# the Association between an Economy's Reliance of the Natural Resources and the Likelihood of the Civil Conflicts

Zikuan (Daniel) Zhu

Advisor: Professor Conor Carney

College of the Holy Cross

Economic and Accounting Department Honor Thesis

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## Abstract

This paper examines the association between the degree of natural resource reliance of a country's economy and the corresponding country's likelihood of civil conflict. The existence of conflicts arises from failed attempts for peace. The paper's theoretical model finds a significant association between natural resource reliance and the likelihood of civil war. Like previous literature, the underlying assumption of the analysis is that natural resource reliance is closely related to the greed narrative of civil conflict. The empirical analysis of the paper utilizes country-level data on natural resources and conflict to show that there is a significant association between a country's reliance on natural resources and the likelihood of civil conflict controlling for other political factors that are correlated with the likelihood of civil conflict. Thus, these empirical results support the theoretical assumptions made in the literature and suggest a connection between natural resources and the greed narrative of civil conflict.

# 1 Introduction

Civil conflict is a globally significant issue given its tremendous potential consequences for its country, including violence, loss of property, fatality, and injury. The occurrence of civil conflict could further cause negative impacts on the rest of the world, like international trade depressions, a refugee crisis, and even ethical issues like the Rwandan Genocide.

Extensive literature has thoroughly discussed the adverse effects and causes of civil wars or conflicts, prompting my interest in comprehending the relation between a nation's reliance on natural resources and the probability of conflict[1].

I collected data from the World Bank, the Polity V Project, the World Income Inequality Distribution Database, and the Uppsala Conflict Data Program to better understand the relationship. Through

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[1]Christopher Blattman and Edward Miguel. 2010. "Civil War." Journal of Economic Literature, 48 (1): 3-57.DOI: 10.1257/jel.48.1.3 2

regression analysis, I aimed to ascertain the significance of this association, utilizing a simple linear regression model where the likelihood of civil conflict served as the response variable and the percentage of real GDP generated from natural resources acted as the independent variable. Then, I introduce political control variables, acknowledging their established significant influence on the likelihood of civil war, per Fearon and Laitin's research[2].

The regression analysis is based on eighteen linear regression equations. The linear regression equations measure civil conflict as the primary outcome of interest. The leading independent variables of interest are the percentage of the real GDP generated by the natural resource and the concentration of the petroleum resources. I then add political control variables to the model to include effects from political factors like ethnic polarization and income inequality, which have been shown in the literature to have a significant influence on the likelihood of civil war for a given country[3].

This investigation holds importance for two reasons. First, demonstrating the combined effect of the political factors like the degree of democracy and degree of equality, the number of resources on the likelihood of the civil war, and providing insight into the risk factors would help policymakers to reduce the risk of civil conflict like the necessity to have an equal allocation to the natural resources.

Second, it seeks to unveil the combined effects of measures such as natural resources and democracy index or income inequality. For example, a country with low democracy levels might not explicitly lead to conflict escalation because there is no extra benefit for people to pursue peacefully or violently. However, the presence of natural resources, which creates an extra economic benefit, could incentivize citizens to seek economic benefits through civil conflict due to the lack of peaceful means in undemocratic environments.

Likewise, high-income inequality alone might not prompt conflict, given that there may be no extra benefit without being pocessed to pursue because people with low income would feel hopeless about gaining higher income and prefer to maintain the present situation. Moreover, civil conflict would be highly costly, and people with low income would lose everything, which may include their lives in the conflicts. However, available resources could motivate lower-income groups to engage in civil wars for economic gains.

A typical example would be the Islamic revolution in Iran. Pre-revolutionary Iran profited most from the oil trade with the U.S. in the 1970s. The profit gained from the oil trade facilitates economic growth and leads to social stability. However, Pahlavi Iran was overturned by the Islamic revolution and other minor political unrest [4]. In this example, it is necessary to consider political factors like the

[2]James D Fearon and David D. Laitin. "Ethnicity, Insurgency, and Civil War." American Political Science Review, vol. 97, no. 1, 2003, pp. 75–90., doi:10.1017/S0003055403000534. 2

[3]James D Fearon and David D. Laitin. "Ethnicity, Insurgency, and Civil War." American Political Science Review, vol. 97, no. 1, 2003, pp. 75–90., doi:10.1017/S0003055403000534. 2

[4]Ray Takeyh, The Last Shah: America, Iran, and the Fall of the Pahlavi Dynasty (New Haven: Yale University Press, 2021). pp.200

degree of democracy for the Pahlavi Iran was an absolute Monarchy with a low degree of democracy, high income, and regional inequality, which are factors of social unrest.

The case of Iran provides a motivation to investigate the effect of resources on the likelihood of civil war, controlling political factors like degrees of democracy, social factors like income inequality, and cultural factors, which in this case is religion. Understanding whether a significant association exists between resources and conflict while controlling for political, social, and cultural factors can aid in conflict mitigation by promoting democracy and reducing inequality.

Contemporary literature categorizes civil war causes into political and economic factors, designating economic factors as greed and political factors as grievances. Greed, arising from pursuing economic benefits, may incite conflicts for various goals, while grievances entail pursuing specific political rights through conflict against governments.

Greed could increase the likelihood of civil war based on the following reasons. When an economic benefit exists in a country, a particular group pursuing more economic benefits may wage a civil conflict against the central government with different goals, like gaining independence or overturning the government.

Grievance could increase the likelihood of civil war because certain groups pursue certain political rights and then wage civil conflicts against the government to gain the rights.

The present-day economic literature argues how economic causes like poverty are more effective in changing a country's likelihood of civil conflict at a specific time. Furthermore, the present literature acknowledges that grievances are also significantly associated with the likelihood of civil conflict. Based on the possible explanation of civil conflicts from political and economic narratives, it is necessary to consider the combined effect of political and economic causes on them.

My research question is based on the greed narrative to investigate the causal relationship between resources and the likelihood of civil conflict in a specific country. I control the political factors like the democracy index and the Gini coefficient to ensure the comparison between countries with similar political circumstances is established and investigate the combined effect of these political factors and resources on the likelihood of civil conflicts.

## 2    Literature Review

Civil conflict and even civil war stand as pivotal aspects of conflict economics. Blattman and Miguel have observed prior research indicating a connection between poverty and the risk of civil wars[5]. To address this, I delve into past theoretical models and empirical studies, applying them to the question

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[5]Christopher Blattman and Edward Miguel. 2010. "Civil War." Journal of Economic Literature, 48 (1): 3-57.DOI: 10.1257/jel.48.1.3 2

I intend to explore.

Theoretical models serving as the foundation for civil conflict often center around different players and their interactions. Initially, Trygye Haavelmo introduced a two-sector model involving the central government and rebels[6] . This model expanded to encompass multiple players, acknowledging ordinary individuals positioned between governments and rebels. Garfinkel and Skaperdas summarized these models, emphasizing the probability of winning for players concerning available resources[7] .

These models gradually incorporated various external and internal variables, considering technology, asymmetric information, and trade between production and war. They later extended to investigate determinants of civil wars, exploring tradeoffs between conflict and production[8]. In 2004, Ernesto Dal Bo and Pedro Dal Bo argued that low income might incite civil wars, suggesting that adverse income shocks incentivize recruitment for conflict at a reduced opportunity cost[9] . However, validating this theory empirically is crucial.

Theoretical models find applicability in two primary scenarios. Firstly, they explain situations where unequal income distribution heightens the likelihood of civil war between existing government and rebel sectors. Specifically, this Model could help explain the formation of civil conflicts when the rebels already existed. The rebel sectors could have a tradeoff between average economic production tolerating the suppressive authority from the government sectors and war to fight for the possible economic benefit and rights when there is an unfair allocation of the profit generated from natural resources. The decision of the trade, which includes comparing the cost of the conflict or the production and the probability of winning the conflict for each player in the conflict, could easily be applied to predicting the likelihood of civil war.

