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A dissimilarity-adjusted index of ethnic diversity: Measurement and implications for findings on conflict, growth and trade

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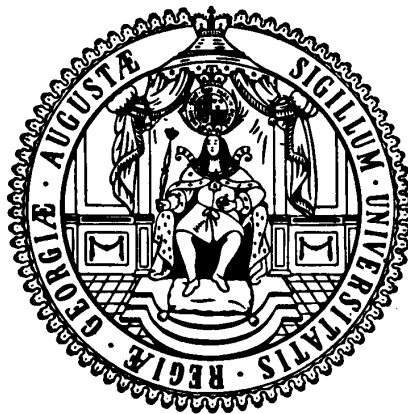
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Discussion Papers

No. 195

**A dissimilarity-adjusted index of ethnic diversity:
Measurement and implications for findings on
conflict, growth and trade**

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A dissimilarity-adjusted index of ethnic diversity:
Measurement and implications for findings on conflict,
growth and trade

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Abstract

Existing indices of ethnic diversity are generally based on pre-defined groups, disregarding the (dis)similarities between them. This paper proposes an index that includes the dissimilarity in language, ethno-racial characteristics and religion between groups. The resulting distance-adjusted ethno-linguistic fractionalization index (*DELFI*) is based on highly disaggregated data on the language, ethnic and religious composition of groups and allows an assessment of differentiation between groups within and across countries.

The *DELFI* is subsequently applied by replicating some key studies on the effects of ethnic heterogeneity on economic outcomes. The results confirm the generally found growth-reducing effect of ethnic heterogeneity but also shows that this does not hold true for ethnic diversity in more developed countries. As regards the cultural distance between countries and its impact on trade, the *DELFI* is, indeed, a very valuable measure of cultural affinity between countries, also showing this affinity affects trade flows in a positive way, especially of heterogeneous goods.

Key words: Composite Index, Conflict, Distance, Ethno-Linguistic Fractionalization (ELF), Growth, Trade

JEL classification: C43, D63, D74, F15, O10, Z10

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1 Introduction

There has been a rapid increase in the literature on ethnicity and its role in the economic development of a country or the incidence of conflicts.¹ In order to advance research in this area, current approaches try to improve data sources, increase its coverage, and construct indices to measure its complexity more effectively. As ethnicity is not a clear cut concept, improving indices implies developing ones that reflect the different aspects of ethnicity more adequately. Research to date includes the ethno-linguistic fractionalization index (ELF) by Taylor and Hudson (1972), as well as indices on polarization (Garcia-Montalvo and Reynal-Querol, 2002), politically relevant groups (Posner, 2004) and the role of regional segregation of ethnicity (Alesina and Zhuravskaya, 2011).

All these indices, however, are based on pre-defined groups. This gives rise to an important problem. All calculations rely on a rather arbitrary definition of groups that do not necessarily share a comparable line of differentiation. This calls for a common differentiator, be it on the grounds of ethnicity, language, religion, or any other characteristic. Hence, an assessment of distances between groups “is such an absolutely fundamental concept in the measurement of dissimilarity that it must play an essential role in any meaningful theory of diversity or classification” (Weitzman, 1992, p. 365).² Nearly all authors treat these attributes equally, irrespective of the differences between the groups, i.e. how big the distance is. It is obvious, though, that two groups whose respective members speak two completely different languages, follow different religions and have different physiognomic attributes, are more distant than two groups that share similarities in language, religion and appearance. For many economic problems, it is not the mere number of groups that is of interest, but rather how difficult the coordination or instrumentalization between the various groups is. Thus, these differences are crucial.

The main aim of this article is to address this gap and to offer an index that takes these aspects into account. A global data set offers the possibility to construct an index that covers the degree of diversity between groups within countries as well as the cultural or ethnic (dis)similarity between countries. Assessing this new index forms a base to further expand current research, taking into account a new aspect of ethnicity - its diversity. It represents the broadest data base of its kind allowing an assessment of differentiation between groups within and across 210 countries.

