Income inequality and conflicts: A new Gini decomposition analysis

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Abstract

There has been little research examining how income inequality may or may not contribute to the "grievance" aspect of conflict. For the most part, the measure used is the traditional Gini index, which is suitable to reflect vertical inequality (VI) rather than horizontal inequality (HI). Calculating HI requires the ability to decompose inequality indices, especially the Gini index, into a within-subgroup component and a between-subgroup component. There exists a long-standing stream of literature discussing how to decompose the Gini index. This article discusses the shortcomings of existing Gini decomposition methods and proposes a novel method that divides the Gini index into *within-subgroup* and *across-subgroup* components. This novel method is then applied to the case of Thailand in the years 2009–2017. The differences in the two components derived from the method of this article and those of existing methods are large. In addition, the HI measure this article introduces is also large relative to non-Gini measures such as the Theil and Shorrocks indices. Therefore conflict-related papers that include an existing Gini decomposition and HI measure among their independent variables may wish to test their models with those of this article and other measures—to examine if the results are consistent and to mitigate a risk of misleading policymakers.

I ncome inequality is a key problem in many, if not all, human dimensions, such as access to education, health care, and political rights. It is caused by many factors, but economic policies are among the most important. Policies that benefit some groups of people, while being a problem to others, include limited access to investment funds, education, and health care services. Many non-economic factors also have an important role in the unequal distribution of income—by being based on race, religion, and culture, the rights and opportunities of some groups of people are limited and inferior to those of the majority or dominant groups. In many areas of the world, inequality persists between people or groups in the same or different societies; sometimes igniting into conflict.

Often placed within the context of the "greed and grievance" debate on the causes of civil war, little research has examined how income inequality may or may not contribute to the "grievance" aspect of conflict. Even if a causal link is found to exist, the transmission mechanism from inequality to conflict is often not addressed—for example through "upward-envy" by the poor wishing to catch up with the rich, or "downward-envy" by the rich not wishing the poor to catch up. However, whether a transmission mechanism is addressed or not, this article instead critically queries the very *measure* of inequality used in the literature.[1]

For the most part, the measure used is the traditional Gini index, sometimes tweaked to reflect horizontal inequality (HI), rather than vertical inequality (VI) for which it is better suited. VI assumes a uniform, undifferentiated population (except for income differences); in contrast, HI additionally introduces subpopulations to recognize segmentation by some criterion such as subnational region, economic distinction, political grouping, or cultural status marker ("Buddhist/Muslim", "ethnic majority/minority", and so on). Sometimes such markers overlap e.g., Melayu Muslims in Thailand's southernmost region. Calculating HI requires the ability to decompose inequality indices, especially the Gini index, into a within-subgroup component and a between-subgroup component. The

former may stimulate conflict between income classes, while the latter can ignite conflicts between culturally-defined subgroups. This topic is much discussed in the literature.

This article discusses the shortcomings of the existing methods of Gini decomposition and proposes a novel method which is then applied to the case of Thailand 2009–2017. The differences in the decomposition methods are substantial, and are also large relative to non-Gini measures such as the Theil entropy index and the Shorrocks index. This suggests that conflict-related papers that include an HI measure among their set of independent variables might wish to test their models with the HI of this article, along with several other different inequality measures, to determine whether consistent results emerge.[2]

The rest of this article commences with a review of the literature on inequality, conflicts, and their economic causes. There follows a discussion on the existing decomposition methods of the Gini index and proposes a new method. Thailand is then used as an example, commencing with a background of conflict and inequality in the country. Based on the regional decomposition of the Gini index, the gross Gini across-subgroup is calculated and compared with the traditional between-subgroup inequality indices. Following the article's conclusion, the mathematics of the Gini index and its new decomposition can be found in Appendix A.

Inequality, conflicts, and economic causes

There are two types of inequality. Vertical inequality (VI) means inequality between people (individuals or households) that assumes a uniform and undifferentiated population exists (except for income differences). Horizontal inequality (HI) is inequality in the economic, social, political, and cultural status within a culturally-defined group. In other words, HI means equality between groups of people with attributes that are shared by group members such as culture, religion, and ethnicity. Regional inequality can also be considered HI if people in one region share common attributes that distinguish them from those in other regions.

A great deal of literature examines the importance of economic inequality in relation to civil conflicts which

Decomposing the Gini index using a novel *across-subgroup* component, rather than the traditional between-subgroup, can uncover a much greater horizontal inequality than would otherwise be revealed. It achieves this by being based on income gaps *across all pairs of members* of different subgroups (rather than the mean income gaps *between* different subgroups). This, therefore, highlights a need for inequality analysis to apply a range of Gini decomposition methods to ensure robustness.

can be divided into two sides. First, a small amount of literature examines how income inequality may or may not contribute to conflict. In the context of the "greed and grievance" debate on the causes of civil war, Collier and Hoeffler (2002) found that most proxies for grievance (including income and asset inequalities) were insignificant in explaining civil wars. Fearon and Laitin (2003) suggested that the prevalence of civil wars in the 1990s was mainly the result of an accumulation of protracted conflicts since the 1950s. They state factors that explain which countries are at risk of civil war are the conditions that favor insurgency, such as poverty, political instability, and a large population—rather than ethnic and religious diversity and measures of grievances such as economic inequality (country-level Gini index) or state discrimination against religious or language minorities. Cramer (2003) suggested that economic inequality is critically important in explaining civil conflicts if it is inseparable from other dimensions of inequality. His findings are in line with those of Stewart (1998 and 2000) which also pointed out that HI is the root cause of civil conflict while VI is not. Groups exploit racial and religious differences in explaining social, economic, and political inequality in order to ignite hatred, hostility, conflict and civil war (Stewart, 2000). Cederman, Gleditsch, and Buhaug (2013) found that HI based on subgroups' relative mean income is more likely to inspire conflict, especially for politically excluded groups. Moreover, groups that are poorer than average experience more wars than those closer to the country average. In a recent study, Huber and Mayoral (2013) decomposed the Gini index into three components, a *within-group* component, a *between-group* component and a residual term, and measured HI

The Economics of Peace and Security Journal
© EPS Publishing, 2020.