Secondly, these models offer insights when people form rebel groups following unfair income distribution from natural resources. Leveraging these models aids in predicting the probability of conflict. Using such a model also satisfies the work of Dal Bo[10] . In this case, people in the region have a negative shock between their actual living quality and the expected living quality measured by the amount of spending. The multiple-player model could be extended from the work of Dal Bo and validated by empirical research on regions with plenty of natural resources in different countries. Specifically, when there is the presence of natural resources, people living in the local region would expect to have an

[6]Christopher Blattman and Edward Miguel. 2010. "Civil War." Journal of Economic Literature, 48 (1): 3-57.DOI: 10.1257/jel.48.1.3 9

[7]Michelle R. Garfinkel and Stergios Skaperdas. 2007."Economics of Conflict: An Overview." In Handbook of Defense Economics, Volume 2, Defense in a Globalized World, ed. Todd Sandler, and Keith Hartley, 649–710. Amsterdam and Oxford: Elsevier, North-Holland. 4

[8]Christopher Blattman and Edward Miguel. 2010. "Civil War." Journal of Economic Literature, 48 (1): 3-57.DOI: 10.1257/jel.48.1.3 9

[9]Christopher Blattman and Edward Miguel. 2010. "Civil War." Journal of Economic Literature, 48 (1): 3-57.DOI: 10.1257/jel.48.1.3 10

[10]Christopher Blattman and Edward Miguel. 2010. "Civil War." Journal of Economic Literature, 48 (1): 3-57.DOI: 10.1257/jel.48.1.3 10

improved quality of life. However, due to the unfair allocation of the benefits generated by the natural resources, people gained less than expected, leading to the formation of the rebellion, and further increasing the likelihood of civil conflicts. Based on this reasoning, Do Bol's theoretical models could help answer the possible significant association between low income and the likelihood of civil war.

The question I study is indispensable from the empirical data. As for the remark on Blattman's work, there is a constant demand for new data because the present literature always wants to establish a significant association between economic factors like poverty and the likelihood of civil war. The main challenges for my empirical analysis are identifying the lurking variable that would confound the causation, finding good proxies for the political factors, and including economic factors to explain their association with the likelihood of civil conflicts.

First, I need to identify possible lurking variables in the association. The most important one is inflation [11]. The change in the price level is a typical example in which the economists tried to eliminate the possible confounding variables. Considering the statistics relating to the real income generated by natural resources is necessary because inflation can easily influence nominal income and confound the possible association between different variables related to the income and the likelihood of the civil conflicts. My data set considers the percentage of GDP generated by natural resources, which checks an economy's reliability on natural resources and gets rid of the influence of possible inflation, given that the percentage is about the relative size of the value of natural resources compared to the value of economic output for a given country at a given year.

Next, I need to find and include political variables to be included in my models, given that present-day literature tried to find a good proxy for the political factors in the empirical model to have a better explanation of the likelihood of civil conflicts [12]. Typical example is the works of Fearon and Laitin [13]. In the work of Fearon and Laitin, one of the proxies for the political factors is the fraction of the ethnicity within the region. Given a significant positive correlation between the risk of civil war and ethnic fractions, Fearon and Laitin conclude that ethnic fractions may have a significant effect on the risk of civil war. It is necessary to check ethnic diversity in each region I investigated and try to compare the region with low ethnic diversity with the region that has similar conditions.

Moreover, including political factors in the model is crucial because previous literature has already shown a significant association between the likelihood of civil conflicts and political factors. A typical example would be Antonio Cabrales and Esther Hauk's work on the relationship between resource abundance and the level of democracy. They state, "Natural resources have antidemocratic properties:

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[11]Christopher Blattman and Edward Miguel. 2010. "Civil War." Journal of Economic Literature, 48 (1): 3-57.DOI: 10.1257/jel.48.1.3 25

[12]Christopher Blattman and Edward Miguel. 2010. "Civil War." Journal of Economic Literature, 48 (1): 3-57.DOI: 10.1257/jel.48.1.3 26

[13]James D Fearon and David D. Laitin. "Ethnicity, Insurgency, and Civil War." American Political Science Review, vol. 97, no. 1, 2003, pp. 75–90., doi:10.1017/S0003055403000534. 2

oil and mineral wealth tends to make states less democratic."[14] The negative association between the abundance of natural resources and the democracy level provided the insight that the abundance of natural resources may be negatively related to the level of democracy[15] . There are also economists working on the relationship between the abundance of natural resources and income inequality[16]. A typical example would be the work conducted studying the relationship between natural resources and income inequality by Anyanwu et al[17]. The positive association between inequality and the abundance of natural resources provides insight into the need to control the variable about social inequality, which is Gini.

Then, I need to find possible economic variables to measure the economic benefits of natural resources. Economists try to find whether there is a significant relationship between economic factors and the likelihood of civil war. A typical example of this is the work done by Collier and Hoeffler in 2004[18] , arguing that the proxies for the economic factors have an overall more significant effect on the likelihood of civil war[19]. Collier and Hoeffler also remarked that resource abundance, which they measured by using the primary goods of export, significantly affected the civil war. I build from this result and explore the empirical relationship between abundant natural resources and the likelihood of a civil war. Additionally, I consider possible omitted variables, especially those political factors like the political system, social inequality, and government corruption.

Unlike other literature, understanding the economic cause of civil war with market mechanisms, this research focuses on the relationship between GDP generated from natural resources and the likelihood of civil conflict for a specific country at a specific time. The paper expands and simplifies the theoretical model from Morelli and Rohner[20]. Morelli and Rohner point out a positive relationship between the resource concentration, measured by the petroleum Gini, and the likelihood of civil war for a country at a given time. My paper expands the research to more natural resources, including petroleum and mineral resources. It simplifies the measurement by focusing on the economic reliance on natural resources using the percent of GDP generated by natural resources.

[14]Cabrales, Antonio, and Esther Hauk. "The Quality of Political Institutions and The Curse of Natural Resources." The Economic Journal 121, no. 551 (2011): 58–88. http://www.jstor.org/stable/41057768.

[15]Cabrales, Antonio, and Esther Hauk. "The Quality of Political Institutions and The Curse of Natural Resources." The Economic Journal 121, no. 551 (2011): 58–88. http://www.jstor.org/stable/41057768.

[16]Cabrales, Antonio, and Esther Hauk. "The Quality of Political Institutions and The Curse of Natural Resources." The Economic Journal 121, no. 551 (2011): 58–88. http://www.jstor.org/stable/41057768. pp.2.

[17]Anyanwu, Ugochukwu, et al.(2021). "Does Abundant Natural Resources Amplify the Negative Impact of Income Inequality on Economic Growth?" Resources Policy. 74 102229. 10.1016/j.resourpol.2021.102229

[18]Paul Collier, and Anke Hoeffler. "Greed and Grievance in Civil War." Oxford Economic Papers, vol. 56, no. 4, 2004, pp. 563–95. JSTOR, http://www.jstor.org/stable/3488799. Accessed 5 Feb. 2023.

[19]Paul Collier, and Anke Hoeffler. "Greed and Grievance in Civil War." Oxford Economic Papers, vol. 56, no. 4, 2004, pp. 563–95. JSTOR, http://www.jstor.org/stable/3488799. Accessed 5 Feb. 2023. pp.11

[20]Massimo Morelli and Dominic Rohner, "Resource Concentration and Civil Wars", Journal of Development Economics 117 (2015): 32-47, accessed December 8, 2023, https://doi.org/10.1016/j.jdeveco.2015.06.003.

# 3  Data and the Summary Statistics

I apply the data about the likelihood of civil war, the percentage of the GDP that relies on the natural resources of each country, the democracy index, and finally, the Gini Coefficient. The time length of these data ranges from 1990 to 2018.