The new index is then tested by replicating some prominent studies on conflict, growth and trade. The mere quantity of groups might demonstrate more divisions through which conflicts may ignite, arguing for the ELF index. Caselli and Coleman (2008) point out the

¹Ethnic fractionalization is supposed to increase corruption (Mauro, 1995) and lower economic growth (Alesina et al., 2003; Easterly and Levine, 1997), public goods provision (Alesina et al., 1999), communal participation (Alesina and La Ferrara, 2000), general quality of government (Alesina and Zhuravskaya, 2011; La Porta et al., 1999) and democracy (Akdede, 2010). Collier (1998) initiated a new and now broad strand of literature exploring ethnicity’s impact on conflicts. A good description of concepts and measures of ethnicity is found in Brown and Langer (2010).

²For a good discussion of the prerequisites to measure diversity, see Bossert et al. (2003) and Nehring and Puppe (2002). Both rely on the earlier concept developed by Weitzman (1992).

significance of obvious barriers between groups as regards the decision to enter conflicts. This, in turn, would argue for the distance-adjusted ethno-linguistic fractionalization index (*DELFL*) and the importance it gives to the the distances between groups.³ Indeed the *DELFL* shows a strong positive impact on conflict onset.

High ethnic fragmentation is associated with lower growth rates, mainly because of its effect on other socioeconomic variables (Alesina et al., 2003; Alesina and La Ferrara, 2005; Easterly and Levine, 1997). A government's struggle to achieve a consensus and the distribution of available funds could, of course, depend on the mere quantity of groups, but also equally on the difficulty to converge different views. In contrast, the different backgrounds and experiences of a country's working population may be an asset to sustain more complementary production procedures and drive innovation. For this, not only the mere quantity of groups, but also their differences seem to be relevant. This potential might, however, only unfold in more developed countries. For higher levels of development the *DELFL* reveals the positive impact of ethnic diversity in terms of innovation and an increase in productivity.

The *DELFL* has another major advantage in that it can be used to assess cultural differences between countries. To date, cultural differences between countries have been assessed with data based on limited differences (e.g., genetic distance) or a broad set of - often regional - proxy variables (e.g., mutual voting behavior at regional song contests). The global *DELFL* goes beyond these limitations, showing that ethnic distance between countries lowers their bilateral trade volumes.

The remainder of this article is structured as follows. Section 2 briefly summarizes the current discussion surrounding the conceptual and measurement problems of ethnicity. In section 3 the data sources used are introduced and the background of the similarity calculations is outlined. Section 4 discusses the operationalization of the distance values and the composite index. Section 5 outlines the resulting distance-adjusted ethno-linguistic fractionalization index (*DELFL*), and compares it with existing measures. The applicability of this index is verified in section 6 in terms of its role on conflict, growth and trade. Finally, section 7 summarizes the key findings, concludes and gives an outlook for further research.

2 Different aspects of ethnicity and its measurement

In order to improve the operationalization of ethnicity, this article follows Barrett et al. (2001), whose data is used later on in this article. Following these authors, ethnicity is defined along language, ethno-racial (ethnic origin, skin pigmentation and race) and religious aspects. Defining the characteristics of ethnicity in detail, which is already more attentive than most papers in this field, is, however, not sufficient for what this article strives for.

³A full data set of country specific *DELFL* values, as well as mutual country distance indices can be found under www.delf-index.de

Within each of the defining criteria, a (dis)similarity level between two distinct groups must also be assignable. Information on the degree of (dis)similarity is the crucial starting point in any assessment of diversity (Bossert et al., 2003). Not only have many authors been reluctant to define the characteristics of ethnicity, a more thorough examination of similarity differences has not been discussed at all yet. Distances between groups neither influenced the decision of how to draw the line between groups, nor the interpretation of the fractionalization found.⁴