ISSN 1749-852X
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by the ratio between each subgroup's mean income and the country's mean income. The study found a strong positive association between within-group inequality and conflict which implies that the poor provide cheap labor and the rich provide necessary economic resources. But they did not find any significant association between HI indices and group participation in conflict. In sum, most literature employed country or subgroup level data on VI, measures of polarization, and subgroups' relative mean income, but ignored individual income gaps across subgroups in their analyses. Hence an appropriate measurement of HI is highly important for inequality-conflict analysis.[3]

A second differing viewpoint, about which there is little literature, stems from an investigation of a reciprocal relationship between inequality and conflict. Bircan, Bruck and Vothknecht (2010) employed an econometric model and the data of countries in six regions from 1960 to 2005 to study wars that were related to changes in inequality. They found that inequality increased both during war time and during the first five years of the post war reconstruction period. The increase in inequality during the first period was caused by the collapse of the market system and government action/inaction (especially in the enforcement of laws and regulations). However, inequality began to decrease after the war and went back to the pre-war inequality level within a decade.[4]

Sambanis (2005) stated that the construction of the Gini index as a VI measure is the reason why inequality was found to be insignificant in the quantitative analysis of the economic effects of war. In other words, the Gini index is not suitable for horizontal inequality analysis. Cramer (2003) added that poor quality of distribution data used in inter-country analysis was another reason why inequality was insignificant in explaining conflict.[5]

Some recent studies attempted to explain the relations between inequality and conflict via "envy or jealousy". People feel envy when they observe another person has something they want, but lack. They feel the need to have what the other person has. Even worse, they may even want another person *not* to have what he/she has in order to maintain "social superiority". Envy can be upward,

e.g., the poor are envious of the rich, or downward, e.g., the rich are downwardly envious of the poor. Envy can be positive, i.e., aspire people to improve. Negative envy may lead to conflict, with or without violence.

Examples of the literature in this category are Neumark and Postlewaite (1998), Vai-Lam Mui (1995), Zizzo and Oswald (2001), and Wodtke (2016). Neumark and Postlewaite employed the relative income concept and found that a married woman in the U.S. was 16–25% more likely to work outside the home if her sister's husband earned more than her own husband. In this case, envy was upward, did not cause any conflict, and had a positive economic effect. This behavior is similar to "the Demonstration Effect" where household decisions to consume do not depend on their own income, but on their income in relation to those of others. Their consumption decisions depend not only on their own taste, but also on the frequency of their contact with superior goods consumed by people they know.[6]

Envy may cause conflicts that are followed by retaliation, with or without violence. Vai-Lam Mui employed an economic model to analyze a problem faced by a member of a society who improved his or her socioeconomic status, but was envied by others, including neighbors, whose status and quality of life did not improve to the same extent. Retaliation came in many forms—from theft to property destruction, and to the use of violence. Even though envy cannot be eliminated, the report also identified the importance of sharing his or her fortune with other members of the society, and punishing those who envy and put pressure upon others who have succeeded in improving their socioeconomic status. Zizzo and Oswald conducted an experimental study which revealed that two-thirds of the experimental subjects exploited their wealth and position to eliminate part or whole of other people's wealth, but the intensity of the envy did not decrease much even though the cost of using violence increased. Wodtke, based on a theory of social class, reviewed mechanisms that link property ownership and authority to personal income and concluded that distributional mechanisms are shaped mainly by three interrelated factors. The first two factors are market competition and technological change that

benefit larger and better endowed firms at the expense of inferior firms. The third factor is political mobilization by which dominant groups exploited their political advantage to suppress inferior groups. In the 1970s and '80s, large proprietors and high-level managers in the U.S. organized political activities that aimed to depress worker compensation and shifted income toward higher social classes. The distribution of personal income in the U.S. became more unequal after the 1980s. The findings of the three studies revealed that inequality can create "negative envy" between individuals or groups which subsequently fuels conflict and retaliation, no matter how costly the use of retaliation is.

The awareness of socio-economic inequality in society and consequent envy can trigger conflict. Haile, Sadrieh and Verbon (2008) experimented with the effect of heterogeneity in income and race on cooperation in South Africa where there are conflicts between whites and non-whites. They found a strong and significant cross-racial and upward envy effect caused by socio-economic information on the income level and the race of their partners. When this information was not provided, no significant behavioral differences of both groups were observed. When the information was available, the low-income experimental subjects from both groups invested significantly less in partnerships with the high-income subjects of the other group than in any other partnership. In the real world, the awareness of socio-economic differences that may inspire envy and conflict is increased by heightened connectivity between people and better access to socio-economic information.

There can be envy not only between individuals, but also between groups. Tocqueville (1969) in his book "Democracy in America" pointed out that "the Southern States are permeated by envy and mistrust toward the North". Elster (1991), also quoted the leader of West Germany, Helmut Kohl, stated that "other nations fear of a united Germany may really be economic jealousy".[7]

Gini index and decomposition methods

Existing Gini decomposition methods
The Gini index, hereafter GINI, was first used by Gini

(1912) and has been used widely in the analysis of income inequality since then. Conceptually, it measures the gap between the actual distribution of income and the idealistic distribution of income by which everybody has equal income. Mathematically, it is the average relative income gap of all pairs of members.[8]

Generally, total inequality can be decomposed by subgroups into within-subgroup and between-subgroup inequality components. If subgroups are defined by attributes such as culture, religion and ethnicity, the between-subgroup component can reflect HI. The literature calculates the between-subgroup component from the relative mean income of the subgroup, which is observable by statistical and planning authorities and recognized by governing authorities. Individual income gaps are ignored.

Many past studies attempted to decompose the Gini index (G) by subgroup. Bhattacharya and Mahalanobis (1967) divided Gini (G) into two parts: Inequality between subgroups (G^B), and inequality within subgroups (G^W). Where μ is the mean income of total population, and μ_g and V_g are the mean income and population share of subgroup g, respectively. G^B is calculated from the gaps between the mean income of all pairs of subgroups weighted by their respective shares in the total population, i.e.,[9]

$$(1) \qquad G^B = \frac{1}{2\mu} \sum_{g=1}^{G} \sum_{k=1}^{G} V_g V_k |\mu_g - \mu_k|) \text{ for all } k \neq g$$

G^W is assumed to equal residual or $G - G^B$. However, as Dagum said, the decomposition has no appropriate interpretation for G^W.