I use binary variables data for the dependent variable to determine whether a country has a civil conflict at a specific time. To offer criteria for the binary variable to assign 0 or 1 for each observation, the present literature defines "civil war" as "a violent conflict within a state between a government and one or more internal opposition groups, with sizeable combatant or battle-related fatalities" which are required "at least 5 percent of the weaker side's fatalities" and "Sub-war Civil Conflict" as "a violence between a government and one or more internal opposition without any quantitative requirement." [21]. Given that the binary variable would be 1 if there is a civil conflict at that time and 0 otherwise, the dependent variable is the likelihood of having a civil conflict for a specific country in each year.

One of the independent variables is the total natural resources rents (% of GDP) from the World Bank[22]. Total natural resources rents (% of GDP) is the percentage of the GDP that relies on each country's natural resources, the economic value generated by the natural resources divided by the GDP. According to the World Bank, the definition of such statistics is "Total natural resources rents are the sum of oil rents, natural gas rents, coal rents (hard and soft), mineral rents, and forest rents."[23]

The other one of the independent variable would be the oil Gini which is calculated based on the number of different ethic groups within different countries and the amount of petroleum occupied by the different ethnic groups.[24] Then the Gini Coefficient is calculated based on the formula of Gini.

The economic model also includes several control variables. The Gini coefficient is based on the World Income Inequality Database data. The Gini is calculated as the ratio between the area between the line of equality and the Lorenz Curve, which is the area below the equality line. I use the index Polity 2 from the Polity V project to measure the political system. The Polity 2 index has a 21-point index ranging from -10 to 10[25]. 10 is full democracy like Japan and South Korea, -10 is full autocracy like North Korea, the index in the middle is like -2, and 2 is anocracy like Mongolia with an index of 10. The U.S. has an index of 8 in 2018. The index is calculated based on the grade from 4 categories

[21]Charles Anderton., & John Carter. (2019). Civil Wars. In Principles of Conflict Economics: The Political Economy of War, Terrorism, Genocide, and Peace (pp. 229-252). Cambridge: Cambridge University Press. doi:10.1017/9781316875506.012.

[22]World Bank,Total natural resources rents (% of GDP), data.worldbank.org,
https://data.worldbank.org/indicator/NY.GDP.TOTL.RT.ZS.

[23]World Bank, Total natural resources rents (% of GDP), data.worldbank.org,
https://databank.worldbank.org/metadataglossary/adjusted-net-savings/series/NY.GDP.TOTL.RT.ZS

[24]Massimo Morelli and Dominic Rohner, "Resource Concentration and Civil Wars", Journal of Development Economics 117 (2015): 32-47, accessed December 8, 2023, https://doi.org/10.1016/j.jdeveco.2015.06.003.

[25]Marshall, M.G., and T.R. Gurr. 2020. "Polity5: Political Regime Characteristics and Transitions, 1800–2018." Dataset Users' Manual. Center for Systemic Peace. Available:
http://www.systemicpeace.org/inscr/p5manualv2018.pdf. Accessed: May, 2nd, 2022.

and has a combined evaluation as an index.

Furthermore, I use ethnic polarization to measure the ethnic factors of different countries. The polarization will measure how isolated a country is from the rest within the country and can be calculated by the formula as following[26]:$R.Q. = 1 - \sum_{i=1}^{N} \frac{\frac{1}{2} - \pi_i}{\frac{1}{2}} \pi_i$ where $\pi_i$ is the proportion of people belonging to the i-th ethic group, and the N means that there are N ethnic groups within the state. R.Q. means the degree of ethnic polarization. The data source is the data sets accompanied by the article of Fearon and Laitin[27] and the article of Alberto Alesina et al[28]. The data set constructed by Fearon and Laitin and Alberto Alesina et al. is based on the formula about. Lastly, the summary statistics are attached as Table 1, and the data is between 1990 and 2018.

Table 1

| Variable | Observation | Mean | Standard Deviation | Min | Max |
|---|---|---|---|---|---|
| Civil War | 1519 | 0.066 | 0.249 | 0 | 1 |
| Civil Conflict | 8,279 | 0.1523131 | 0.3593458 | 0 | 1 |
| Natural Resources as % GDP | 7,823 | 8.667728 | 10.31358 | .0006549 | 59.34108 |
| Oil Gini | 7,823 | 0.1700097 | 0.2596664 | 0 | 0.9765269 |
| Gini Index | 7,858 | 44.84392 | 11.84769 | 17.71 | 77.085 |
| Democracy | 8,096 | 0.2231966 | 7.412305 | -10 | 10 |
| Ethnic Polarization Alesina | 8,073 | 0.5529812 | 0.2426001 | 0 | 0.96764 |
| Ethnic Polarization Fearon and Laitin | 7,814 | 0.5377077 | 0.2681706 | 0 | .9856 |

From the summary statistics, about 7% of all observations in the data set are going through a civil war, and about 20% of the total observations are experiencing civil conflicts. An economy can be highly reliant on natural resources, which is about 80%, or there is no reliance. However, the typical economy is not primarily reliant on natural resources, given that the typical percent of GDP generated by natural resources is about 7.6%. A typical country could achieve a equality in the oil allocation since the average Gini of oil is 0.1700097. However, oil Gini also indicates that there could be extreme inequality of 0.9765269 in the oil allocation and extreme equality of 0. Based on the summary statistics of the ethnic polarization, I could see that ethnic groups cannot live in isolation from other ethnic groups, which is 0, and can also live in almost complete isolation, which is 0.98 or 0.96, respectively, based on different data sources. Typically, different ethnic group polarization is

[26]Montalvo, José G., and Marta Reynal-Querol. "Ethnic Polarization, Potential Conflict, and Civil Wars." The American Economic Review 95, no. 3 (2005): 796–816. http://www.jstor.org/stable/4132741

[27]James D Fearon and David D. Laitin. "Ethnicity, Insurgency, and Civil War." The American Political Science Review 97, no. 1 (2003): 75–90, http://www.jstor.org/stable/3118222.

[28]Alberto Alesina et al. "Fractionalization." Journal of Economic Growth 8, no. 2 (2003): 155–94, http://www.jstor.org/stable/40215942.

between these two extremes, about 0.55. This means that different ethnic groups in a country have moderate interactions with each other.

Along with these independent variables and control variables, The model includes different kind of interaction variables. For example, the interaction variable between the percent of GDP generated by the natural resources and the oil Gini coefficients would be important. This is because it is reasonable to think that ethnic group with few procession of oil would be more likely to launch civil wars or civil conflicts against the ethnic groups which possessed a large amount of oil in a country of which the economy is highly relied on the natural resources. Other interaction variables like the interaction variable between the Democracy level and oil Gini is also important for a country with high oil Gini combined with low democracy level would also lead to higher likelihood of civil war since the ethnic groups with few possession of oil and has no other political approach except war to fight for more possession of natural resources which in this case the oil.

# 4    Theoretical reasoning and The Model

The statistical model should include economics, the economy's reliance on natural resources, and political variables like levels of democracy and social inequality. Such formation of the model is because the formation of civil conflicts satisfies both greed and grievance narratives.

First, the relation is suitable in the greed narrative. Suppose there is a certain amount of natural resources in the country. In that case, it generates an economic benefit, measured by the proportion of the GDP generated by natural resources. This is based on economic value of natural resources having been extract in different countries in different years. Then, given the opportunity for economic benefit, people decided to wage civil conflict to gain those benefits, which agreed with the greed narrative. The presence of natural resources would increase the likelihood of a civil war.