Based on the defined number of ethnic groups, the question of its mathematical operationalization arises. The most common measure for ethnicity is its fractionalization, known as the ethno-linguistic fractionalization index (ELF). It is calculated as an Herfindahl-Hirschman concentration index:

$$ELF = 1 - \sum_{i=1}^K p_i^2, \quad i = 1, \dots, K \quad (1)$$

where K is the number of groups i and p_i their relative sizes. Its value moves between zero and one and represents the probability that two randomly selected individuals from a population come from different groups. A higher value thus indicates a more fragmented country, i.e. a country with a higher number of distinct ethnic groups. After the introduction of the ELF by Taylor and Hudson (1972), based on the data of the Atlas Narodov Mira (Bruk, 1964), several additional indices were developed. The second most prominent one is the measure of polarization introduced by Garcia-Montalvo and Reynal-Querol (2002).⁵ It shows a completely different aspect of a country's ethnic set-up, and underlines that for each economic problem under analysis, the appropriate index needs to be applied. Assessing the variation away from an even 50/50 split of two groups, Garcia-Montalvo and Reynal-Querol (2002) find that this index is a much better predictor of conflicts than the ELF measure. It is better at measuring the ethnic constellations responsible for an uprising. The polarization index (POL) is defined as:

$$POL = 1 - \sum_{i=1}^K \left(\frac{0.5 - p_i}{0.5} \right)^2 \cdot p_i, \quad i = 1, \dots, K \quad (2)$$

p_i are again the relative group sizes of groups i . The POL index also tends towards zero for very homogeneous countries, i.e. with only one group. However, with increasing group numbers, ELF and POL show clearly different courses. While ELF is an increasing function of the number of groups, POL reaches its maximum at two equally sized groups and decreases thereafter.

⁴Taking language groups as an example, groups could be divided based on mere dialects, different languages or even different language families. Depending on the level of similarity between groups, different group set-ups would then emerge. For a discussion on how different aggregation levels affect the outcomes in the analysis of ethnic conflicts, see Desmet et al. (2012).

⁵Their approach goes back to earlier work by Esteban and Ray (1994).

Bossert et al. (2011) introduce a more flexible version of the ELF, the generalized ethnolinguistic fractionalization index (GELF). This index brings two important improvements. Firstly, it does not rely on pre-defined groups but takes the individual and its specific characteristics as a starting point. Based on these specific characteristics, a mutual similarity matrix between individuals takes the distance between them into account. Hereby, the groups emerge ‘endogenously’ from the matrix. The similarity value between two individuals i and j for all $i, j \in \{1, \dots, N\}$ is given through s_{ij} , with:

$$1 \geq s_{ij} \geq 0 \quad (3)$$

$$s_{ii} = 1 \quad (4)$$

$$s_{ij} = s_{ji} \quad (5)$$

A similarity value of one indicates perfect similarity, whereas a value of zero would indicate two individuals that do not share any characteristics. For a society with N individuals, all $\{s_{ij}\}$ are contained in a $N \times N$ matrix, labeled similarity matrix S_N , which is the main building block of the GELF. As data on individuals is rarely available, the transfer to group-specific data on the smallest aggregation level is used. This is especially true in developing countries. In a society with N individuals, K groups exist with respective populations of m_k individuals for all $k \in \{1, \dots, K\}$. It holds that $\sum_{k=1}^K m_k = N$ and $p_k = m_k/N$ is the respective relative group size. The individuals in each group are all perfectly similar, i.e. their mutual individual similarity values would be one. By grouping all individuals that share similarity values of one together, groups emerge ‘endogenously’. The similarity between two groups, k and l , is denoted as \hat{s}_{kl} and is equivalent to the individual similarity value s_{ij} for any $i \in m_k$ and $j \in m_l$. It follows that:

$$\begin{aligned} G(S_n) &= 1 - \frac{1}{N^2} \sum_{k=1}^K \sum_{l=1}^K m_k m_l \hat{s}_{kl} \\ &= 1 - \sum_{k=1}^K \sum_{l=1}^K \frac{m_k}{N} \frac{m_l}{N} \hat{s}_{kl} \\ &= 1 - \sum_{k=1}^K \sum_{l=1}^K p_k p_l \hat{s}_{kl} = DELF \end{aligned} \quad (6)$$