Another decomposition method, hereafter referred to as Mehran's method, was suggested by Mehran (1975), Mookherjee and Shorrocks (1982), and Lambert and Aronson (1993). The method decomposed the Gini index into three components. The within-subgroup component (G^W) is calculated from the sum of inequality within each subgroup (G_g) weighted by the product of its income share (S_g) and population share[10]

$$(2) \qquad G^W = \sum_{g=1}^{G} V_g S_g G_g$$

The remaining part $(G-G^W)$ equals the between-subgroup component (G^B) plus an interaction term or R. G^B is calculated by assuming that the income of all members equals the mean income of subgroups to which they belong, which is exactly the same as that of Bhattacharya and Mahalanobis. Radaelli (2010), pointed out that it is impossible to interpret R with any precision.

With no residual, Dagum (1997) divided the Gini index into two components, i.e., the within-subgroup component (G^W) and the between-subgroup component (G^{GB}). G^W has the same definition as that of Mehran's method. G^{GB} can be rewritten as a half of the sum of between-subgroup Gini weighted by the average of the product of their population and income shares or

$$(3) \qquad \frac{1}{2} \sum_{g=1}^{G} \sum_{k=1}^{G} G_{gk} |V_g S_k + V_k S_g|$$

where $G_{gk} = \dfrac{1}{N_g N_k (\mu_g + \mu_k)} \sum_{i=1}^{N_g} \sum_{j=1}^{N_k} |Y_{gi} - Y_{kj}|$, for all $k \neq g$,

where N is the total number of population and N_g is the number of population in subgroup g. Moreover, Dagum separated G^{GB} into the extended Gini between subgroups (G^{NB}) and the income intensity of transvariation between subgroups (G^T). Both G^{NB} and G^T depend D_{gk}, the relative income affluence between subgroups g and k, that has values in the closed interval [0,1]. D_{gk} equals 0 if all subgroups have the same mean income, and equals 1 if they are different and the distribution of income within all subgroups is non-overlapping. However, the estimation of D_{gk} is quite complicated.

A new decomposition method

This article decomposes GINI into two components, i.e., an inequality *within*-subgroup, and an inequality *between* (or more precisely *among*) the members of different subgroups. Hereafter, the second component will be called the *inequality across-subgroup component*. The across-subgroup component can be used to estimate the

gross Gini across-subgroup (GAS) which is the average relative income gap of all pairs of members of different subgroups (see Appendix A for detail). Much of the literature suggests that "interpersonal inequalities" are at the core of stimulating political grievances and higher risk of conflicts. From this perspective GAS better reflects HI than the traditional inequality between subgroups.[11]

To demonstrate why the across-subgroup component is a more accurate measure than the traditional between-subgroup component, let us assume that there is a country in which there are two subgroups, the majority and the minority for whom mean income is equal. The distribution of income of the majority has zero variance while the minority has non-zero variance. In this case, the existing decomposition methods will show that the total inequality is 100% contributed by the within-subgroup component, i.e., there is no contribution from the between-subgroup component. With this article's method, the total inequality consists of both non-zero within-subgroup and across-subgroup components.

GAS, as another measure of HI, has a factual socioeconomic interpretation and policy implications that are different from those of the traditional between-subgroup inequality. First, with better transport and communication, distance and time are no longer barriers to people's connectivity. People are well-connected and aware of the socioeconomic differences between them. Inequalities between individuals create a sense of being in different socioeconomic classes, that can mobilize people to join/start a conflict. Second, between-subgroup inequality based on the mean income of subgroups is observable and reported by statistical and planning authorities—as such, it has been used as a basis when designing policies to reduce income gaps between subgroups, especially regions. But across-subgroup inequality is not observed and recognized by the governing authorities although it is more meaningful in explaining how inequality causes conflicts among the members of different subgroups.

Three points about this article's method should be noted. First, this article estimates the across-subgroup component from the income gaps of all members of

different subgroups and thus captures both the mean and variation of within-subgroup distribution of income. By contrast, Bhattacharya and Mahalanobis' method and Mehran's method estimate the between-subgroup component from the mean income of subgroups. Second, despite a different mathematical decomposition, this article
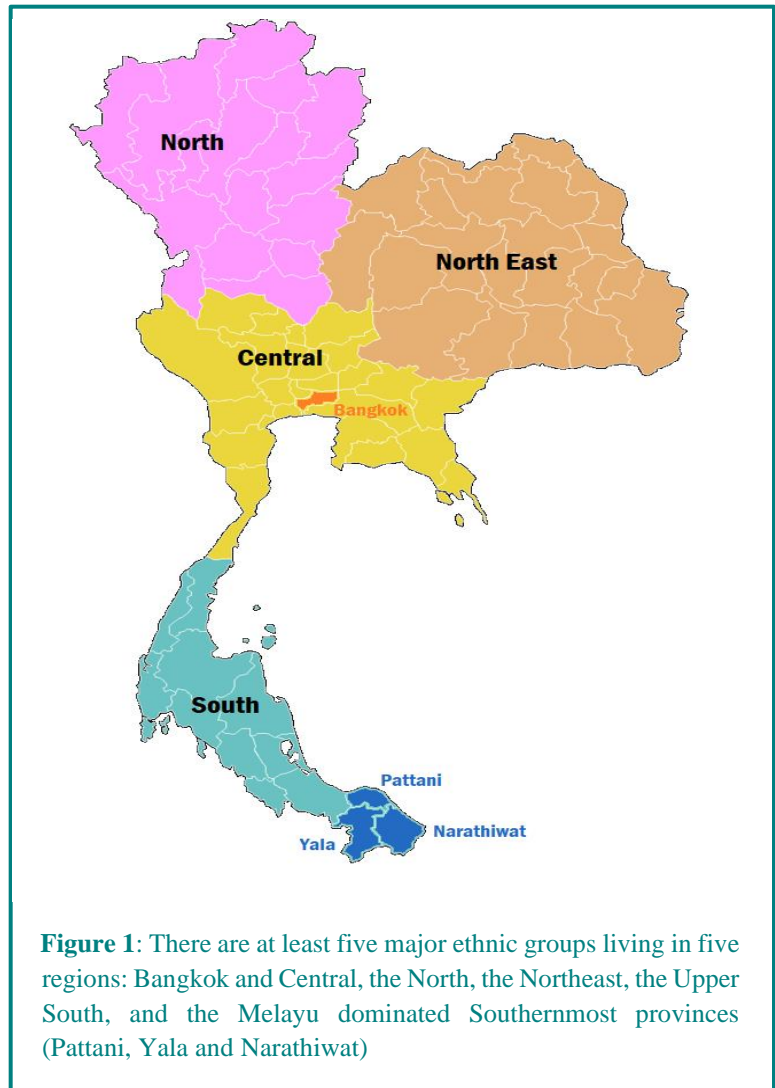
Table 1: U.S. family income by type of families in 1990