However, the grievances, which are political factors, also explain the relation. The typical logic is that people fight for their rights through violence. The causes of the grievances are varied. Exaggerated social inequality is one cause driving the relationship between the likelihood of civil conflict and natural resources. The exaggerated social inequality is caused by the enormous upfront costs of natural resource extraction, which is indispensable. These capital-intensive costs make it difficult for specific individuals or groups to benefit from the presence of natural resources, increasing social inequality and disputes over the ownership of these resources. These disputes can often result in civil conflict and civil wars, given the extremely high value of natural resources relative to total output in specific settings. For example, suppose there is the presence of petroleum; people who possess cars would profit more than those without cars, and people with extraction capital would also profit more than others. The uneven

income distribution generated by natural resource extraction would lead the people without any capital already at the low end of the income distribution to fight for a just allocation of resources and increase the likelihood of a civil conflict. Therefore, the grievances also explain the relationship between the abundance of natural resources and the likelihood of civil conflict.

The other three factors in the Grievances category that could also explain the association are the level of democracy and ethnic factions within the country. For the level of democracy, the public would fail to pursue their rights to allocate the benefit from the natural resources through peaceful negotiation in a country with a low democracy level. The lack of peaceful democratic negotiation would force the people to fight for their rights violently and thus would lead to civil conflicts. The degree of ethnic polarization could also explain the causation; if there is a high ethnic polarization within a country, any ethnic group is unwilling to share its benefits with other ethnic groups. A high degree of ethnic polarization would lead to grievances for people in a specific ethnic group who would tend to think they have an unfair allocation, which would more likely lead to civil conflict. Moreover, the whether there was a civil or conflict in the recent year would also have an association with the likelihood of the civil war or the the civil conflict in the present. It is important for the statistical model to include the lag variable measuring whether there is a previous war.

By showing that both narratives could explain association, it is necessary to include proxies from the economic, political, and social factors. The response variable would be the likelihood of civil war or civil conflict for different countries at different times. The main covariates in my model are the economic value of the natural resources, the likelihood of civil conflict for country i at time t, the level of democracy, the degree of social inequality, and ethnic polarization. The model would also include the time-fixed effects. In the analysis, I first investigate the case of the civil war from the general cases of civil conflicts, mainly because civil war is more severe than civil conflicts. Moreover, the set of covariates may affect the likelihood of civil war differently from the likelihood of civil conflicts.

In this case, I use the proportion of GDP generated by the natural resource in percentage to measure the economic value of the natural resource. The reason to apply this is because the percentage would show how much a nation economically relied on the natural resources. The proportion of GDP generated by natural resources in percentage is helpful because I want to check the sole effect of the resources on the likelihood of civil war. If I use only the economic value of the natural resources, I include countries with substantial amounts of natural resources but do not solely rely on them. Such an economy would have more economic opportunities, leading to less likelihood of civil war based on the narrative of greed, which would be the measurement bias. Thus, the analysis would underestimate the effect of the resource on the likelihood of a civil war if there were a positive relation between the resource and the likelihood of civil war and overestimate the effect if there is a negative relation

between the resource and the likelihood of a civil war.

The likelihood of a civil war is calculated based on the following procedure. First, a binary variable signifying the occurrence of the civil conflict is created for each country. Next, the binary variable would be equal to 1 if there was a civil conflict in the country, and the binary variable would be 0 otherwise. The average value of those binary values would be the likelihood of that country's civil war throughout the given years. The measures of the likelihood of civil conflict for each country at different times are also created based on the same methods.

I also control the omitted variable bias, such as the level of democracy and income inequality. To control these political factors, I include the democracy index and the Gini coefficient. The reason why the democracy index influences an economy's dependence on natural resources is that when there is deficient democracy, there would be many restrictions for the country to have opportunities to have economic benefits. Then, the country would rely more on the economic benefit generated by the natural resources. Then, social inequality would also influence the reliance on natural resources. People capable of extracting natural resources have a high social status and, therefore, would rely on natural resources, making the economy's reliance on natural resources high.

By listing out all the possible omitted variables, dependent and independent variables, the linear regression model is as follows:

$$y_i t = \beta_0 + \beta_1 NR_{it} + \beta_2 OilGini_{it} + \beta_3 Gini_{it} + \beta_4 Demo_{it} + \beta_5 etho_{it}$$
$$+\beta_6 lagy_{it} + \beta_7 Demo_{it} \times NR_{it} + \beta_8 Gini_{it} \times NR_{it}+$$
$$\beta_9 etho_{it} \times NR_{it} + \beta_{10} OilGini_{it} \times NR_{it} + \beta_{11} Year_i + \beta_{12} Country_t + \beta_{13} y_{it-1} + \epsilon_{it}$$

The dependent variable $y_i t$ signifies the likelihood of a civil war or civil conflict for a specific country each year. The independent variable $NR_i t$ signifies the percent of reliance on natural resources for a specific country in a specific year.

The variable $OilGini_{it}$ is the oil Gini Coefficient for country i at time t. The variable $Gini_{it}$ is the Gini Coefficient for country i at time t. The variable $Demo_{it}$ is a grade for each country's polities at various times ranging from -10 to 10. $etho_{it}$ is ethnic polarization, which measures how isolated each ethnic group is within a country each year. The consideration of ethnic factorization is vital to control based on account of Laitin[29]. The model also included a lagged variable which indicates whether the there is a previous civil war or civil conflicts for this specific country in the specific year. Different interaction variables, $Demo_i t \times NR_i t$, $Gini_i t \times NR_i t$, and $etho_i t \times NR_i t$, are applied to investigate the unique effect of the reliance on natural resources to investigate the possible effect on the likelihood of the civil war or civil conflicts in different levels of democracy, inequality, and ethnic polarization. The model also considered the fixed effect of the year and country to avoid any other bias like the

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[29]James D Fearon and David D. Laitin. "Ethnicity, Insurgency, and Civil War." The American Political Science Review 97, no. 1 (2003): 75–90, http://www.jstor.org/stable/3118222.

business cycle. The model will also include the dependent variable $y_{it-1}$ to consider whether there is a civil war or a civil conflict in the previous year for a given country and in a given year.

The linear model also has a binary variables version of the analysis and considers the democracy index and Gini coefficient. The binary model is necessary because both extreme autocracy and extreme democracy could decrease the likelihood of civil wars or civil conflicts. An autocracy would decrease the likelihood of civil war or civil conflict because the autocracy would oversee the activities of its citizens to avoid any conspiracy for upheavals. A democracy would decrease the likelihood of civil conflict or civil war because citizens could pursue their rights and economic benefits peacefully and thus be less likely to be pugnacious.

Moreover, the binary variable version of the regression model is also necessary because extreme inequality and equality may increase the likelihood of civil wars or conflicts. Specifically, high-income inequality may increase the likelihood of civil war or civil conflicts because low-income people were forced to launch a civil war or civil conflict like the French Revolution to fight for more rights and benefits. However, high inequality could also decrease the likelihood of civil war or civil conflicts because the high incomers concentrate all the wealth in the society. The rest of the people are in extreme poverty, and there is no way to fight to improve their circumstances because there is no wealth to fund an upheaval.

Considering the different narratives of relation between different political factors and the binary version of the model is as follows:

$$y_i t = \beta_0 + \beta_1 NR_{it} + \beta_2 HighOilGini_{it} + \beta_3 LowOilGini_{it} + \beta_4 HighGini_{it}$$
$$+\beta_5 LowGini_{it} + \beta_6 HighDemo_{it} + \beta_7 LowDemo_{it} + \beta_8 etho_{it} + \beta_9 lagy_{it}$$
$$+\beta_7 LowOilGini_{it} \times NR_{it} + \beta_7 HighOilGini_{it} \times NR_{it} + \beta_7 LowGini_{it} \times NR_{it}$$
$$+\beta_8 HighGini_i t \times NR_i t + \beta_9 LowDemo_{it} \times NR_{it}$$
$$+\beta_1 0 HighDemo_{it} \times NR_{it} + \beta_1 1 etho_{it} \times NR_{it} + \beta_{12} Year_i$$
$$+\beta_{13} Country_t + \beta_{14} y_{it-1} + \epsilon_{it}$$

In the model above, $y_{it}$ represents either the likelihood of the civil war or the civil conflicts and $NR_{it}$ signifies the percent of reliance on the natural resources for a specific country in a specific year. Two binary variables, low Gini and high Gini, replace the Gini.

