of EF. The 2010 census allows us to construct actual measures of EF for all districts in 2010. In the example we considers 3 districts (A, B and C), created after a splitting in 2003, with respective level of EF indicated by EF_A, EF_B and EF_C. For those districts that experienced one or more splitting since 2000, it is possible to re-construct pre-splitting population by aggregating the population within pre-splitting administrative borders. This allows us to compute pre-splitting EF measures based on the aggregated distribution of population across ethnic groups (EF for 2000 and 2002 in Figure 1). Because the unit of analysis is a district as defined by 2000 administrative borders, in case of splitting, aggregate EF is measured by the weighted average of the EF levels of the newly formed districts, where weights (w) correspond to the respective population shares.

Our measure implicitly assumes that changes in EF are only due to splitting. While migration from and to areas outside the 2000 administrative district borders and demographic changes are also likely to affect the level of heterogeneity of the population, the lack of data

relatively more in parent districts.

prevent us from constructing a more precise measure. An index of EF constructed using the 2000 census shows a correlation coefficient of 99% with our "constructed" measure for 2000, which confirms the overall consistency of our measure with cross-districts differences in ethnic fractionalization in 2000. On the other hand, however, the two indices are not directly comparable, i.e. we cannot substitute our "constructed" EF in 2000 with actual EF from the 2000 census. This is because the two census differ in terms of representativeness and coverage. In fact, according to Ananta et al. (2013), ethnicity classification changed between the two census for many of the 15 largest groups and there is reported under-estimation of some ethnic groups (Acehnese, Dayak and Chinese in particular) in 2000 mainly because of political and security issues. This issue poses serious challenges for the comparability of the two sources. We, therefore, prefer to use the 2010 population census for the backward construction of our time-variant measure of ethnic fractionalization so that changes in administrative borders are the only drivers of the variations in ethnic fractionalization over time.[9]

Data on elections are from Burgess et al. (2011), originally obtained from the Centre for Electoral Reform (CETRO). They include information on the year and results of the district head elections and the incumbent status of the candidates. We also use several control variables (descriptive statistics and relative sources are reported in Table 2), such as the share of people involved in different land-related activities over the total population obtained from the 2010 population census. A set of variables capturing geographic and ecological characteristics were obtained using geo-referenced data on elevation (mean and standard deviation), distance from the sea and the number of rivers in the district. The estimated extent of forest fires by province was taken from the 2011 Forestry Statistics of Indonesia for the period 2007-2011. For the panel analysis we include measures of district-

[9]Mapping 2000 census data to final 2010 district boundaries was not possible because data on ethnicity are not available at a lower administrative level than the district.

level GDP[10], population and public expenditure obtained from the Indonesia Database for Policy and Economic Research (INDO DAPOER).

Table 2: Summary Statistics and Sources

Variable	Mean	SD	Min	Max	Source
Cross-section (465 districts)					
EF	0.44	0.31	0.01	0.94	Census 2010
Population in 2000	10.75	33.70	-85.27	193.71	INDO-DAPOER
Population growth	510924.10	599890.70	22410.00	5073116.00	INDO-DAPOER
Dummy Javanese	0.03	0.17	0.00	1.00	Census 2010
New districts in a province	1.91	1.33	1.00	8.00	BPS
Share of agriculture	49.05	24.73	0.34	99.71	Census 2010
Share of estate	26.31	27.17	0.04	96.25	Census 2010
Share of forestry	1.75	4.18	0.02	47.95	Census 2010
Share of animal activities	4.51	7.12	0.04	62.96	Census 2010
Elevation (mean)	337.32	348.07	2.82	2050.29	DIVA GIS
Elevation (sd)	264.13	218.66	1.20	1277.61	DIVA GIS
Distance to sea (kilometers)	0.32	0.33	0.00	2.07	DIVA GIS
Number of rivers	2.15	6.42	0.00	89.00	DIVA GIS
Forest fires	1077.85	1282.42	0.00	5625.00	Forestry Statistics 2011
Panel data (337 districts)					
Expenditure (Million IDR)	659,245	562,800	4,777	5,212,000	INDO-DAPOER
District-level GDP (Million IDR)	5,272,118	10,213,462	104,706	117,400,000	INDO-DAPOER
Infrastructure (Million IDR)	105,067	138,102	391	3,150,000	INDO-DAPOER
Population	657,980	635,718	22,734	5,469,803	INDO-DAPOER

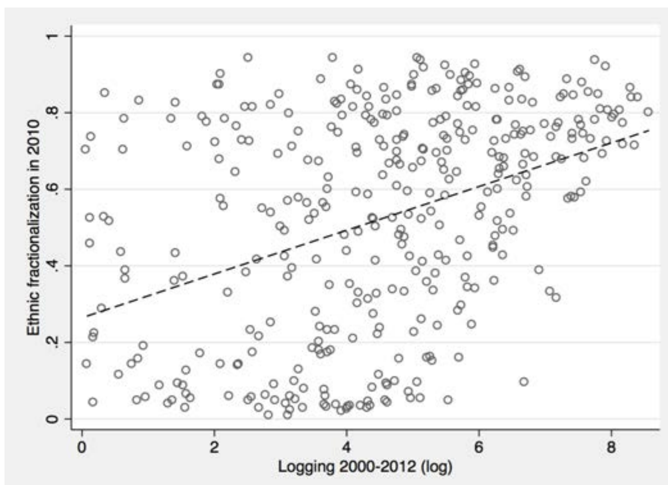
5 Empirical strategy

[10]This is a measure of gross regional domestic product that includes gas and oil revenues. McCulloch and Malesky (2011) point out that although all districts are supposed to follow the same procedures in computing their GDP, there is variation in the capacity of local statistical offices across the country. Moreover, some components of GDP such as agricultural or manufacturing output are much better measured than others, due to the accuracy of their underlying sources. Nevertheless, sub-national level data are cleaned and standardized by the World Bank upon release into the INDO-DAPOER dataset.

5.1 Suggestive Evidence

In this section we begin with some suggestive evidence on the relationship between ethnic fractionalization and deforestation. Using a cross-section of districts we correlate total logging over the period 2000-2012 with the ethnic fractionalization index in 2010. Figure 2 shows a positive correlation: high levels of deforestation are only found in highly fractionalized districts.

Figure 2: Correlation between logging and ethnic diversity



Each circle represents a district. The dashed line indicates the linear fit. The graph omits districts in the Island of Java.