Type of family (g)	Mean income (μg)	Income share (S_g)	Population share (V_g)	Gini index G_g	G_{gk}
Total	42,652	1.000	1.000	0.395	-
1. Female householder, no husband	22,140	0.088	0.170	0.444	$G_{12} = 0.458$
2. Male householder, no wife	34,685	0.036	0.043	0.387	$G_{23} = 0.391$
3. Married-couple families	47,528	0.876	0.787	0.364	$G_{31} = 0.489$

Source: Dagum (1997).

and Dagum's methods equally divide total inequality into two proportions with no residual term. However, inequality across any pair of subgroups is defined differently. Dagum measured Gini between subgroups g and k (G_{gk}) from the income gaps of their members in relation to the simple average of the subgroups' mean income. This article measures G_{gk} from the individual income gaps in relation to the mean income of the total population. Third, Dagum called the between-subgroup component the gross contribution of Gini "between subgroups" (G^{GB}) while this article calls the contribution of Gini "across-subgroups" (G^A). Based on G^A and the cohesion coefficient, which equals 1 less the sum square of the population shares of all subgroups, this article measures the gross Gini across subgroups (GAS), an alternative measure of HI, from the relative income gaps of all pairs of individuals in different subgroups.

The comparison of different decomposition methods is highly informative (Table 1). The sample consisted of 66,322 U.S. families. Married-couple families had the highest mean income, income share, and population share but the lowest within-group income inequality. Female householder families had the smallest mean income but the highest within-group income inequality. Male householder families had

Figure 1: There are at least five major ethnic groups living in five regions: Bangkok and Central, the North, the Northeast, the Upper South, and the Melayu dominated Southernmost provinces (Pattani, Yala and Narathiwat)

Table 2: Comparison of the four decomposition methods

Decomposition methods	Total Gini	Contribution of G^W	Contribution of G^B, G^{GB} or G^A	R	G_{gk}		
					G_{12}	G_{23}	G_{31}
B&M's	0.395	0.356 (90.13%)	0.039 (9.87%)	-	-	-	-
Mehran's	0.395	0.258 (65.32%)	0.039 (9.87%)	0.098 (24.81%)	-	-	-
Dagum's	0.395	0.258 (65.32%)	0.137 (34.68%)	-	0.458	0.391	0.489
This article's	0.395	0.258 (65.32%)	0.137 (34.68%)	-	0.305	0.377	0.359

Notes: B&M's means Bhattacharya and Mahalanobis's method. Based on Equation 4, this article's G_{gk} are calculated from Dagum's G_{gk}. Cohesion coefficient equals 0.35, and GAS $= \frac{0.137}{0.35} = 0.392$.

the lowest income and population shares and a within-group inequality closer to that of married families.[12]

The total inequality of U.S. family income is divided into two components, within-subgroup and between/across-subgroup components, by the methods proposed by Bhattacharya and Mahalanobis, Mehran, Dagum, and this article (Table 2). The comparison can be summarized as follows. For the within-subgroup component (G^W), The Bhattacharya and Mahalanobis estimate of 0.356 is, by definition, greater than that of other methods (0.258). Dagum's and this article's estimates of the between/across-subgroup component (G^{GB} and $G^A = 0.137$) are greater than Bhattacharya and Mahalanobis's and Mehran's estimates ($G^B = 0.039$). This difference indicates that using the traditional between-subgroup component underestimates the crucial role of income difference between/across subgroups in any income distributional analysis. Nevertheless, Dagum and this article's methods have both similarities and dissimilarities. Both provide the same contribution of within-subgroup inequality to total inequality ($G^W = 65.32\%$), as well as that of between/across-subgroup inequality (G^{GB} and $G^A = 34.68\%$). But Gini between/across each pair of subgroups (G^{gk}) were different. However, the gross Gini across subgroups or

GAS that, estimated by this new method, equals 0.392, indicates that it is as important as VI in the analysis of 1990 U.S. family income.

Inequality decomposition and unrest in Thailand

Thailand has more than 70 ethnic groups, with at least five major ethnic groups living in five regions: Bangkok and the Central region, the North, the Northeast, the Upper South, and the Melayu dominated Southernmost provinces (Pattani, Yala and Narathiwat)—see Figure 1. While there is no institutional or legal structure that overtly creates or promotes HI, there is evidence that HI exists—as such, Thailand presents as a good example to demonstrate this article's decomposition method.

Past studies on the decomposition of inequality in Thailand

Few past studies decomposed income inequality in Thailand. Such studies were conducted by Hutaseranee and Jitsuchon (1988), and Ikemoto (1991). Hutaseranee and Jitsuchon, based on the Shorrocks index, pointed out that the contribution of inequality within subgroups to total inequality was significantly more than that of the inequality between subgroups (see Table 3). The contribution of inequality between subgroups to total

inequality depended on how subgroups were defined. The between-subgroup contribution was around 26–34% when the subgroup was defined by socioeconomic class; 23–32% by occupation of the household head; at around 15–25% by geographical factors; 20–28% by the type of community; and less than 1% when defined by the gender and age of the household head. Despite being small, the contribution of inequality between subgroups tended to increase over the study period from 1975 to 1986.