A country will be assigned as 1 in the high inequality if its Gini is greater than or equal to 50 and 0 otherwise. Then, these two binary variables assign the data into three groups: high inequality, low inequality, and moderate inequality. Similarly, two binary variables, low democracy and high democracy, replace the democracy index. A country will be assigned as 1 in the high democracy if its democracy index is greater than or equal to 7 and 0 otherwise. A country will be assigned as 1 in the low democracy if its democracy index is less than or equal to 0 and 0 otherwise. These binary

variables then combine with the independent variable I want to investigate to check the combined effect using the interaction terms: $LowGini_{it} \times NR_{it}$, $HighGini_{it} \times NR_{it}$, $LowDemo_{it} \times NR_{it}$, and $HighDemo_{it} \times NR_{it}$. This model also includes the time-fixed effect to avoid bias from the business cycles, like the previous model. Again, The model would include the dependent variable $y_{it-1}$ to consider whether there is a civil war or a civil conflict in the previous year for a given country and in a given year.

## 5  Result and Analysis

I separate the data analysis into four parts to check the civil conflict and the civil war in the regular and binary linear regression models. The regular linear model is the following, as mentioned before:

$$y_i t = \beta_0 + \beta_1 NR_{it} + \beta_2 OilGini_{it} + \beta_3 Gini_{it} + \beta_4 Demo_{it} + \beta_5 etho_{it}$$
$$+\beta_6 lagy_{it} + \beta_7 Demo_{it} \times NR_{it} + \beta_8 Gini_{it} \times NR_{it}+$$
$$\beta_9 etho_{it} \times NR_{it} + \beta_{10} Year_i + \beta_{11} Country_t + \beta_{12} y_{it-1} + \epsilon_{it}$$

The binary linear model is the following as mentioned before:

$$y_i t = \beta_0 + \beta_1 NR_{it} + \beta_2 HighOilGini_{it} + \beta_3 LowOilGini_{it} + \beta_4 HighGini_{it}$$
$$+\beta_5 LowGini_{it} + \beta_6 HighDemo_{it} + \beta_7 LowDemo_{it} + \beta_8 etho_{it} + \beta_9 lagy_{it}$$
$$+\beta_7 LowOilGini_{it} \times x_{it} + \beta_7 HighOilGini_{it} \times x_{it} + \beta_7 LowGini_{it} \times x_{it}$$
$$+\beta_8 HighGini_i t \times x_i t + \beta_9 LowDemo_{it} \times NR_{it}$$
$$+\beta_1 0 HighDemo_{it} \times NR_{it} + \beta_1 1 etho_{it} \times NR_{it} + \beta_1 2 Year_i$$
$$+\beta_1 3 Country_{it} + \epsilon_{it}$$

Because I have two data sets that measure the ethnic factors, I adopt both versions of both regression models for analysis. The analysis starts with a simple regression model based on the following linear model:

$$y_i t = \beta_0 + \beta_1 NR_{it} + \beta_2 OilGini_{it} \ (1)$$

Next, I analyze the model with all the control variables and the model with all the control variables and the fixed effects, which is based on the following linear model:

$$y_{it} = \beta_0 + \beta_1 NR_{it} + \beta_2 OilGini_{it} + \beta_3 Gini_{it}$$
$$+\beta_4 Demo_{it} + \beta_5 etho_{it} + \beta_6 y_{it-1} + \epsilon_i t \ (2)$$
$$y_{it} = \beta_0 + \beta_1 NR_{it} + \beta_2 OilGini_{it} + \beta_3 Gini_{it} + \beta_4 Demo_{it}+$$
$$\beta_5 etho_{it} + \beta_6 Year_i + \beta_7 Country_t + \beta_8 y_{it-1} \epsilon_{it} (3)$$

Then, I analyze the complete model, which is the following:

$$y_{it} = \beta_0 + \beta_1 NR_{it} + \beta_2 OilGini_{it} + \beta_3 Gini_{it} + \beta_4 Demo_{it} + \beta_5 etho_{it}$$
$$+\beta_6 lagy_{it} + \beta_7 Demo_{it} \times NR_{it} + \beta_8 Gini_{it} \times NR_{it}+$$

$$\beta_9 etho_{it} \times NR_{it} + \beta_{10} OilGini_{it} \times NR_{it} +$$

$$\beta_{11} Year_i + \beta_{12} Country_t + \beta_{13} y_{it-1} + \epsilon_{it} (4)$$

I first discuss the regression result for civil war incidence. Civil war is a particular case of civil conflict because the incidence of civil war is more severe than typical civil conflicts. Next, I analyze and discuss the regression result for civil conflict. Then, I discuss the binary regression model's results for civil war and conflicts. Furthermore, given that the potential effects of the explanatory variables may not appear instantaneously on the change in the likelihood of the civil war or civil conflicts, the analysis lagged all the covariates one year in the models[30].

| Table 2 | | | | | | | |
|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| VARIABLES | Civil War Incidence | Civil War Incidence | Civil War Incidence | Civil War Incidence | Civil War Incidence | Civil War Incidence | Civil War Incidence |
| NR%GDP | 0.000273 | -5.33e-05 | -7.54e-05 | 0.00281* | -1.00e-05 | -6.75e-05 | 0.00308* |
| | (0.000243) | (0.000194) | (0.000366) | (0.00157) | (0.000204) | (0.000372) | (0.00161) |
| Oil Gini | 0.159*** | 0.0464*** | 0.0581*** | -0.149 | 0.0448*** | 0.0583*** | -0.171 |
| | (0.00964) | (0.00754) | (0.0201) | (0.114) | (0.00773) | (0.0204) | (0.119) |
| Gini | | 0.000242 | 0.00118* | 0.00178* | 0.00114 | 0.00120* | 0.000988 |
| | | (0.000169) | (0.000639) | (0.000983) | (0.000820) | (0.000651) | (0.000815) |
| Democracy | | −0.000483* | 0.000253 | 0.000972 | -0.000446 | 0.000243 | 0.00103 |
| | | (0.000273) | (0.000494) | (0.000634) | (0.000279) | (0.000507) | (0.000652) |
| PolarAlesina | | 0.00346 | -0.0544 | -0.0689 | | | |
| | | (0.00837) | (0.136) | (0.138) | | | |
| NR%GDPx OilGini | | | | -0.000929 | | | -0.000198 |
| | | | | (0.00190) | | | (0.00187) |
| NR%GDPx Gini | | | | −7.7e-5* | | | −6.6e-5 |
| | | | | (4.27e-5) | | | (4.05e05) |
| NR%GDP x Democracy | | | | 7.09e-6 | | | −2.20e-7 |
| | | | | (4.40e-5) | | | (4.48e-5) |
| NR%GDPx PolarAlesina | | | | 0.000965 | | | |
| | | | | (0.00225) | | | |
| Oil Gini x Gini | | | | 0.00395* | | | 0.00386* |
| | | | | (0.00203) | | | (0.00204) |
| Oil Gini x Democracy | | | | −0.00407*** | | | −0.00408** |
| | | | | (0.00156) | | | (0.00159) |
| Oil Gini xPolarAlesina | | | | 0.0225 | | | |
| | | | | (0.101) | | | |
| Civil War Year-1 | | 0.656*** | 0.552*** | 0.549*** | 0.656*** | 0.552*** | 0.549*** |
| | | (0.00883) | (0.00994) | (0.00996) | (0.00896) | (0.0101) | (0.0101) |
| Polar Fearon and Laitin | | | | | 0.00454 | -0.0537 | -0.0546 |
| | | | | | (0.00783) | (0.134) | (0.135) |
| NR%GDPxPolar Fearon&Laitin | | | | | | | -0.000638 |
| | | | | | | | (0.00169) |
| OilGinixPolar Fearon&Laitin | | | | | | | 0.0525 |
| | | | | | | | (0.0965) |

The regression result for the civil war is attached in Table 2. Model (1) is the simple regression model with only the likelihood of a civil war for a given country at a given time and the percentage of GDP generated by natural resources. Model (2) is the regression model with (1) and the control variables. Model (3) is the regression model, including both (2) and the time-fixed effects. Model (4) is the regression model, including both (3) and the interaction variables.