The relation between the *DELFL* and the ELF index is quite obvious. The ELF is based on groups that either have a similarity value of one, given both belong to an identical group, or zero. Thus, the products are always zero if two different groups are matched. A value of one is only assigned if the groups are matched with themselves, leading to a value of $(p_k \cdot p_k \cdot 1) = p_k^2$ and $(p_k \cdot p_l \cdot 0) = 0$, respectively. The sum over all K groups then directly leads to *Equation (1)* that specifies the ELF.⁶ Esteban and Ray (2011) and Esteban and

⁶The *DELFL* delivers the same result as a monolingual weighted index proposed by Greenberg (1956), and used by Fearon (2003) in his calculation of ‘cultural fractionalization’.

Mayoral (2011) use it as the ‘Greenberg-Gini’ index and show the different theoretical attributes of the different indices. The important improvement in this approach is that it does not rely on pre-defined groups, thus avoiding to treat groups as equal that actually have very large distances between them.

Finally, de Groot (2009) assessed the ethnic affinity between African nations. The ethnic linguistic affinity (ELA) of de Groot (2009) measures, in contrast to the ELF, the amount of characteristics shared between two countries and thus follows an inverse logic. Equally, this article draws on the articles of Fearon (2003) and an earlier version of Bossert et al. (2011). While Bossert et al. (2011) add the theoretical details and show the application of group distances across states in the US⁷, Fearon (2003) was the first to assess the cultural distance between groups by using language differences. de Groot (2009) extends those concepts on a broader taxonomy of ethnicity, however, only offers data on ethnic affinity between countries and limits his assessment to Africa. This article now consequently extends the work of all three studies by assessing the differences between groups in a more consistent and broader way by combining language, ethno-racial characteristics and religion for over 12,000 groups. Finally this article extends previous literature by enlarging the data set to become the most extensive of its kind covering 210 countries.

3 Data sources and assessment of group distances

3.1 Data sources

Various sources are used for religious, ethnic and language data.⁸ All these sources have their advantages and are certainly applicable for the intention of the respective authors. They lack one important aspect, though, which is very relevant for the analysis here. To build the similarity matrix based on all three traits (language, ethno-racial group, religion), each group needs to be defined in accordance with all three of them. This is not possible with the above-mentioned sources as the groups found in them vary depending on the defining criteria.

The source offering the required data is the *World Christian Encyclopaedia* (Barrett et al., 2001).⁹ It contains data for over 12,000 groups in 210 countries, classified according to language, ethno-racial group and religion. The data on languages and ethno-racial

⁷Alesina et al. (2012) extends the approach of using income differences to assess group distances on a global scale.

⁸Besides the wide range of ethno-linguistic groups in the *Atlas Narodov Mira* (Bruk, 1964), Alesina et al. (2003) mainly use data from the *Encyclopædia Britannica* (Encyclopædia Britannica, 2007) and from the *CIA World Fact Book* (CIA, 2011) for their study on ethnicity. For languages, the *Ethnologue* project (Lewis, 2009) offers very detailed data of nearly 7,000 languages. Finally, *L’Etat des Religions dans le Monde* (Clévenot, 1987) offers very exhaustive data on religious affiliation. Akdede (2010) gives a good overview of the data sources used in a broad set of influential articles and discusses their differences.

⁹For all calculations, the online version, *The World Christian Database* (Johnson, 2010), is used. It reflects the data in the printed version of Barrett et al. (2001) but includes significant updates and refers to the 2005 – 2010 time period.