Table 3 confirms this correlation with a set of regressions on 465 districts, as defined by 2010 administrative borders, which control for several additional variables. The coefficient of ethnic fractionalization suggests that a one standard deviation increase in ethnic fractionalization (0.3) is associated with a 25% increase in logging. We begin by controlling for overall size of the district both in terms of population and area of forest cover and by including one of the major drivers of deforestation, population growth, that is also possibly correlated with ethnic diversity. We are also concerned with another particular population phenomenon that is the migration resulted from the Transmigrasi program[11] that could have influenced both ethnic diversity, as it involved the relocation of people mainly of Javanese origin, and deforestation through land clearing for agriculture and infrastructure. The dummy "Javanese" is aimed at controlling for the presence of this particular ethnic group in a district. We also include the number of new districts created in a given province since 2000 as way to account for the possible correlation between the creation of new jurisdictions and increased deforestation, as documented in Burgess et al. (2012), and ethnic diversity as a potential driver of district splitting. We then include measures of the importance of different land-related activities since ethnic fractionalization could potentially be associated to the presence of ethnic groups with particular preferences over certain forest-related activities. The coefficient indeed drops significantly when controlling for these variables but remains large and highly significant. Because Michalopoulos (2012) established that geographical variability is an important driver of ethnic diversity, and so is of deforestation, we then include a set of geographic and ecological endowments using geo-referenced data on elevation (mean and standard deviation), distance from the sea and the number of rivers in the district. The last two columns of Table 3 deal with the potential correlation between ethnic fractionalization as a possible cause of forest fires and conflicts and deforestation. The relationship between ethnic fractionalization and deforestation remains positive and statistically significant at 1% throughout all specifications.

5.2 District Splits, Ethnic Fragmentation and Deforestation

It is usually difficult to identify exogenous changes in ethnic fractionalization. The way in which redistricting happened in Indonesia gives us the possibility to use a quasi-experimental

[11]The program aimed at relocating landless people from highly populated areas, mainly Java, to less density populated areas. Javanese is the most widespread ethnic group in Indonesia.

Table 3: Correlation between ethnic fractionalization and logging

Dep. var.: logging 2000-2012 (log)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
EF in 2010	0.971***	0.976***	1.008***	0.972***	0.877***	0.877***	0.881***	0.717***
	(0.165)	(0.169)	(0.166)	(0.193)	(0.162)	(0.162)	(0.162)	(0.164)
Population growth	0.007**	0.007**	0.007**	0.007**	0.006**	0.006**	0.006***	0.004*
	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)
Population in 2010 (log)	0.027	0.026	0.038	0.109*	0.097	0.097	0.106	0.241***
	(0.064)	(0.064)	(0.063)	(0.063)	(0.068)	(0.068)	(0.070)	(0.066)
Forest Area in 2000 (log)	0.503***	0.504***	0.499***	0.411***	0.436***	0.436***	0.435***	0.577***
	(0.056)	(0.055)	(0.056)	(0.056)	(0.051)	(0.051)	(0.052)	(0.042)
Dummy javanese		-0.154	-0.156	-0.094	-0.147	-0.147	-0.151	-0.095
		(0.150)	(0.149)	(0.144)	(0.143)	(0.143)	(0.144)	(0.139)
Number of new districts in province			0.049*	0.013	0.056	0.056	0.055	0.042
			(0.029)	(0.030)	(0.039)	(0.039)	(0.039)	(0.042)
Share agriculture				0.007*	0.007**	0.007**	0.007**	0.005
				(0.004)	(0.003)	(0.003)	(0.003)	(0.003)
Share estate				0.008**	0.008**	0.008**	0.008**	0.004
				(0.004)	(0.003)	(0.003)	(0.003)	(0.003)
Share forest				-0.001	-0.018**	-0.018**	-0.018**	-0.024***
				(0.004)	(0.007)	(0.007)	(0.007)	(0.007)
Share animal				0.009	0.016	0.016	0.016	-0.011
				(0.010)	(0.009)	(0.009)	(0.009)	(0.008)
Elevation (mean)					-0.001***	-0.001***	-0.001***	-0.001**
					(0.000)	(0.000)	(0.000)	(0.000)
Elevation (sd)					-0.000	-0.000	-0.000	-0.000
					(0.000)	(0.000)	(0.000)	(0.000)
Distance to the sea					0.192	0.192	0.188	0.200
					(0.161)	(0.161)	(0.159)	(0.176)
Number of rivers					0.004	0.004	0.004	-0.000
					(0.004)	(0.004)	(0.004)	(0.004)
Forest fires						-0.034***	-0.034***	-0.035***
						(0.006)	(0.006)	(0.005)
Conflicts							-0.000	-0.000
							(0.000)	(0.000)
Province FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	465	465	465	465	465	465	465	349

Robust standard errors clustered at the province level in parentheses, $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$. The dependent variable is the log of logging. The last column excludes the island of Java.

setting to study the association between ethnic diversity and deforestation. In particular, we exploit the exogenous timing of district splits to provide causal evidence on the relationship between these two variables.

In the theoretical framework we discussed how ethnic diversity might increase deforestation because heads of district, who are in charge of releasing legal and illegal logging licences, are kept less accountable due to the lower social capital characterising more diverse districts. It is important to emphasize that the mechanism we highlight works at the district level where the relevant political power resides.[12] According to this line of argument the relevant units of observation should be districts based on pre-splitting borders before the splitting, and districts based on post-splitting borders, after the splitting. Clearly in order to study changes in ethnic fractionalization and deforestation over time we need to choose a unique and consistent unit of observation throughout the entire pre- and post-splitting period. The strategy we adopt in this paper is to conduct the analysis using districts defined according to pre-splitting borders. The alternative approach would have been to use post-splitting borders. The first approach is chosen due to both data availability and a conceptual argument. As described in the data section, the data on ethnic fractionalization before splitting comes from the 2000 population census and are available at the district level. Therefore, we cannot compute the change in ethnic fractionalization over time at a smaller scale than the pre-splitting borders, without imposing very strong assumptions. After splitting, data on ethnic fractionalization comes from the 2010 population census and are available for all districts according to post-splitting borders. We compute the index of fractionalization of the original distrct, after splitting, as a weighted average of the indexes of fractionalization of all districts lying within pre-splitting district borders.

[12]Ethnic diversity could of course operate also at a more local level through other mechanisms but we believe that the mechanism of control of the head of district we focus upon is more suitable to explain major illegal logging happening in the district. The analysis of local level dynamics goes beyond the scope of this paper.

In addition, logging decisions in the pre-splitting period at the level of 2000 administrative borders could result in a heterogenous distribution of logging across the areas corresponding to newly formed districts following the splitting. As a consequence studying changes in deforestation within post-splitting borders over time could be misleading and the results could actually capture the decisions on the distribution of logging activity across areas within district borders. Therefore, our preferred unit of observation is the pre-splitting administrative unit.