Models (5), (6), and (7) in the result table have the same regression model as models (2), (3), and (4) correspondingly. However, (5), (6), and (7) use the ethnic polarization measurement from Fearon and Laitin , while (2), (3), and (4) use the ethnic polarization measurement from the paper from Alberto Alesina et al in table 2

First, model (1) exhibits a significant association between the Oil Gini and the likelihood of civil war. Given that the slope coefficient is greater than 0, there could be a significant positive association between the oil Gini and the likelihood of civil war. The test statistic shows a significant association between the likelihood and resource inequality. However, the regression also shows that there is no significant association between the economy's reliance on the natural resources and the likelihood of the civil war. This is reasonable given the fact that few modern countries wage civil war because of the high or low degree of reliance of natural resources for if this is true there should be lots of civil war occurred in Japan which is country with few reliance of natural resources or Saudi Arabia which heavily relied on the natural resource. This model provide some insight to the relation between Oil Gini and the likelihood of the Civil War. However, the model must also consider the omitted variable biases and fixed effects using multiple controls, fixed effects, and interactional variables. Furthermore, the regression also shows that there is no significant relationship between the percent of GDP generated by the natural resources.

Model (2), which includes model (1) and the control variables, and Model (3) which includes model (2) and the time fixed effect show that the association between the likelihood of a civil war and the oil Gini is positively significant. The significant association indicates that the inequality in the oil allocation can be one of the reasons for the civil war, agreeing with model (1)'s conclusion. Furthermore, Model (5) and (6) which use the same regression model as the model (2) and (3) but with different measure of the ethnic polarization from model (2) and (3) exhibit similar behavior that there is a significant positive association between the oil Gini and likelihood of the civil war. All the model 2, 3, 5, and 6 indicated that the whether there is a previous civil war would significantly influence whether there is a previous civil war. This actually indicates that whether there is a previous civil war could explain whether there is a civil war in the present significantly.

Then, I analyze the Model (4), which includes all the variables. The result table shows that Economics's reliance on the natural resource is significantly positively associated with the likelihood of

civil war. Inequality is significantly positively associated with the likelihood of civil war. Both of these two variables are significant at the 10% significance level. Even though there is no significant association between the civil war and the Oil Gini in this model, the result table shows that there is a significant positive association between the likelihood of the civil war and the interaction variable between oil Gini lagging one year and Democracy in the notation $OilGini \cdot Democracy$. The significance of the interaction between the democracy level and the oil Gini implies that the increase Oil Gini only may not increase the likelihood of civil war but the combined effect between the oil Gini and the democracy level may increase the likelihood of the civil war. The significance could be understood as the countries with either a high Oil Gini or a low democracy level may have less likelihood of civil war than the countries with both an increase Oil Gini and an increase in the democracy level. Furthermore Model 4 also indicates that there is a significant association between between the likelihood of the civil war and the interaction variable between oil Gini lagging one year and Gini in the notation $OilGini \cdot Gini$.

Model (7) is the same as model (4). Model (7) exhibits the same conclusions for the combined effect between democracy and the Oil Gini lagging one year. Moreover, Model (7) shows that inequality measured by Gini and democracy have significant negative associations with the likelihood of civil war. Moreover, similar to the previous model previous status of civil war is the most essential variable to estimate the likelihood of the present civil war.

There are two counterintuitive results. First, both models (7) and (4) exhibit the positive effect of the combined effect between democracy and the oil Gini. The negative association is counterintuitive, given that democracy is expected to decrease the likelihood of civil war in the interaction term. I should have further analysis in the binary variable analysis in the later part of the paper, given that there might be a nonlinear relation between likelihood and the level of democracy. Moreover, the result shows a negative relationship between oil allocation inequality and the likelihood of a civil war, meaning that increased oil inequality would decrease the likelihood of a civil war, which is counterintuitive. This is possible because people extremely lack of oil have no wealth to fund a civil war to fight for their rights in some extreme inequality for they have nothing to consume for oil. These counterintuitive results imply a nonlinear relationship between the combined effect of democracy, the Oil Gini, and the likelihood of civil war. Similarly, there is a nonlinear relation between income inequality and the likelihood of civil war. The significance of these nonlinear behaviors would be tested through the binary Model.

Next, I analyze the effect of each independent variable on the likelihood of the civil conflict. The regression result for the civil conflict is attached as Table 3 below. Table 3 arranges the result in the same format as Table 2. Table 3 also shows that Oil Gini is more related to the likelihood of the Civil Conflicts than the Percent of GDP generated by the Natural Resources.

First, model (1) exhibits a significant association between the percent of GDP generated by natural resources and the likelihood of civil conflict. Given that the slope coefficient is less than 0, there could be a significant negative association between the percentage of GDP generated by natural resources and the likelihood of civil war. The Model (1) shows that there is a positive association between the likelihood of the Civil Conflicts and the oil Gini. Given that there is a significant association between the likelihood of the Civil Conflict and the percent of the GDP generated by the natural resource, the model indicates that the increase of the reliance of the natural resource would decrease the likelihood of the Civil Conflict. This is reasonable that the increase in the economic performance would increase people's satisfaction to the life would lead to less likelihood of the Civil Conflicts. The model (1) then suggest that the Oil Gini is positively associated with the likelihood of the civil conflicts. This satisfied with the common sense for the inequality would wage grievance and thus there is a higher likelihood of the civil conflicts. However, the theoretical Model must also consider the omitted variable biases and fixed effects using multiple controls, fixed effects, and interactional variables.

Model (2), which includes Model (1) and the control variables, demonstrates that the relation between reliance on natural resources and the likelihood of civil conflicts is insignificant when the significance level is 5% but significant at 10%. Similar to Model 2, Model (5) demonstrates the insignificant relationship between reliance on natural resources and the likelihood of civil conflicts. However, these models exhibit a significant relationship between the likelihood of civil conflicts and the oil Gini using different measures of polarization of ethnicity. Combining the results from both models, the association between Oil Gini and the likelihood of civil conflicts is significant while economic reliance on the natural resources only is not significantly related to the occurrence of the Civil Conflicts.

Furthermore, the Model (2) and the Model (5) exhibit a significant negative relationship between Gini and the likelihood of civil conflict. The result implies that Income inequality should be considered in the Model to find the sole effect of the natural resources especially oil in this case. Another thing to be notified is that the civil conflict in the previous year is a important factor on the likelihood of a civil Conflict this year for each country.

Model (3), including Model (2) and the time-fixed effect, shows that the association between the likelihood of a civil conflict and the oil Gini is significant. The significant association indicates that inequality in the petroleum distribution can be one of the reasons for civil conflict, agreeing with the conclusion of Model (1). Furthermore, Model (3) also shows a significant association between whether there is a civil conflict in the previous year and the likelihood of civil conflict this year for different countries, agreeing with the insight of Model (2). Model (6), which has the same structure as Model (3) but uses different measures of ethnic polarization, indicates that there is significant association between the likelihood of the civil conflict and the Oil Gini. However, similar to the model 3, model

5 indicates that there is a significant association between whether there is a previous civil conflict and the likelihood of the present civil conflicts.