Table 1: Descriptive statistics of ethnic groups by geographical area

	World	Western Coun- tries^a	MENA	Latin America^b	Asia^c	Eastern Europe	SSA
Number of countries ^d	210	33	21	38	40	29	49
<i>Fraction of total</i>		<i>16%</i>	<i>10%</i>	<i>18%</i>	<i>19%</i>	<i>14%</i>	<i>23%</i>
Number of groups	12,432	1,716	625	1,405	4,143	1,019	3,524
<i>Fraction of total</i>		<i>14%</i>	<i>5%</i>	<i>11%</i>	<i>33%</i>	<i>8%</i>	<i>28%</i>
Average groups per country	59	52	30	37	104	35	72
Max. number of groups	884	300	71	255	884	156	513
Min. number of groups	3	3	14	6	3	8	6
Average pop. share of largest group	57%	68%	60%	64%	52%	75%	39%
Number of countries with a group $\geq 50\%$	123	25	14	27	19	26	12
<i>Fraction of all countries</i>	59%	<i>76%</i>	<i>67%</i>	<i>71%</i>	<i>48%</i>	<i>90%</i>	<i>24%</i>

^aWestern Europe and Australia, Canada, Greenland, Japan, New Zealand and United States.

^bIncludes the Caribbean.

^cIncludes the Pacific islands.

^dIn total data for 239 countries and constituencies are provided. Data on small islands and legally unclear constituencies were excluded: Anguilla, Bougainville, British Indian Ocean, British Virgin Islands, Christmas Island, Cocos (Keeling) Islands, Cook Islands, Falkland Islands, French Guiana, Gibraltar, Guadeloupe, Holy See, Martinique, Montserrat, Niue, Norfolk Island, Northern Cyprus, Pitcairn Islands, Reunion, Western Sahara, Saint Helena, Saint Pierre & Miquelon, Somaliland, Spanish North Africa, Svalbard & Jan Mayen, Taiwan, Tokelau Islands, Turks & Caicos Islands, Wallis & Futuna Islands.

affiliation is widely used.¹⁰ Due to the Christian background of the publishing institutions, one could argue (at least for the data on religion), that the numbers might be biased. Their very detailed assessment of Christian denomination, however, is an indication of a real interest in surveying Christianity, drawing an unbiased picture of their faith.¹¹

Below, the most granular group data is used in order to offer the best possibility of endogenous group formation. Although data at the individual level is not available, this very granular data is close to the desired approach outlined earlier. *Table 1* summarizes detailed descriptive statistics of the *WCE* group data. It clearly confirms the higher granularity, showing far more groups than alternative sources. Alesina et al. (2003) have, on average, less than six groups per country, while 59 groups are counted in the present data set. Besides the higher number of groups in general, the pattern of fractionalization across the regions is quite similar, drawing attention to Sub-Saharan Africa (SSA) as the most fragmented region. The average population share of the largest group is only 39% of the total population in Sub-Saharan African countries, whereas it is at least 50% in all other regions. Also, the number of countries that have a majority group of 50% is significantly lower. The higher amount of small groups also has an effect on the ELF values based on the *WCE* data, reflected in a noticeably higher mean value. A higher number of groups will increase the ELF index by design. *Table 2* confirms this by showing the summary statistics of the ELF values for the various sources described earlier.

Source	Obs.	Mean	Std. Dev.	Min.	Max.
ANM	169	0.458	0.273	0.000	0.984
Alesina	186	0.440	0.257	0.000	0.930
ELF Annett	144	0.479	0.275	0.010	0.950
Fearon	153	0.471	0.270	0.002	0.953
WCE	210	0.563	0.270	0.019	0.982

Table 2: Main statistical characteristics of ELF values for different sources

3.2 Assessment of group distances

Language classification Language is probably the most researched and operationalized characteristic.¹² As is the case with a family tree, languages can be ordered in accordance with their mutual relatedness. The distance between the branches is a measure of their degree of (dis)similarity. The categorization as a separate language (instead of a dialect)

¹⁰See, for example, Annett (2001), Barro (1999), Barro and McCleary (2003), Collier and Hoeffler (2004), Collier et al. (2004), Garcia-Montalvo and Reynal-Querol (2005a), Loh and Harmon (2005), or Okediji (2005).