The analysis employs a linear model where we regress logging (f) on the time-varying level of ethnic diversity (EF) controlling for district-level fixed-effects, u_i:

$$f_{ipt} = \beta EF_{ipt} + \gamma X_{ipt} + ysplit_{ipt} + d_t + u_i + d_t \times v_p + \epsilon_{ipt}, \quad (9)$$

where the coefficient of interest, β, identifies the effect of a change in the index of ethnic fractionalization, EF, on the level of deforestation f, in district i of province p. The vector X includes a set of control variables, discussed below. The parameters d_t, and $d_t \times v_p$ represent year fixed effects, and province by year fixed effects. Year fixed effects account for shocks common to all districts, while year-by-province fixed effects account for differential trends in deforestation across provinces. For instance, Burgess et al. (2012) highlight that the creation of new districts induced an increase in deforestation at the province level. Also the provincial government decides the maximum amount of legal logging allowed in the province. District fixed effects control for time invariant, district-specific characteristics such as geographical conformation and variability, which render some districts more prone to deforestation. In all specifications we include a dummy for the year of splitting, $ysplit_{ipt}$, to control for any concurrent unobservable event happening at the time of splitting also having an impact on deforestation. For instance, in the year of splitting, a district might experience a period of political turmoil with a negative impact on the provision of enforcement activity and in turn on illegal logging. Robust standard errors are clustered at the province level to account for arbitrary serial correlation over time within provinces.

The model in (9) is estimated using OLS, where we consider the logarithm of logging as dependent variable. Since EF changes only after the splitting and the time of the splitting varies across districts, this exercise can be viewed as a generalization of a diff-in-diff estimation with more than two groups and more than two periods, where the change in EF corresponds to the intensity of treatment. This specification allows us to also account for multiple splitting which we observe in our sample, i.e. 20 districts split twice during the period.

Notice that the coefficient of interest, β, identifies the effect of a change in the average index of fractionalization, given that in the post-splitting period we consider a weighted average of the EFs of the newly created districts and total deforestation within the pre-splitting district borders. As discussed in the data section the weights used to compute post-splitting EF correspond to population shares of new districts. Giving higher weights to a more populous district in the post-splitting period is plausible given that population is correlated to the district area and deforestation tend to be higher in larger districts. In the robustness section we also run the regressions computing post-splitting EF as a simple average, imposing equal weights for all districts and results are confirmed.

This estimation procedure eliminates any potential heterogenous effects across post-splitting administrative units. For instance, after splitting ethnic fractionalization might decrease (relative to the pre-splitting index of EF of the district they originated from) less in parent districts than in child districts, and so could deforestation or vice-versa. The estimated β could mask such dynamics. However, this is not a major concern for two main reasons: first, for the reasons explained above, we are interested in average changes in deforestation and ethnic diversity within pre-splitting borders. Second, the

Table 4: Descriptive statistics of time-varying ethnic fractionalization

	Average EF	Change in EF (weighted average)	Change in EF (simple average)	Districts
Districts that split	0.58	-0.046	-0.051	95
By quintile:				
1		-0.002	0.009	19
2		-0.051	-0.054	19
3		-0.063	-0.075	19
4		-0.054	-0.064	19
5		-0.058	-0.071	19
Districts that did not split	0.35			242
All districts	0.42			337

Source: 2010 Population census. The table reports sample averages. Differences between the 2nd,3rd,4th, and 5th quintiles are not statistically significant but they are statistically different from the first quintile (for both measures).

presence of heterogenous effects across post-splitting administrative units does not seem a very prominent phenomenon. Ethnic fractionalization generally decreased in most post-splitting administrative units compare to their pre-splitting counterparts. In fact one driver of district splitting was the level of ethnic fractionalization, with new districts being created with the purpose of having a more ethnically homogenous population. Table 4 confirms this pattern showing that the average level of EF decreased within all districts that experienced a splitting. This trend implies that at least the most populated areas had a decrease in ethnic fractionalization after splitting.

Table 4 also shows that ethnically heterogeneous districts were more likely to split, which is consistent with the vast anecdotal evidence on the post-Suharto decentralisation wave and it is in line with the argument that ethnic fractionalization can increase political fragmentation since each (sufficiently strong) ethnic group tends to create its own jurisdiction. In order to account for different dynamics of the effect of ethnic diversity over time, we also estimate the following distributed lag model:

$$f_{ipt} = \sum_j \beta_j EF_{ipt-j} + \gamma X_{ipt} + ysplit_{ipt} + d_t + u_i + d_t \times v_p + \epsilon_{ipt}, \tag{10}$$

where $\sum_j \beta_j EF_{ipt-j}$ is the sum over the number of lags of ethnic diversity included in the model. We do so because it is reasonable to expect a lagged effect of a change in ethnic diversity on deforestation if we believe that institutions take some time to adjust to the new order. In addition, the effect of a change in ethnic diversity might last longer than just one year, therefore we also study what happens in the medium run. We consider both one and two lags.

5.3 Identification

The identification strategy of our empirical exercise relies on the exogeneity of the time of splitting with respect to logging.[13] In Section 2 we have discussed how the administrative procedures and the two moratoria introduced by the central government induced idiosyncratic variations in the date of splitting. In this section we follow a similar approach adopted by others (Burgess et al. (2012), Bazzi et al. (2015), and Padro et al. (2013)) to verify that the timing of splitting can be considered exogenous. First, we regress the number of years before splitting of district i, since 2000, on a set of initial characteristics such as ethnic fractionalization, district-level GDP, population, district size, and share of forest. Following Bazzi et al. (2015), as an alternative dependent variable, we also use an indicator variable for whether the splitting took place after the moratorium which occurred between 2004-2006. Table 5 reports the results which confirm that the timing of the creation of new districts was exogenous with respect to a number of district initial characteristics.

[13]It is also worth to recall that all cross-district differences, including original levels of ethnic fractionalization, are captured by the district level fixed effects.

Table 5: Test of exogeneity of the timing of splitting

Dependent variable:	(1) Years before splitting	(2) Dummy: after moratorium
EF in 2000	-0.202	-0.008
	(1.149)	(0.208)
District-level GDP in 2000 (log)	-0.520	-0.073
	(0.543)	(0.085)
Population in 2000 (log)	-0.230	-0.042
	(0.674)	(0.105)
Area	-0.251	-0.065
	(0.407)	(0.069)
Share of forest in 2000 (log)	-1.102	-0.182
	(1.055)	(0.158)
Districts	95	95

Robust standard errors in parentheses, *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$. For districts that split twice we consider only the first splitting event.

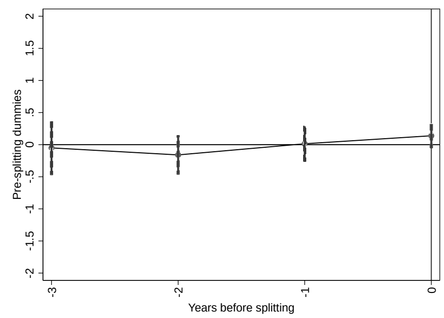
The identification strategy relies also on the assumption that there were no pre-existing trends in our variable of interest, logging, before splitting. To test the parallel trend assumption we estimate a set of specifications where we first regress logging on pre-splitting time dummies and then interact time dummies with initial levels of ethnic fractionalization and post-splitting change in EF, respectively. Figure 3 plots the relevant coefficients. Panel a) shows no statistically significant difference in logging patterns between districts that split and did not split during the pre-splitting period. Crucially this evidence holds when we further distinguish between districts according to their initial level of ethnic diversity (panel b) or the magnitude of the change in ethnic diversity (panel c) experienced after the splitting.