Then, I analyze Models (4) and (7), which include all the variables. The result table shows a significant association between the interaction variable between the reliance on natural resources and Oil Gini and the likelihood of civil conflict in model (4). However, Model 7 indicates that there is shows a significant association between the interaction variable between the oil Gini and percent of the GDP generated by the Natural Resources and the likelihood of civil conflict. Moreover, the both model indicates that there is a significant association between whether there is a Civil Conflict in the previous year and the likelihood of the civil conflict in the present. [31].

| Table 3 | | | | | | | |
|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| VARIABLES | Civil Conflict | Civil Conflict | Civil Conflict | Civil Conflict | Civil Conflict | Civil Conflict | Civil Conflict |
| NR%GDP | $-0.00137^{***}$ | $-0.000355$ | 0.000130 | 0.00204 | $-0.000281$ | 0.000137 | 0.00244 |
| | (0.000387) | (0.000268) | (0.000499) | (0.00214) | (0.000280) | (0.000504) | (0.00217) |
| Oil Gini | $0.393^{***}$ | $0.0849^{***}$ | $0.0451^{*}$ | -0.0571 | $0.0796^{***}$ | 0.0446 | $-0.138$ |
| | (0.0154) | (0.0106) | (0.0274) | (0.156) | (0.0108) | (0.0276) | (0.138) |
| Gini | | $0.000454^{*}$ | 0.000636 | 0.000441 | $0.000507^{**}$ | 0.000706 | 0.000545 |
| | | (0.000234) | (0.000871) | (0.00112) | (0.000238) | (0.000881) | (0.00113) |
| Democracy | | -0.000217 | 0.000399 | -0.000894 | -6.98e-05 | 0.000436 | -0.000830 |
| | | (0.000377) | (0.000674) | (0.000864) | (0.000382) | (0.000686) | (0.000879) |
| PolarAlesina | | 0.0176 | -0.283 | -0.287 | | | |
| | | (0.0116) | (0.186) | (0.188) | | | |
| NR%GDPx OilGini | | | | 0.00391 | | | $0.00450^{*}$ |
| | | | | (0.00259) | | | (0.00251) |
| NR%GDPx Gini | | | | -4.63e-5* | | | -3.99e-5 |
| | | | | (5.82e-5) | | | (5.48e-5) |
| NR%GDP x Democracy | | | | 9.20e-5 | | | 8.82e-5 |
| | | | | (6e-5) | | | (6.07e-5) |
| NR%GDPx PolarAlesina | | | | -0.00131 | | | |
| | | | | (0.00307) | | | |
| Oil Gini x Gini | | | | 0.00343 | | | 0.00266 |
| | | | | (0.00277) | | | (0.00316) |
| Oil Gini x Democracy | | | | 0.00265 | | | 0.00255 |
| | | | | (0.00212) | | | (0.00214) |
| Oil Gini xPolarAlesina | | | | -0.134 | | | |
| | | | | (0.138) | | | |
| Civil War Year-1 | | $0.777^{***}$ | $0.622^{***}$ | $0.620^{***}$ | $0.779^{***}$ | $0.625^{***}$ | $0.623^{***}$ |
| | | (0.00748) | (0.00935) | (0.00937) | (0.00756) | (0.00945) | (0.00948) |
| Polar Fearon and Laitin | | | | | $0.0248^{**}$ | -0.274 | -0.270 |
| | | | | | (0.0108) | (0.182) | (0.183) |
| NR%GDPxPolar Fearon&Laitin | | | | | | | -0.00281 |
| | | | | | | | (0.00228) |
| OilGinixPolar Fearon&Laitin | | | | | | | 0.0326 |
| | | | | | | | (0.155) |

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[31]Notes: 1. Standard errors in parentheses 2.*** p¡0.01, ** p¡0.05, * p¡0.1

The significance of the interaction variable between the percent of GDP generated by natural resources and Oil Gini implies that reliance on natural resources alone may not increase the likelihood of a civil conflict. However, its combined effect with Oil Gini may increase the likelihood of civil conflict. Such significance could be understood as the countries with increased reliance on natural resources may have less likelihood of civil war than the countries with increased Oil distribution inequality level and increased reliance on natural resources. Moreover the significance of the the interaction variable between the percent of GDP generated by natural resources and Gini implies that reliance on natural resources alone may not increase the likelihood of a civil conflict. However, its combined effect with Gini may decrease the likelihood of civil conflict. Such significance could be People at the bottom of the income distribution has no funding to wage civil conflict to fight against the social unfairness.

Furthermore, model (4) also shows a significant positive association between whether there is a civil conflict in the previous year and the likelihood of civil conflict. Like model (4), model (7) shows the same conclusion with model (4). Like the case of the civil war, the positive association between the likelihood of civil conflict and whether there was a civil conflict last year is also significant. Further analysis may need to separate both civil war and the civil conflict into two categories. One is that there is no previous war or conflict. The other is there was a previous civil war or civil conflicts.

The binary model results in Table 4 below, which supports a combined narration of the greed and grievance narratives. Countries with high grievances, characterized as low democracy levels, may not have a higher chance of civil war because war is destructive and costly, and there are enough benefits to incentivize one. Countries with high levels of natural resource reliance may also not increase the likelihood of civil war because no one wants to destroy the benefit generated by the natural resource. However, if a country has both factors, people will have greed for more resources and no peaceful ways to pursue more benefits or rights. Civil war is a reasonable way to advocate for more benefits and rights; thus, a country's likelihood of civil war increases.

The binary model also have a similar conclusion for the interaction variable between the oil Gini and democracy level. The result indicates that the low democracy would would discourage the likelihood of the civil war or the civil conflicts given the same level of the Oil Gini. This phenomenon can be reasoned in the similar logic as the previous paragraph.

The Results indicate that the for the oil Gini explained the occurrence of the civil war better than the economic reliance on the natural resource. However, the economic reliance on the natural resource may better explain the likelihood of the civil conflicts.

For the combined effect, the table exhibit a significant negative association between the combined effect between natural resources and high democracy for the models emphasizing on the civil conflict. This is reasonable because a higher level of democracy leads people to prefer to pursue their rights

peacefully and thus decrease the likelihood of civil conflict. However, the result also exhibits a significant negative association between the combined effect of the reliance on natural resources and the low level of democracy. This means that a country with a high reliance on natural resources may decrease its likelihood of a civil conflict if the government is autocratic. This could be explained by the fact that an autocracy eliminates all possibility of conspiracy for uprising and thus has a small likelihood of civil conflicts.

The Result table also indicates a similar result for the combined effect of the between oil Gini and high democracy for the models emphasizing on the civil war. This is also reasonable for the similar reasoning as the previous paragraph. The thing that is counterintuitive is that there is a negative association between the oil Gini and the likelihood of the civil war incidence even though it is reasonable to think that there is a positive association between the percent of the GDP generated by the natural Resources. People are constantly looking for more economic benefits and in the economy which the natural resources are heavily relied on, people would pursue for more benefits generated by the natural resources through different conflicts. One possible reasoning for the negative oil Gini and the likelihood of the Civil War incidence is that the source of oil is restricted to few people with other economic benefit. the rest of the People, lacked of the income, has no funding to wage civil war to pursue their economic right.

All four models exhibit a significant positive association between economic reliance on Natural resources and the likelihood of civil war or civil conflicts. Furthermore, the likelihood of a significant negative association appeared in all four Model's results. These results agree with the present-day literature's conclusion that natural resources drive a higher likelihood of civil war or conflicts. Democracy could decrease the likelihood of civil conflicts or even civil wars. Furthermore, all four models show significant negative associations between the likelihood of civil war or civil conflicts and the combined effect between the economic reliance on natural resources and both low and high democracies. This result supports my guess about the nonlinear relationship between the combined effect of the reliance on natural resources and democracy and the likelihood of civil wars or civil conflicts.

Model (1) and Model (2) indicate a significant negative association between high-income inequality and the likelihood of a civil war. This could be explained by the fact that in the extreme income inequality society, the top incomers gathered almost all the wealth or capital and left minimal wealth or capital to the bottom mass. People at the bottom have almost no capital to fight for their rights; thus, there is a small likelihood of civil war. Similar to the previous result, the previous civil war is significantly associated with the occurrence of the civil war.