Ikemoto used Theil, Gini, and variance of logarithm to measure income inequality in Thailand in 1969, 1975, 1981 and 1986, and used Theil and variance of logarithm to decompose the inequality. The study had similar findings and are described in Table 4. Inequality between the urban and the rural areas contributed only 10–15% (based on variance of logarithm) and 16–22% (based on Theil) of total inequality—but the urban-rural income gap, which decreased in the earlier years, tended to increase after 1975.

In sum, based on regional mean income, the two studies revealed that development in Thailand has become increasingly more imbalanced over the period. However, the contribution of inequality between subgroups, including regions and areas, was very small and much less than the contribution of inequality within subgroups. Over the period, there were two major periods of violent unrest (in 1973 and 1976) centered in Bangkok and led by the anti-military-dictator movement. Another period of unrest in 1992 followed the same lines, but in the following two decades, the causes of conflict and unrest reflected elements of inequality.[13]

Table 3: Income inequality and decomposition by subgroup in 1975/76, 1980/81 and 1985/86

Index and decomposition (%)	1975/76	1980/81	1985/86
Shorrocks 2	0.30	0.35	0.43
Region (%)			
Between	16.18	19.87	24.90
Within	83.82	80.13	75.10
Location (%)			
Between	15.01	18.86	24.98
Within	84.99	81.14	75.02
Community (%)			
Between	20.20	21.77	28.15
Within	79.80	78.23	71.85
Gender of household head (%)			
Between	0.28	0.52	0.76
Within	99.72	99.48	99.25
Age of household head (%)			
Between	0.47	0.62	0.27
Within	99.53	99.38	99.73
Education of household head (%)			
Between	-	15.14	20.00
Within	-	84.86	80.00
Socioeconomic class (%)			
Between	25.57	26.97	33.82
Within	74.43	73.03	66.18
Occupation of household head (%)			
Between	22.62	24.02	31.31
Within	77.38	75.97	68.68
Sector of production (%)			
Between	21.19	23.94	28.53
Within	78.81	76.06	71.47

Source: Hutaseranee and Jitsuchon (1988).

Conflict and unrest in the 2000 and 2010 decades

Although there have been many examples of major political unrest in Thailand during the past two decades, this article will not discuss the unrest in 2005–2006 and 2008, against the governments of Prime Minister Thaksin Shinawatra and his political heirs (Samak Sundaravej and Somchai Wongsawat), as these were mainly driven by political causes. The unrest led to a *coup d'etat* by General Sonthi Booyaratklin and an interim government under General Surayud Chulanont, not to mention the unrest in the southernmost provinces that was inspired by many factors and has continued with violence since early 2004.

Two more examples of major political unrest that took place between 2009 and 2017 were driven by the desire of authority groups to gain "political and social superiority". These were the unrest in 2009 during the term of Prime Minister Abhisit Vejjajiva and the other was 2013–2014 during the term of Prime Minister Yingluk Shinawatra. While both periods of unrest were, at the onset, ignited by political causes, the second unrest was triggered by opposing views on an amnesty law that aimed to benefit Thaksin Shinawatra. Ordinary people from different regions joined the unrest according to their own agendas, including anti-corruption, justice, better and more transparent policies, fairer access to natural resources, better opportunities and rights for ethnic minorities etc.

The two periods of unrest also had a regional dimension. The first period of unrest against the newly set-up government was dominated by rural people from the North and the Northeast, the two poorest regions. The second period of unrest against the government was inspired and mobilized by the upper and middle-income classes, especially from Bangkok, Central Thailand, and the South. At the same time, there was a pro-government movement in many areas of the North and the Northeast. Following the second period of unrest was another *coup d'etat* in May 2014 by General Prayut Chan-o-cha, who has been in power since then. There were many policy changes over this turbulent period—examples of those that targeted different groups of people are paddy price

Table 4: Income inequality and decomposition by urban/rural subgroups in 1969, 1975, 1981 and 1986

Inequality and Decomposition	*1969*	*1975*	*1981*	*1986*
Gini Index	0.43	0.43	0.45	0.49
Theil	0.37	0.32	0.35	0.42
Within areas (%)	78.1	83.9	84.7	83.4
Between areas (%)	21.9	16.1	15.3	16.6
Variance of logarithm	0.66	0.69	0.75	0.88
Within areas (%)	87.2	89.7	89.9	83.7
Between areas (%)	12.8	10.3	10.1	16.3

Source: Ikemoto (1991).

policies, rubber price policies, and populist policies such as a tax cut for diesel that benefitted farmers and lower income classes. Most paddy farmers are in the Central region, the North, and the Northeast. The majority of rubber farmers are in the South. Populist policies are viewed as political vote buying that target low income classes. They were financed largely by taxes on the upper and middle-income classes, of which the majority are in Bangkok Metropolis and other urban areas. These regionally biased economic policies may have inspired envy that led to conflict and unrest.

Gini decomposition analysis of income inequality in Thailand

The key point of this section is to show how inequality decomposition was (mis)measured in the past studies, but not to address or to measure the causes and effects of the past unrests. The decomposition of inequality is important in the design of policy measures, their expected effects, and the evaluation of welfare effects across regions.

Total inequality and regional inequality between 2009 and 2017

This subsection presents the background of total inequality and within-region inequality in 2009, 2011,

2013, 2015 and 2017 (Table 5). These are VI which indicate how equal or unequal the distribution of income was between people in Thailand, and between people in each region.

Based on the Gini index, income inequality in Thailand moved in different directions between 2009–2015, and between 2015–2017. It continuously decreased from 0.49 in 2009 to 0.48, 0.46 and 0.44 in 2011, 2013 and 2015, respectively, and went up slightly to around 0.45 in 2017. At the regional level, changes in inequality within all regions tended to be minor and insignificant. Except for Bangkok, where inequality increased between 2009 and 2011, and the South where inequality changed slightly between 2013 and 2015 and between 2015 and 2017, changes in the distribution of income within other regions tended to follow the national trend.