6 Main Results

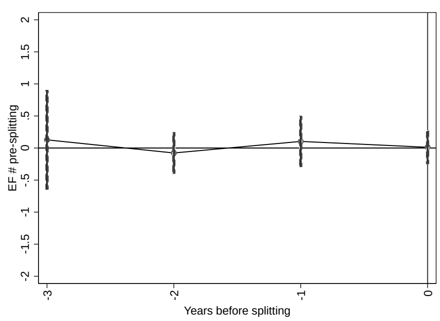
Table 6 reports the results from estimating the baseline model (equation (9)). All specifications include year fixed effects, year-by-province fixed effects, and a dummy for the year

Figure 3: Tests of parallel trends

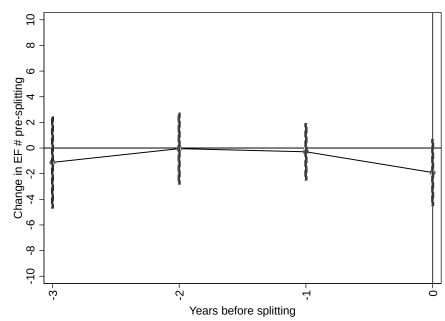
(a) Parallel trends



(b) Interaction with EF



(c) Interaction with changes in EF)



The plots are created by regressing the log of logging of the original districts on a full set of pre-splitting time dummies (panel a) interacted with EF (panel b) and changes in EF (panel c) and group dummies controlling for district fixed effects. The bars indicates 95% confidence interval.

of splitting.

In the first column we test the main hypothesis of the paper including our time-varying measure of ethnic fractionalization. The positive coefficient on EF is consistent with a positive and significant impact of an increase in ethnic fractionalization on deforestation. Since changes in average EF (within pre-splitting borders) were always negative, we can conclude that the reduction in ethnic heterogeneity due to splitting has induced a reduction in deforestation. The effect is large. A decrease in average EF corresponding to the average change observed in the sample (-0.05) leads to a 6% increase in logging. The largest change

Table 6: Ethnic Fractionalization and Logging

	(1)	(2)	(3)	(4)
EF	1.181**	1.428**		
	(0.469)	(0.556)		
EF (sum of L0 - L1)			1.572***	
			(0.525)	
EF (sum of L0 - L2)				2.006***
				(0.722)
Year FE	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes
Province by year FE	Yes	Yes	Yes	Yes
Controls	No	Yes	Yes	Yes
Observations	4044	3937	4044	3937
Districts	337	331	337	331

Standard errors clustered at the province level in parentheses, $*p < 0.1$, $**p < 0.05$, $***p < 0.01$. Controls include a binary variable indicating the year of splitting, the number of new districts in the province, district-level GDP, population, government expenditure and expenditure on infrastructure.

in EF, which corresponds to -0.3 and is equal to one standard deviation, leads to a 35% increase in deforestation. In column 2 we include government expenditure and the number of new districts in the province deal with potential confounding effects. The separation of a major ethnic group, for instance, could be followed by political turmoil and, as a result, by a change in public expenditure with ambiguous consequences on deforestation. The number of new districts captures the competition effects identified in Burgess et al. (2012) as districts compete for the provincial wood market and could also be related to changes in ethnic diversity. We also include population, district-level GDP and expenditure on infrastructures that are important drivers of logging.

In columns 3 and 4 we show the results of a distributed lagged model with one and two lags respectively. Coefficients show the sum of the immediate effect and the lagged effects of EF. The effect is larger in particular when considering the longer time span. Column 3 indicates that one year after splitting the average change in EF (-0.05) would induce a decrease of 7.5% in deforestation. Two years after the splitting the cumulative

Table 7: Robustness

	Initial characteristics (1)	2010 boundaries (2)	EF Simple average (3)
EF	1.058**	0.536**	1.176**
	(0.027)	(0.233)	(0.452)
Post # Forest area	-0.000		
	(0.826)		
Post # Population in 2000	-0.000		
	(0.416)		
Post # GDP 2000	0.000		
	(0.149)		
Controls	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
District FE	Yes	Yes	Yes
Province by year FE	Yes	Yes	Yes
Observations	3705	5301	3937
District	311	469	331

Standard errors clustered at the province level in parentheses, $*p < 0.1$, $**p < 0.05$, $***p < 0.01$. Controls include a binary variable indicating the year of splitting, the number of new districts in the province, district-level GDP, population, government expenditure and expenditure on infrastructure.

impact reaches 9.6%. Overall, results show that the change in ethnic fractionalization due to district proliferation has induced a significant reduction in deforestation both in the short and medium run.

6.1 Robustness

This section presents several robustness checks. First, the main results might raise concerns about the potential correlation between EF and other initial characteristics of districts that could confound its impact on deforestation. To address this issue we interact a dummy for the post-splitting period with a set of initial characteristics, such as population, district-level GDP and forest area in 2000. Column 1 of Table 7 reports the results. The effect of ethnic diversity on deforestation remains positive and statistically significant. The average reduction in EF induces a decrease of 5% in deforestation.

A second concern regards the possibility that our results might be driven by geographical factors or other unobservables characteristics which are correlated with logging activity and work at the level of the areas equivalent to post-splitting administrative units. In the baseline regression the level of deforestation we consider after splitting is total deforestation within the 2000 administrative borders. The advantage of our data on forest cover is that they are available at the pixel level and are characterized by an extraordinary high resolution (30 by 30 meters pixels). Hence we can aggregate the deforestation data at the level of post-splitting administrative borders. In this way it is possible to reconstruct the level of deforestation within new administrative units also for the period preceding the splitting, i.e. before their creation. One of the advantages of this specification is that we can estimate the baseline regression using narrower fixed effects, in particular, district fixed effects based on 2010 administrative borders, which are smaller than the 2000 district borders.[14] Column 2 in Table 7 illustrates the regression outcomes where the dependent variable is the level of deforestation within post-splitting administrative borders while as before EF is computed at the level of pre-splitting borders. The coefficient of interest is significant and with the expected sign, and implies that an average reduction in EF induced a decrease in deforestation of 3% within the areas corresponding to the post-splitting administrative borders. This evidence rules out the possibility that our results are driven by unobservables factors, such as geography or preferences of the local population, characterising the areas corresponding to the newly designed administrative units. And it also leads us to exclude the presence of extended heterogeneous trends in deforestation across those areas. So far we have considered an index of ethnic fractionalization after splitting computed as a weighted average of the indexes of ethnic fractionalization of the post-splitting districts, where the weights correspond to their population shares. However, among the most pop-

[14]The inclusion of this specification only in the robustness section is justified by the fact that our preferred units of observation are pre-splitting border districts. For instance, this specification might be particularly misleading if before the splitting, deforestation levels were distributed across different areas according to their ethnic composition.