Model (3) and Model (4) indicate a significant negative association between the likelihood of civil

| Table 4 | | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| VARIABLES | Civil War | Civil War | Civil Conflict | Civil Conflict |
| NR%GDP | −0.000225 | 0.000737 | 0.00504** | 0.00508*** |
| | (0.00161) | (0.00137) | (0.00217) | (0.00184) |
| Oil Gini | −0.162* | −0.175∗ | 0.114 | 0.122 |
| | (0.0929) | (0.0942) | (0.125) | (0.126) |
| High Gini | 0.00135 | 0.000651 | 0.0127 | 0.0116 |
| | (0.0130) | (0.0133) | (0.0176) | (0.0178) |
| Low Gini | −0.0.0476** | −0.0464** | 0.0341 | 0.0359 |
| | (0.0201) | (0.0207) | (0.0270) | (0.0277) |
| High Democracy | −0.0151 | −0.0146 | −0.00945 | −0.0103 |
| | (0.0114) | (0.0117) | (0.0153) | (0.0156) |
| Low Democracy | −0.00447 | −0.00451 | 0.0176 | 0.0183 |
| | (0.00952)) | (0.00981) | (0.0128) | (0.0131) |
| Polar Alesina | −0.0124 | | -0.447** | |
| | (0.150) | | (0.203) | |
| Polar Fearon and Laitin | | -0.00475 | | -0.445** |
| | | (0.149) | | (0.199) |
| NR%GDP x Oil Gini | 0.000258 | 0.000465 | 0.00105 | 0.000944 |
| | (0.00245) | (0.00251) | (0.00329) | (0.00335) |
| NR%GDPx GiniL | 0.00206** | 0.00177** | 4.12e-05 | 0.000157 |
| | (0.000856) | (0.000823) | (0.00115) | (0.00110) |
| NR%GDPx GiniH | -0.000304 | -0.000195 | 0.00221 | 0.00238* |
| | (0.00101) | (0.00105) | (0.00136) | (0.00140) |
| NR%GDP x DemocracyL | −0.00240*** | −0.00244*** | −0.00449*** | −0.00457*** |
| | (0.000879) | (0.000910) | (0.00119) | (0.00122) |
| NR%GDP x DemocracyH | −0.00160 | −0.00178∗ | −0.00465*** | −0.00468*** |
| | (0.00100) | (0.00103) | (0.00136) | (0.00138) |
| NR%GDPx PolarAlesina | 0.0689 | 0.0799 | −0.0900 | −0.101 |
| | (0.0989) | (0.100) | (0.133) | (0.134) |
| Oil Gini x GiniL | 0.0582 | 0.0618 | −0.112 | −0.117∗ |
| | (0.0515) | (0.0531) | (0.0693) | (0.0711) |
| Oil Gini x GiniH | 0.0571 | 0.0591 | −0.0581 | −0.0563 |
| | (0.0415) | (0.0425) | (0.0559) | (0.0569) |
| Oil Ginix DemocracyL | 0.0923*** | 0.0928*** | 0.0604* | 0.0593* |
| | (0.0240) | (0.0245) | (0.0322) | (0.0328) |
| Oil Ginix DemocracyH | 0.115*** | 0.115*** | 0.164*** | 0.165*** |
| | (0.0279) | (0.0285) | (0.0376) | (0.0382) |
| Oil Gini x PolarAlesina | 0.0689 | 0.0799 | -0.0900 | -0.101 |
| | (0.0989) | (0.100) | (0.133) | (0.134) |
| Civil War Year-1 | 0.566*** | 0.566*** | | |
| | (0.00946) | (0.00964) | | |
| Polar Fearon and Laitin | | -0.00883 | | -0.445** |
| | | (0.148) | | (0.198) |
| NR%GDPxPolar Fearon&Laitin | | 0.000887 | | -0.00234 |
| | | (0.00150) | | (0.00200) |
| OilGinixPolar Fearon&Laitin | | 0.0504 | | -0.0355 |
| | | (0.0956) | | (0.128) |
| Civil Conflict Year-1 | | | 0.623*** | 0.626*** |
| | | | (0.00903) | (0.00917) |

conflict and the low Gini. This implies that low inequality would decrease the likelihood of a civil war, which agrees with the present-day literature. Furthermore, there is a significant positive effect between the likelihood of civil conflict and the combined effect between the low Gini and the reliance on natural resources. This is counterintuitive but could be explained by the fact that people would feel jealous of people who used to have similar income but higher income than them now, thus increasing the likelihood of civil conflict. Similar to the previous result, the previous civil conflict is significantly associated with the occurrence of the civil conflict.

# 6  Conclusion and Further Research

The thesis would conclude that there is a significant association between a country's reliance on natural resources and its likelihood of having a civil conflict or the interaction variable with some control variables. Another conclusion is that there is a significant association between a country's Oil Gini and its likelihood of having a civil war or the interaction variable with some control variables.

Furthermore, a country with low inequality may have less likelihood of civil war than countries with high inequality overall. This is reasonable because people have less grievance to the income allocation and thus are less likely to have civil war.

The intriguing result is that the likelihood of a civil war between two countries with the same level of Oil Gini is lower for the autocratic country. The likelihood of a civil war between two countries with the same level of Oil Gini is lower for the country that is democratic. Countries that are neither fully democratic nor fully autocratic may have a higher likelihood of civil war compared to other countries if all these countries have the same level of reliance on natural resources.

The further research could be separated into two parts: mathematical modeling using a differential equation system to analyze the behavior of the combined effect of democracy and reliance on natural resources on a country's likelihood of civil war, and normative analysis, which is mainly about the causation between reliance of natural resources and the likelihood of a civil war using instrumental variables.

Further research could focus on the mathematical modeling of the statistical Model using differential equation systems. This is inspired by Bianca and Guerrini[32] who use differential equations and persistence topology to analyze the bifurcation behavior of the Solow growth model in the working age. The analysis showed that there is also a bifurcation behavior from democracy and the interaction variable between democracy and the reliance on natural resources in the case of civil war. Holding the reliance on natural resources constant, a country that is either autocratic or democratic is less likely

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[32]Carlo Bianca and Luca Guerrini, "Existence of Limit Cycles in the Solow Model with Delayed-Logistic Population Growth", The Scientific World Journal, vol 2014. Accessed December 8, 2023, https://doi.org/10.1155/2014/207806.

to encounter a civil war than countries that are neither democratic nor autocratic. This would be an essential research topic because it may offer insights to policymakers on the allocation of economic benefit generated by natural resources and whether the ruling class or the citizens should decide the benefit allocation, which may be based on different circumstances.

Further causation analysis between natural resources and the likelihood of Civil war or civil conflicts for a given country at a given time would be necessary. The primary way to establish causation would be to establish an instrumental variable, which, in this case, I could use the increased number of sites within a country in a specific year as an instrumental variable which is related to the percent of GDP generated by the natural resources but is unrelated to the ethnic polarization and democracy index. It is also unrelated to inequality because only the ownership of natural resources is related to inequality, not the number itself. Furthermore, the increase in the number of natural resource sites is random because the time that a new site of the natural resources is created is entirely random.

Understanding the causation is essential to understanding better how to deal with the factors that could cause civil wars. Knowledge of causal relations would help decrease the likelihood of civil war and enhance global peace.

In conclusion, a significant association exists between the civil war and Oil Gini and a significant association exist between conflict and the reliance on natural resources. Further research would explore the theoretical modeling using differential equations and the persistence topology to analyze the possible bifurcation behaviors within the statistical Model. Further research is also needed to investigate whether there is a causal relationship between the reliance on natural resources and the likelihood of civil war or civil conflicts in a country.

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