Table 5: Total Gini and within-region Gini in 2009, 2011, 2013, 2015 and 2017

Region	Gini				
	2009	*2011*	*2013*	*2015*	*2017*
Total	0.49	0.48	0.46	0.44	0.45
Bangkok metropolis	0.47	0.51	0.45	0.40	0.40
Central	0.41	0.40	0.40	0.40	0.40
North	0.45	0.44	0.43	0.39	0.42
Northeast	0.49	0.46	0.44	0.43	0.45
South	0.48	0.46	0.44	0.45	0.44

Source: Poverty and Income Inequality Analysis in Thailand (NESDC, 2017).

Inequality across regions

The Gini index was decomposed to investigate the contribution of within-region inequality and the contribution of across-region inequality to total inequality in Thailand. The decomposition yielded two important findings (Table 6). Firstly, both the contribution of within-region inequality and the contribution of across-region inequality followed the trend of total inequality, which continuously decreased between 2009, and 2015. However, they remained fairly constant between 2015 and 2017. Secondly, the contribution of across-region inequality to total inequality (78-79% of the total inequality) was much more important than that of within-region inequality (21–22%) in every period. This is in total contrast with the results of past studies which found that the contribution of within-region inequality was around 80% while that of between-region inequality was 20%. Thus, the results of past studies may have sent out misleading signals to policy makers, and need to be retested.

Table 6: Gini decomposition within and across regions in 2009, 2011, 2013, 2015 and 2017

Inequality	Decomposition (% Share)				
	2009	*2011*	*2013*	*2015*	*2017*
Total Gini	0.49	0.48	0.46	0.44	0.45
Contribution of within-region inequality (G^W)	0.11 (22.06)	0.11 (22.44)	0.10 (22.21)	0.09 (21.18)	0.10 (21.76)
Contribution of across-region inequality (G^A)	0.38 (77.94)	0.37 (77.56)	0.36 (77.79)	0.35 (78.82)	0.35 (78.24)

Gross Gini across-subgroups (GAS) and between-region inequality

This subsection compares GAS (based on individual income gaps) with three between-region inequality indices that are based on regional mean income gaps: Theil, Shorrocks, and HI or G^B. The magnitude of GAS distribution of income within each region. Therefore, it is either greater than or equal to the between-region inequality indices. The larger the difference between GAS and between-region inequality indices reflects the greater role of individual income gaps in any inequality-conflict analysis.[14]depends on both the mean income and

the variance of the

The comparison shows that GAS was much greater than the total Gini index and the three between-region inequality indices throughout the 2009–2017 period. Three important findings are noted. First, HI as measured by GAS was more important than VI, at least in the analysis of income distribution in Thailand in this period. If inequality had caused conflicts between people living in different regions of the country, HI or GAS was more likely than VI to be the cause. This is in line with Stewart (1998 and 2000), which suggested that VI was not the root cause of civil conflict, but HI could be. Thus, conflict-related papers that want to include an HI measure among their set of independent variables may consider GAS as an alternative. Second, income differences between regions of Thailand were much more severe at the individual level than at the average regional level—GAS could, therefore, be a useful target for development policies.[15]

The third finding is that the between-region inequality and the gross Gini across-region differ not only by magnitude, but also by the direction of changes (Figure 2). While the between-region inequality index increased and was very high in 2015 and 2017, GAS still followed the decreasing trend of total inequality.

In sum, the regional mean income gaps show that development in Thailand has increasingly become more imbalanced over the period, but individual income gaps have not. Moreover, GAS and other HI measures tended to be slightly negatively correlated, i.e., a smaller regional mean income gap may increase individual income gaps across regions.

A puzzle between 2015 and 2017

However, there is a puzzle. After the coup d'etat that
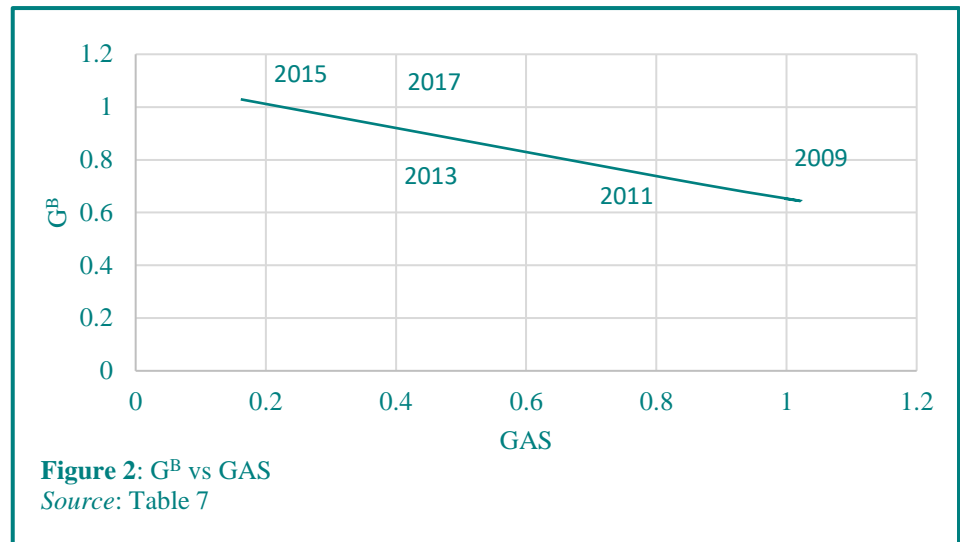
Figure 2: G^B vs GAS
Source: Table 7

Table 7: Income inequality between/across regions in 2009, 2011, 2013, 2015, and 2017

Inequality Index	2009	2011	2013	2015	2017
Total Gini	0.49	0.48	0.46	0.44	0.45
GAS	0.50	0.49	0.47	0.46	0.47
Theil	0.03	0.02	0.02	0.06	0.06
Shorrocks 2	0.09	0.08	0.07	0.18	0.16
HI and G^B	0.19	0.18	0.17	0.26	0.26

Note: By rounding off to two decimal points, the cohesion coefficient equals 0.76 for all five years, and GAS = G^A/0.76.

subsequently followed the second period of unrest, GAS increased slightly between 2015 and 2017 and the relative mean income of Bangkok Metropolis and the central region rose sharply at the expense of the other three regions (Table 8).