Table 8: Robustness: Excluding one Island at a Time

Excluding:	(1) Sumatra	(2) Java	(3) Nusa Tenggara	(4) Kalimantan	(5) Sulawesi	(6) Maluku	(7) Papua
EF	1.374**	1.298**	1.327**	1.486**	1.280*	1.719***	1.457*
	(0.047)	(0.012)	(0.041)	(0.022)	(0.070)	(0.009)	(0.054)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Province by year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2831	2689	3579	3482	3407	3841	3793
Districts	237	227	301	293	286	323	319

Standard errors clustered at the province level in parentheses, $*p < 0.1$, $**p < 0.05$, $***p < 0.01$. Controls include a binary variable indicating the year of splitting, the number of new districts in the province, district-level GDP, population, government expenditure and expenditure on infrastructure.

ulous districts there could be districts with small forest cover, so it could be misleading to assign those areas a higher weight. Column 3 of Table 7 proves that the effect of ethnic fractionalization on deforestation remains positive and significant when we assign equal weights to all post-splitting districts to compute the index of fractionalization.

Fourth, we test whether our results are driven by a particular island in Indonesia. Table 8 shows the results when we perform the Jackknife method and estimate the baseline regression excluding one island at a time. The coefficient of EF is positive and significant in each column, which confirms that the effect we found is not driven by any given island in Indonesia.

Fifth, migration of ethnic groups in the wake of district splitting could bias our results if it is correlated with trends in logging. Two types of migration could happen in the period of analysis: migration across 2000 district borders and migration across post-splitting districts but within 2000 administrative borders. Recalling that we estimate the model at the level of 2000 administrative borders, we refer to the former as “external” migration and to the latter as “internal” migration. Issues related to external type of migration are taken care by the way we compute the index of fractionalization. Since we use the 2010 Census to construct both the pre-splitting and the post-splitting average index of fractionalization we are abstracting from changes in ethnic diversity due to external migration and we only capture changes due to administrative splitting. Internal migration is more problematic. It cannot be measured because we cannot track population movements within district boundaries and could bias our results due to reverse causality. This relates to the possibility that changes in deforestation after splitting induced movements of ethnic groups across new districts within pre-splitting administrative borders. For instance, if after splitting a new district head allowed for more deforestation to raise revenues, this might lead some ethnic groups to leave causing a change in the index of fractionalization both in the origin and in destination district. In turn this would have an impact on our index of ethnic fractionalization in the post-splitting period. There are several arguments that make this possibility unlikely; first, the process of political fragmentation was very often driven by the willingness of ethnic groups to live in districts that were better reflecting their own identity, and individual and social preferences. Therefore, it is implausible that they moved to another district after such a political process of self-determination. Second, it is very unlikely to observe a sizeable change in ethnic fractionalization due to deforestation-induced migration in such a short time period. Third, while it is possible that some internal migration occurred, there are so many forces at play that is it difficult to establish a unidirectional relationship between deforestation and migration that could systematically bias our results. Previous evidence remains unaltered when as a final check, we repeat the analysis using bootstrapped standard errors and standard errors clustered at the district level.[15]

[15]Results from these further checks are available upon request.

7 Control of politicians

In this section we focus upon the control of politicians through electoral punishment as highlighted in our stylized model. Skoufias et al. (2014) provide a comprehensive description of local elections in Indonesia. In the pre-1999 Suharto era district heads (Bupatis) were appointed by the regime. The decentralisation law (Law 22), passed in 1999, stipulated that district heads were to be indirectly elected by local parliament. The following law on regional autonomy (Law 32), passed in 2004, established that district heads had to be elected directly by the population. Therefore direct elections of Bupatis started in 2005 but the timing of the elections varied from district to district depending on when the terms of previous Bupati's were coming to an end. Some districts had their first direct elections in 2005 while others only in 2010. Skoufias et al. (2014) show how the timing of direct elections was exclusively due to idiosyncratic factors. In our sample we observe the incumbent status of candidates running for reelection and so we are able to study the probability of reelection as a function of Bupati's misbehaviour. Exploiting the fact that the date of election can be considered exogenous to the level of logging, we investigate what happens to incumbent reelection probability as a function of logging.

The estimated equation is the following:

$$Reelection_i = \gamma \tilde{f}_i + \beta \tilde{f}_i * EF + \delta EF + \zeta oil\&gas_i + p_i + t_i + \epsilon_i, \qquad (11)$$

where *Reelection* indicates the probability of reelection of an incumbent head of district i and $\tilde{f}$ is our measure of exceptionally high levels of deforestation in the year prior to the election. In particular, we compute the average level of deforestation over the pre-election period (2001- year of election), excluding the year prior to the election, and consider the difference between the level of deforestation in the year before the election and average deforestation.[16] We then interact this measure with the level of ethnic fractionalization EF at the time of election. As an additional check we first repeat this exercise replacing $\tilde{f}$ with the overall change in logging activity between the initial year, 2001, and the year prior to the election. Second, we replace $\tilde{f}$ with the one period change in logging activity between two years and one year before the elections. The purpose of these additional specifications is to understand whether voters are also responsive to a general increase in logging in the pre-election year, and whether they are paying attention to a short term increase in logging ahead of elections. In all specifications we control for oil and gas revenues, $oil\&gas$, received by the district in the year of the election.[17] We do so since Burgess et al. (2012) finds that $oil\&gas$ revenues influence the number of candidates running in the elections and also the level of logging since politicians tend to substitute between different sources of rents, at least in the short run. In any case our results of interest hold even when excluding oil and gas revenues.[18] We also include province fixed effects, p, and year of election fixed effects, t, in order to control for common province and time unobservable characteristics.

We expect the probability of re-election of the incumbent to decrease when in the year before the election the district experiences a higher deviation from average deforestation. At the same time we expect this effect to be smaller in ethnically heterogeneous districts. Results in Table 9 confirm this argument.

The first column shows that on average a higher level of pre-election logging has no effect on the probability of re-election. However, when interact pre-election deviations in deforestation with the level of ethnic diversity (column 2) we find that in more homogenous

[16]The measure can be formalized as follow: $\tilde{f}_i^P = f_{it-1} - 1/(t-2)\sum_{j=0}^{t-2} f_{ij}$ for the pre-election period, where t is the year elections take place.

[17]Oil and gas revenues per capita at the district level come from Burgess et al. (2012). The revenues data were originally obtained from the Indonesian Ministry of Finance webpage (http://www.djpk.depkeu.go.id/datadjpk/57/) and the population data for 2008 from the Indonesian Central Bureau of Statistics.

[18]Results are available upon request.

Table 9: Logging and incumbent re-election

Dep. Var.: re-election	(1)	(2)	(3)	(4)	(5)	(6)
Deviation from average pre-elec	-0.0000	-0.0006*				
	(0.0001)	(0.0003)				
EF		0.2159		0.2077		0.2281
		(0.1575)		(0.1594)		(0.1567)
Deviation from average pre-elec # EF		0.0007*				
		(0.0004)				
Deviation from previous year			0.0000	-0.0005		
			(0.0001)	(0.0004)		
Deviation from previous year # EF				0.0006		
				(0.0005)		
Deviation from initial deforestation					-0.0000	-0.0005*
					(0.0000)	(0.0003)
Deviation from initial deforestation # EF						0.0006
						(0.0004)
Year Election FE	Yes	Yes	Yes	Yes	Yes	Yes
Districts	222	222	222	222	222	222

Robust standard errors in parentheses, $*p < 0.1$, $**p < 0.05$, $***p < 0.01$. Each column reports OLS cross-sectional regressions where the dependent variable takes value one in case of re-election of the incumbent. A unit of observation is a district, based on post-splitting 2010 borders, where the candidate is an incumbent. All specifications control for population and oil and gas revenues. The deviation from average deforestation in the pre-election period captures exceptionally high levels of deforestation in the year prior to the elections. We also compute alternative measures. In columns 3 and 4 we measured the difference between pre-election deforestation and deforestation in the previous year. In columns 5 and 6 we use the difference between pre-election deforestation and deforestation in 2001.

districts an exceptionally high level of deforestation in the year before election decreases the probability of re-election, while the opposite holds in more heterogeneous districts. Back on the envelope calculations show that the latter effect happens in 17% of the districts. On the contrary, although pointing in the same direction we do not find a significant effect when considering the alternative measures: increase in deforestation over the whole pre-electoral period and a one period increase in deforestation in the year before elections. This evidence is consistent with our theoretical framework and suggests that voters dislike and "punish" exceptionally high increases in deforestation, but only in more homogenous districts.

8 Conclusions

This paper studies the relationship between ethnic diversity and deforestation in Indonesia. Relative to many other papers in which the effects of ethnic fragmentation on various variables is studied in cross sections here we can use a panel since we have plausibly exogenous variation in ethnic fractionalization in localities in Indonesia.

Our model predicts that in a corrupt environment, where local politicians receive bribes from logging companies in exchange of logging permits, areas characterized by high ethnic diversity experience more deforestation. Empirically we find that this is indeed the case: ethnically fractionalized areas display more deforestation than their more homogenous counterparts after controlling for a variety of possible confounding factors, including several geographic and socioeconomic controls. We are able to exploit the exogenous timing of variations in ethnic diversity due to the splitting of jurisdictions and document a casual relation between ethnic fractionalization and deforestation.

A previous paper by Burgess et al. (2012) highlights the negative effect of decentralisation on deforestation, which has led some researchers to conclude that centralisation might be desirable to reduce logging. This paper, instead, suggests that when the underlying communities are ethnically fragmented, decentralisation in natural resource management can reduce the scope for rent seeking behaviour. Our findings highlight a trade-off between reduced ethnic heterogeneity and increased competition in the natural resource market when deciding the optimal level of decentralisation of natural resource management. Our results are not incompatible with an overall positive impact of splitting on deforestation at the province level as found in Burgess et al. (2012). The comparison between our district-level results and the province level effects is complex. For example, while a decrease in EF might affect mostly within-district deforestation, the competitive effects caused by a splitting ought to have an impact also on deforestation in other districts

The optimal size of a community from the point of view of deforestation depends upon a trade off between size and heterogeneity of its population. Our findings evoke a number of open questions that we aim to address in future research: how does the relationship between ethnic diversity and deforestation work at a smaller scale? In particular, how does the distribution of ethnic groups impact deforestation in different areas within a district? And does the specific ethnicity of the local politician matter? Finally it would be interesting to study whether the evidence we provide in this paper is valid for other types of common resources such as water or fisheries in similar environments characterized by weak institutions.

Appendix

A Additional Channels

In this section we describe two additional channels that may link ethnic fractionalization and deforestation. The first is the ability of local communities to fight against logging companies. The second channel is that because of less cooperation in more diverse communities, in case of no conflict with the logging company they receive a lower compensation from the latter making logging cheaper. We retain all the main assumptions of the model in Section 3 and we add a stage in which the logging company starts a negotiation with the local community. In particular the company offers a compensation for using the forest. We allow for the possibility of conflict between the company and the community in case the negotiation fails. The timing is the following: in t_0 the politician decides the amount of logging concessions, f, to give to the company in exchange for a bribe, in t_1 the company decides how much to pay (in terms of bribes) to obtain the concessions. In t_2 the bargaining takes place and the company offers a compensation payment to the community. If the community refuses it, the negotiation fails and the community tries to block the logging activity. With probability q the community wins the conflict and stops the logging. In this case the logging company loses the bribe, b, it already paid, while the community controls the forest and enjoys a utility, $U(F)$, which is an increasing and concave function of the size of the standing forest, F, with $F \in [0, \bar{F}]$. With probability $(1 - q)$ the company wins the conflict and continues to log without paying any compensation to the community. In the next section we will assume that the probability that the community wins the conflict, q, depends negatively on its level of ethnic fragmentation. The model is solved backward and has two different equilibria, one where negotiation succeeds (*under negotiation*) and one where negotiation fails (*under conflict*).[19] For each equilibrium we derive the optimal level of deforestation and how this level is influenced by changes in ethnic diversity. First we characterize the equilibrium under negotiation and then we turn to the one under conflict. We begin describing the problem faced by the company and we analyze the outcome of the negotiation between the company and the community. Then we determine the bribe that the company is willing to pay and finally we study the decision of the local government and define the equilibrium.

A.0.1 Negotiation Stage

In the last stage the company decides whether to start a conflict with the community comparing the payoffs under the two different scenarios. In case of conflict the expected payoff for the company is:

$$\pi_C^L = -bfq(EF) + (1 - q(EF))f(p - c - b) \tag{A-1}$$

where the superscript L stays for "logging company" and the subscript C indicates "conflict". EF stands for ethnic fractionalization, which, in the empirical section, will be measured by a commonly used Herfindhal index. We assume that $q_{EF}(EF) < 0$, namely more ethnically fractionalized communities are less likely to prevail against logging companies. f is the amount of wood extracted by the company, p is the price that is determined at the province level and we consider as exogenous, c is the marginal cost of extraction and b is the bribe per unit of wood to be paid to the local politician. Let $\bar{F}$ be the total size of

[19] Given the free entry assumption the company is always indifferent between negotiation and conflict. Hence it is not possible to pin down a unique equilibrium where the agreement is the option preferred by the company. The understanding of the emergence of conflict vs negotiation goes beyond the scope of this paper.