But the Gini index for Bangkok and the Central region remained constant (Table 5). Based on the well-known intersecting Lorenz curve debate, it cannot be concluded that the income increase benefitted any specific income class in the two areas. Nevertheless, an area-specific GAS can be calculated and identify whether inequality

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across income classes increased or decreased if data on the Gini index of each income class of Bangkok and the Central region are available.

Conclusion

Little research has examined how income inequality may or may not contribute to the "grievance" aspect of conflict. For the most part, the measure used is the traditional Gini index, which is constructed to measure *vertical* inequality(VI) rather than *horizontal* inequality (HI). Calculating HI requires the ability to decompose the Gini index into a within-subgroup component and a between-subgroup component.

This article attempts to decompose the Gini index into these two components. The second component differs from the traditional between-subgroup component because it is based on income gaps *across all pairs of members* of different subgroups (rather than the mean income gaps *between* different subgroups). The gross Gini across subgroups (GAS), another measure of HI, can be estimated from the second component.

With better transport and communication, people are well-connected and aware of the socioeconomic differences between them. Inequalities between individuals create a sense of being in different socioeconomic classes. Such a situation can induce envy, and as a result, conflicts between individuals and subgroups may follow. Thailand's income data demonstrates this important issue.

Decomposing the Gini index reveals the extent to which within-region and across-region inequality contributes to total inequality. In Thailand's case, this yielded two important findings. First, both the contributions of within-region and across-region inequalities followed the trend of total inequality, which continuously decreased between 2009 and 2015, but remained fairly constant between 2015 and 2017. Second, the contribution of across-region Gini, which was 78–79% of the total inequality in every period, and that of the within-region Gini, which was 21–22%, was in contrast with the results of past studies. Thus, the past studies may have sent misleading signals to policymakers, and the policies that aimed to reduce the regional income gaps may have to be retested.

Table 8: Relative mean income, whole kingdom and by region in 2009, 2011, 2013, 2015 and 2017

Area	Relative mean income				
	2009	2011	2013	2015	2017
Whole Kingdom	1	1	1	1	1
Bangkok metropolis	2.33	2.34	2.16	2.67	2.53
Central	1.04	0.93	1.05	1.24	1.29
North	0.80	0.80	0.82	0.68	0.70
Northeast	0.70	0.75	0.73	0.61	0.59
South	1.05	1.14	1.06	0.88	0.90

Note: Calculated from per capita household income.
Source: Household Socioeconomic Surveys (National Statistical Office, 2017)

Looking at HI, the comparison shows that, throughout the period 2009–2017, GAS was much greater than the total Gini index and the three between-region inequality indices of Theil, Shorrocks, and HI or G^B. This yields three important findings; first, HI as measured by GAS is more important than VI (at least for Thailand). If inequality had caused conflicts between people living in different regions of the country, HI or GAS may be more likely to be the cause than VI. Second, income differences between the regions of Thailand were much more severe at the individual level than at the average regional level. Thus, GAS should be considered as another independent variable in any conflict-related study. Third, GAS and the between-region inequality differ not only by magnitude, but also by the direction of change. While the between-region inequality indices showed an increase in this period (it was very high in 2015 and 2017), GAS followed the decreasing trend of total inequality. Thus, regional mean income gaps indicate that development in Thailand has increasingly become more imbalanced over the period, but individual income gaps have not.

The findings from the data of Thailand suggest that conflict-related papers that include an inequality

measure among their independent variables might wish to test their models with several different inequality measures, especially GAS, to determine whether the results are consistent. This may usefully be extended to the decomposition analysis by subgroups that are defined by other criteria such as religion, language, and ethnicity.

Notes

I wish to thank Professors Jurgen Brauer, J. Paul Dunn, and C. Mike Brown, and the two anonymous referees for their valuable comments on the draft of this article, and Steve Cannell and Reena Saeng-Eam for their assistance.

1. Greed and grievance: Collier and Hoeffler (2002). Downward-envy: This article defines "downward-envy" as the emotion or feeling felt by the privileged which drives them to suppress the ability of the underprivileged to join their ranks.
2. Indices: Theil (1967) cited in Sen (1973); Shorrocks (1984).
3. Stewart(1988): Cited in Cramer (2003).
4. Regions: Africa, Asia, Latin America, Former East Bloc, Western Europe, and the Pacific.
5. Sambanis: Cited in Bircan, Bruck, and Vothknecht (2010).
6. Neumark and Postlewaite: cited in Alvarez–Cuadrado and Long (2012). Demonstration Effect: Duesenberry (1959).
7. Tocqueville : quoted in Elster (1991). Kohl: In an interview in the International Herald Tribune on 5 February 1990.
8. Gini: Cited in Sen (1973).
9. Bhattacharya and Mahalanobis : Cited in Dagum (1997).
10. Mehran : Cited in Radaelli (2010). Methods: Mehran (1975), Mookherjee and Shorrocks (1982), and Lambert and Aronson (1993) are grouped in the narrative as "Mehran's method" but are counted as three of the five existing methods of Gini decomposition.
11. Interpersonal inequalities: Cederman, Gleditsch, and Buhaug (2013).
12. Table 1: For the sake of simplicity, Table 1 borrows data from Dagum (1997).
13. The oil price shock in 1973 could have a role, but was not a major factor.
14. HI: Mancini, Stewart, and Brown (2008). G^B: Mehran's method.
15. Stewart(1998): Cited in Cramer (2003).

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Appendix A: Mathematics of a new Gini decomposition by subgroup

The Gini index, hereafter GINI, is based on the gap between the Lorenz Curve, that explains the actual distribution of income, and the Egalitarian Line, that shows a situation in which income is equally distributed. By definition, when a graph is drawn in the 0–1 scale, the index equals 2 times the area between the Lorenz Curve and the Egalitarian Line (A).