the forest, then the expected payoff of the community is:

$$\pi_C^C = q(EF)U(\bar{F}) + (1 - q(EF))U(\bar{F} - f) \tag{A-2}$$

where the superscript C stays for "community" and $(\bar{F} - f)$ represents the size of the forest left to the community after deforestation. To avoid the conflict the company needs to compensate the local community and solves the following problem:

$$\underset{f}{Max}\ \pi_{NC}^L(f) \equiv pf(1 - \alpha) - cf - bf \tag{A-3}$$

$$s.t.\ \pi_{NC}^L(f) = 0\ and\ U(\bar{F} - f) + \alpha pf \geq \pi_C^C \tag{A-4}$$

where the subscript NC indicates "no conflict". The profit of the logging company is reduced by α which is the share of the revenues from logging paid to the community as a compensation benefit. Given the free entry assumption, the company maximizes its profit under the zero profit condition. The share of the logging revenues given to the community needs to be at least equal to its reservation utility, which corresponds to the expected revenues that the community can extract from the forest if the arrangement with the company is not agreed, namely π_C^C. Notice that the compensation payment is lower when the community is ethnically heterogeneous. This result is supported by the empirical evidence found by Engel and Palmer (2006) who, looking specifically at Indonesia, show that the compensation benefits paid by the companies are increasing in the degree of ethnic homogeneity of the community. Substituting the expression for π_C^C in the zero profit condition, we can derive the maximum bribe the company is willing to pay, as: $b = p - c - \frac{q(EF)[U(\bar{F}) - U(\bar{F} - f)]}{f}$. Turning to the first stage of the problem, we need to determine the equilibrium bribe and the number of logging permits the politician will supply in equilibrium. Recall that the politician makes this decision knowing the amount of the compensation the company pays to the community.

A.0.2 Equilibrium Under Negotiation

As before the local politician decides how many permits to sell to the companies, facing a probability of detection $\phi(f - \bar{f})$, which now depends only on the difference between the number of illegal permits issued and the legal quota, $\bar{f}$, set for the district. In case the head of the district is caught she loses all the future rents from holding office, r, or more generally she faces a penalty. The local politician solves:

$$\underset{f}{Max}\ V \equiv bf - \phi(f - \bar{f})r \tag{A-5}$$

which substituting with the expression for b, becomes:

$$\underset{f}{Max}\ V \equiv f(p - c) - q(EF)[U(\bar{F}) - U(\bar{F} - f)] - \phi(f - \bar{f})r \tag{A-6}$$

Hence the first order condition is:

$$p - c - q(EF))U_F(\bar{F} - f) \quad = \quad \phi_f(f - \bar{f})r \tag{A-7}$$

From equation (A-3) we can easily derive the effect of an increase in the degree of ethnic diversity on the number of logging permits supplied in equilibrium, as:

$$f_{EF}(EF) = -\frac{-q_{EF}(EF)U_F(\bar{F} - f)}{q(EF)U_{FF}(\bar{F} - f) - \phi_{ff}(f - \bar{f})r} \tag{A-8}$$

Given the denominator is negative[20] and recalling that $q()$ is a decreasing function of ethnic fractionalization, proposition 1 follows.

[20]The denominator represents the second order condition of the maximization problem thus it has to be negative at the optimum. This is the case given the concavity of $U()$.

Proposition 1 *When ruling ethnically diverse communities, which are less able to organize and win a fight against the logging companies, the politician releases a larger number of illegal logging permits increasing the equilibrium level of deforestation. Formally, in equilibrium* $f_{EF}(EF) > 0$.

In this section we have shown that when the company goes for the agreement, the compensation payment to a fragmented community is lower, while the politician faces the prospect of a higher bribe. As a consequence the politician raises the number of logging permits and the equilibrium level of deforestation increases.

A.0.3 Equilibrium Under Conflict

If the company decides to go for conflict she sets $\pi_C^L = 0$ to determine its willingness to pay for a permit. In particular the optimal bribe in case of conflict is: $b = (1 - q(EF))(p - c)$. The local politician solves the same problem as above, which substituting with the new expression for b, becomes:

$$\underset{f}{Max}\, V \equiv f(1 - q(EF))(p - c) - \phi(f - \bar{f})r \tag{A-9}$$

Hence the first order condition is:

$$(1 - q(EF))(p - c) \quad = \quad \phi_f(f - \bar{f})r \tag{A-10}$$

The effect of an increase in the degree of ethnic diversity on the number of logging permits supplied in equilibrium can be derived as before:

$$f_{EF}(EF) = -\frac{q_{EF}(EF)(p - c)}{\phi_{ff}(f - \bar{f})r} \tag{A-11}$$

Given the denominator is negative and recalling that $q()$ is a decreasing function of ethnic fractionalization, we show that ethnic fractionalization increases deforestation also in the case of a conflict between the company and the community. In fact when the company goes for the conflict, the bribe paid to the politician increases with the chance of winning the conflict by the company. The latter in turn is higher if the company fights against an ethnically fragmented community. Expecting a higher bribe the politician raises the number of logging permits and the equilibrium level of deforestation increases.

A.1 A second channel: Negotiation Power

Ethnic diversity can also influence the compensation payment obtained by a community in a direct way. In particular, there can be situations in which conflict is not an option, for example because the logging company faces high reputation costs. However, even during a peaceful negotiation a community which is ethnically diverse, can extract a lower share of the logging company's revenues as a compensation benefit. The reason is that fractionalized communities, being less cooperative and experiencing more disagreement in the decision making process are able to exert a lower bargaining power. To illustrate this point we can simply assume the share, α, of the logging revenues that go to the community, being a decreasing function of ethnic fractionalization, i.e. $\alpha(EF)$, with $\alpha_{EF}(EF) < 0$. The problem is solved as before and it is easy to show that the equilibrium bribe, namely the maximum price the company is willing to pay for a permit, is: $b = p(1 - \alpha(EF)) - c$. Substituting it in the politician's objective function, we can derive the first order condition:

$$p(1 - \alpha(EF)) - c = \phi_f(f - \bar{f})r \tag{A-12}$$

In this case the effect of an increase in ethnic diversity on the equilibrium number of logging permits is:

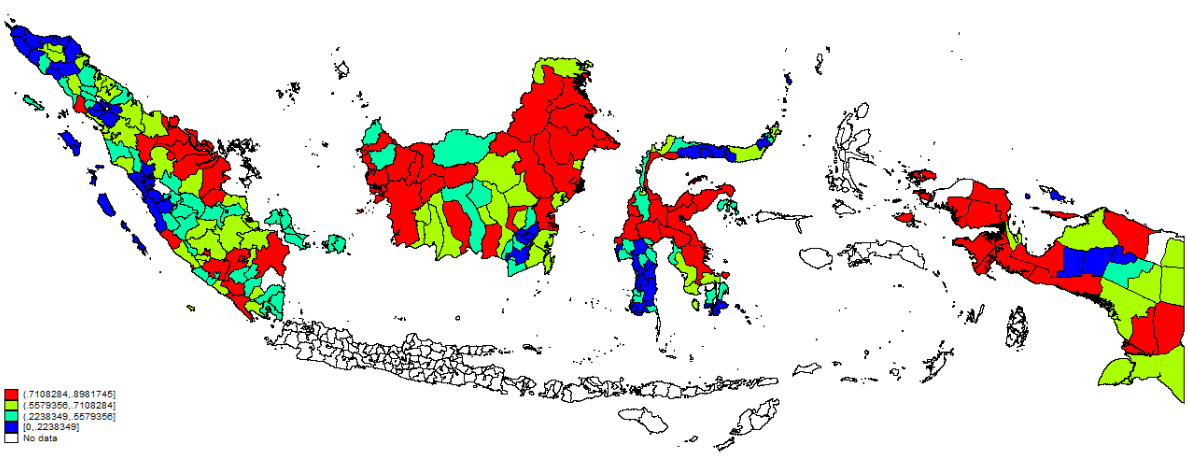
$$f_{EF}(EF) = -\frac{\alpha_{EF}(EF)p}{\phi_{ff}(f-\bar{f})r} \tag{A-13}$$