(A1) $\text{GINI} = 2A$

There are many other ways by which GINI can be calculated. When $\mathbf{Y} = (Y_1, Y_2, Y_3,......,Y_N)$ is a set of ordered income distribution of N members of which mean income is μ, and the sorting of income is in ascending order ($Y_1 \le Y_2 \le Y_3 \le .... \le Y_N$). By Equation (A2), the value of GINI equals the average income gap of all pairs of income in relation to mean income i.e., relative mean difference or relative mean income gap (Sen, 1973). This equation is the most suitable for a decomposition of GINI by subgroup. It is independent of the order of each member in the distribution of income, but depends on the income gaps of all pairs of members.

(A2) $\text{GINI} = \dfrac{1}{2\mu N^2} \displaystyle\sum_{i=1}^{N} \sum_{j=1}^{N} |Y_i - Y_j|$

GINI possesses some strengths and weaknesses that are well-discussed in the literature. Most importantly, it is said to have no additive decomposability property and is inferior to other indices that can be decomposed by subgroup and by income sources. It is said to be subgroup decomposable only under a condition called non-overlapping partition, i.e., the income of all members of any subgroup is either higher or lower than that of the members of other subgroups. In addition, it cannot be decomposed by sources of income unless the order of income from each source is the same as the order of the total income. However, in the literature there are several approaches that decompose the index. Their pros and cons are discussed in the article.

Generally, subgroup-decomposition has two components, i.e., within-subgroup inequality and between-subgroup inequality that depends on the mean income of subgroups. This paper proposes a decomposition that contains an across-subgroup inequality component. It does not depend on the mean income of subgroups, but on individual income gaps. It is by the application of this concept that the measure of inequality reflects the degree of envy between individuals.

The overall distribution of income, $\mathbf{Y} = (Y_1, Y_2, Y_3,......,Y_N)$, can be divided into G subsets or subgroups that are mutually exclusive. Any subset g has N_g members, where $N = \displaystyle\sum_{g=1}^{G} N_g$. The distribution of income within any subset g can be written as $\mathbf{Y_g} = (Y_{g1}, Y_{g2}, Y_{g3},......,Y_{gN_g})$, where mean income equals μ_g and inequality equals G_g. Every $\mathbf{Y_g}$ does not have to be in ascending or descending order, or a non-overlapping partition. The income gap between any two members of a pair of subgroups $= |Y_{gi} - Y_{kj}|$, where Y_{gi} is the ith member of subgroup g and Y_{kj} the jth member of subgroup k.

Based on this arrangement, GINI can be easily decomposed into two terms. The first term is the contribution of within-subgroup inequality weighted by the income share and population share of each subgroup. The second term is the total relative income gaps across subgroups g and k, $\forall g \neq k$ (Equation A3).

(A3) $\text{GINI} = \dfrac{1}{2\mu N^2} \displaystyle\sum_{i=1}^{N} \sum_{j=1}^{N} |Y_i - Y_j|$

$$= \frac{1}{2\mu N^2} \sum_{g=1}^{G} \left\{ \sum_{i=1}^{Ng} \sum_{g=1}^{G} \sum_{j=1}^{Ng} |Y_{gi}-Y_{gj}| + \sum_{i=1}^{Ng} \sum_{k=1}^{G} \sum_{j=1}^{Nk} |Y_{gi}-Y_{kj}| \right\}$$

$$= \sum_{g=1}^{G} V_g S_g G_g + \frac{1}{2\mu N^2} \sum_{g=1}^{G} \sum_{i=1}^{Ng} \sum_{k=1}^{G} \sum_{j=1}^{Nk} |Y_{gi}-Y_{kj}|$$

Where Y_{gi} = income of ith member of subgroup g,

Y_{kj} = income of jth member of subgroup k ≠ g,

$V_g = \frac{N_g}{N}$ or population share of subgroup g, and

$S_g = \frac{\mu_g N_g}{\mu N}$ or income share of subgroup g.

The first term is the within-subgroup component (G^W in the literature). The second term, or G^A, can be rewritten as the population share weighted sum of Gini across subgroups g and k or G_{gk}, which equals $\frac{1}{2\mu N_g N_k} \sum_{i=1}^{Ng} \sum_{j=1}^{Nk} |Y_{gi}-Y_{kj}|$,

∀ g ≠ k. G^A is equivalent to but not the same as G^{GB} in Dagum (1997), and is either larger than or equal to the between-subgroup inequality or G^B that is calculated from the mean income of subgroups. It equals the between-subgroup inequality only when the distributions of income within all subgroups are perfectly equal, i.e., $Y_{gi} = \mu_g$, ∀i ∈ g.

(A4) $\text{GINI} = \sum_{g=1}^{G} V_g S_g G_g + \sum_{g=1}^{G} \sum_{k=1}^{G} V_g V_k G_{gk}$

If the gross Gini across subgroups (GAS) is defined as the average relative income gap across subgroups or

$\dfrac{1}{2\mu(N^2 - \sum\limits_{g=1}^{G} N_g^2)} \sum\limits_{g=1}^{G} \sum\limits_{i=1}^{Ng} \sum\limits_{k=1}^{G} \sum\limits_{j=1}^{Nk} |Y_{gi}-Y_{kj}|$, then

(A5) $\text{GINI} = \sum_{g=1}^{G} S_g V_g G_g + (1 - \sum_{g=1}^{G} V_g^2)\, \text{GAS}$

The term $(1 - \sum_{g=1}^{G} V_g^2)$, henceforth cohesion coefficient, captures the extent to which GAS contributes to total inequality. Its value is in the interval [0,1] and equals 0 when there is only one subgroup. A larger number of subgroups or G, decreases $\sum_{g=1}^{G} V_g^2$ and consequently increases the contribution of inequality across subgroups to total inequality. Also, a more equal population share increases the contribution of inequality across subgroups. Equations A4 and A5 are not limited to conditions such as the mean income of all subgroups being the same or the distributions of income within all subgroups being non-overlapping. By Equation A6, GAS can be easily calculated.

$$\text{GAS} = [\text{GINI} - \sum_{g=1}^{G} S_g V_g G_g]/(1- \sum_{g=1}^{G} V_g^2)$$

(A6)

$$= G^A/(1- \sum_{g=1}^{G} V_g^2)$$

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