Recalling that the share $\alpha(EF)$ is decreasing in EF, the second proposition follows:

Proposition 2 *More ethnically diverse communities, being able to obtain a lower share of the logging revenues, render logging cheaper for the company. As a consequence the politician, with the prospect of a higher bribe, releases a larger number of illegal logging permits increasing the equilibrium level of deforestation. Formally, in equilibrium* $f_{EF}(EF) > 0$.

B Figure

Figure 4: Ethnic Diversity across Indonesian Districts (2006).



References

Alesina, A. (2003). The size of countries: Does it matter? *Journal of the European Economic Association 1*(2-3), 301–316.

Alesina, A., R. Baqir, and W. Easterly (1999). Public goods and ethnic divisions. *The Quarterly Journal of Economics 114*(4), 1243–1284.

Alesina, A. and E. La Ferrara (2000). Participation in heterogeneous communities. *The quarterly journal of economics 115*(3), 847–904.

Alesina, A. and E. La Ferrara (2005). Ethnic diversity and economic performance. *Journal of Economic Literature 43*, 762–800.

Alesina, A. and E. Spolaore (2003). The size of nations.

Ananta, A., E. N. Arifin, M. S. Hasbullah, N. B. Handayani, and A. Pramono (2013). Changing ethnic composition: Indonesia, 2000-2010. In *XXVII IUSSP International Population Conference*, pp. 26–31.

Arnold, L. L. (2008). Deforestation in decentralised indonesia: what's law got to do with it? *4/2 Law, Environment and Development Journal (2008)*, 75–101.

Banfield, E. C. (1958). *The moral basis of a backward society.* New York: Glencol.

Barr, C., I. A. P. Resosudarmo, A. Dermawan, and B. Setiono (2006). Decentralization's effects on forest concessions. In C. Barr, I. A. P. Resosudarmo, A. Dermawan, and J. McCarthy (Eds.), *Decentralization of Forest Administration.* Center for International Forestry Research (CIFOR).

Bazzi, S., M. Gudgeon, et al. (2015). Local government proliferation, diversity, and conflict. Technical report, Boston University-Department of Economics.

Burgess, R., M. Hansen, B. A. Olken, P. Potapov, and S. Sieber (2011, September). The political economy of deforestation in the tropics. *Working Paper Series, National Bureau of Economic Research 17417.*

Burgess, R., M. Hansen, B. A. Olken, P. Potapov, and S. Sieber (2012). The political economy of deforestation in the tropics. *The Quarterly Journal of Economics 127*(4), 1707–1754.

Casson, A. and K. Obidzinski (2002). From new order to regional autonomy: Shifting dynamics of illegal logging in Kalimantan, Indonesia. *World Development 30*(12), 2133–2151.

Collier, P. and A. Hoeffler (2004). Greed and grievance in civil war. *Oxford economic papers 56*(4), 563–595.

Engel, S. and C. Palmer (2006). Who owns the right? The determinants of community benefits from logging in Indonesia. *Forest Policy and Economics 8*(4), 434–446.

Fitrani, F., B. Hofman, and K. Kaiser (2005). Unity in diversity? the creation of new local governments in a decentralising Indonesia. *Bulletin of Indonesian Economic Studies 41*(1), 57–79.

Guiso, L., P. Sapienza, and L. Zingales (2013). The Determinants of Attitudes toward Strategic Default on Mortgages. *The Journal of Finance 68*(4), 1473–1515.

Hansen, M. C., P. V. Potapov, R. Moore, M. Hancher, S. Turubanova, A. Tyukavina, D. Thau, S. Stehman, S. Goetz, T. Loveland, et al. (2013). High-resolution global maps of 21st-century forest cover change. *Science 342*(6160), 850–853.

Hansen, M. C., S. V. Stehman, P. V. Potapov, T. R. Loveland, J. R. G. Townshend, R. S. DeFries, K. W. Pittman, B. Arunarwati, F. Stolle, M. K. Steininger, M. Carroll, and

C. DiMiceli (2008). Humid tropical forest clearing from 2000 to 2005 quantified by using multitemporal and multiresolution remotely sensed data. *Proceedings of the National Academy of Sciences 105*(27), 9439–9444.

Hardin, G. (2009). The tragedy of the commons. *Journal of Natural Resources Policy Research 1*(3), 243–253.

Lloyd, W. F. (1833). *Two lectures on the checks to population.*

Martini, M. (2012). Causes of corruption in indonesia. U4 anti-corruption resource centre, Transparency International.

McCulloch, N. and E. Malesky (2011). Does better local governance improve district growth performance in Indonesia? *IDS Working Papers 2011*(369), 1–48.

Michalopoulos, S. (2012). The origins of ethnolinguistic diversity. *The American economic review 102*(4), 1508.

Miguel, E. and M. K. Gugerty (2005). Ethnic diversity, social sanctions, and public goods in kenya. *Journal of public Economics 89*(11), 2325–2368.

Nannicini, T., A. Stella, G. Tabellini, and U. Troiano (2013). Social capital and political accountability. *American Economic Journal: Economic Policy 5*(2), 222–50.

Okten, C. and U. O. Osili (2004, December). Contributions in heterogeneous communities: Evidence from Indonesia. *Journal of Population Economics 17*(4), 603–626.

Ostrom, E. (1990). Governing the commons: The evolution of institutions for collective action.

Ostwald, K., Y. Tajima, and K. Samphantharak (2016). Indonesia's decentralization experiment: Motivations, successes, and unintended consequences. *Journal of Southeast Asian Economies (JSEAE) 33*, 139–156.

Padro, G., N. Qian, Y. Yao, et al. (2013). Social fragmentation, public goods and elections: Evidence from china. Technical report, CEPR Discussion Papers.

Putnam, R. D., R. Leonardi, and R. Y. Nanetti (1993). *Making democracy work: Civic traditions in modern Italy*. Princeton university press.

Skoufias, E., A. Narayan, B. Dasgupta, and K. Kaiser (2014). Electoral accountability and local government spending in Indonesia. *World Bank Policy Research Working Paper* (6782).

Tajima, Y. (2014). *The Institutional Origins of Communal Violence: Indonesia's Transition from Authoritarian Rule*. Cambridge University Press.

Transparency International Indonesia (2011). Forest governance integrity report. indonesia. Technical report, Transparency International Indonesia.