¹¹De Groot (2009) uses a similar, unorthodox evangelical source, the Joshua Project (2007). He concludes that the “religious fervency with which this organization collects data works in our advantage” (de Groot, 2009, p. 14). Collier and Hoeffler (2004) and Collier et al. (2004) used it for their index on religious fractionalization. However, Garcia-Montalvo and Reynal-Querol (2005a) discuss some bias towards Christianity at the expense of Animist cults in Latin American countries.

¹²Ginsburgh and Weber (2011, Ch. 3) offer a good overview of the different approaches to assess the distances between languages.

not only follows pure linguistic and lexical similarities, but also considers how a mutual understanding in communication is possible.

This article relies on the *World Christian Encyclopedia* (henceforth *WCE*) (Barrett et al., 2001).¹³ Here, a seven-character code is assigned to each distinct language. A distinct language is defined as “the mother tongue of a distinct, uniform speech community with its own identity” (Barrett et al., 2001, V.II, p. 245). It comprises all dialects that share at least 85% of their vocabulary and grammar to ensure adequate communication.¹⁴ In total, 6,656 distinct languages are contained in the data analyzed. Two persons speaking one language are treated as completely similar ($s_{ij} = 1$). The more characters of the assigned code two languages share, the more similar they are. The structure is depicted in *Table 3*.

Glossocode	Description	Minimal similarity level	Number of distinct groups	\bar{s}_{kl}^L
0	Macrozone	0%	10	0.01
01	Glosso-zone	5%	100	0.06
01-A	Glosso-set	30%	594	0.35
01-AA	Glosso-chain	50%	1,213	0.59
01-AAA	Glosso-net	70%	2,388	0.82
01-AAAA	Glosso-cluster	80%	4,241	0.94
01-AAAA-a	Language	85%	6,656	1.00

Table 3: Language similarity classification according to Barrett et al. (2001)

The Afghan Persian (58-AACC-b) and Southern Pathan (58-ABDA-b) group share the first three digits and thus belong to one Glosso-set, sharing between 30% and 50% of their vocabulary and grammar. Subsequently, both groups are assigned a similarity value \bar{s}_{kl}^L . The assigned values are normalized on a scale between zero and one, and are matched to demonstrate the same decreasing slope as the lexical similarity levels. Belonging to one language group and thus sharing 85% lexical similarity corresponds to the highest \bar{s}_{kl}^L with $\bar{s}_{kl}^L = 1$. In the case of the example, \bar{s}_{kl}^L takes a value of 0.35.

Ethno-racial distance Fragmentation that is derived from a biological taxonomy of species is mainly based on genealogical relatedness. This long evolutionary process is described by Ahlerup and Olsson (2007) as ‘genetic drift’ and means that the human species developed quite differently in various parts of the world, thus enabling a genealogical tree to be mapped based on the genetic congruence of the resulting races. Cavalli-Sforza and Feldmann (1981) created these phylographic trees by mapping the differences in special sections of the human DNA.

¹³A very closely related approach is analyzed and operationalized in the *Ethnologue* project (Lewis, 2009). A high congruency of both sources exists as the *World Christian Encyclopedia* is one of the sources for the *Ethnologue* data.

¹⁴The same threshold is used by the *Ethnologue* project (Lewis, 2009). The second source is Dalby and Williams (1999). The data and classification can also be found online: <http://www.linguasphere.info>.

This was certainly a pioneering piece of work, but it also demonstrates some limitations. The first one is the small number of 42 population groups for the global classification. It is quite obvious that this might not be sufficient to describe global diversity. The second caveat is brought forward by Giuliano et al. (2006) who discuss in detail the use of genetic distance data and conclude that it is a proxy for geographical distances, rather than a proxy for cultural distances. The genes used to assess the genetic distance in Cavalli-Sforza et al. (1993) are only in a very limited way responsible for the phenotypical or anthropometric differences. The part of the DNA used is located on neutral points that are subject to random drift, and less so to evolutionary selection. However, to assess the distance between two human beings with respect to their ease or willingness to cooperate, phenotypical or anthropometric markers should be relevant.

In order to combine these views and caveats, this article follows an ethno-racial taxonomy outlined by Barrett et al. (2001). Each unique group is assigned a six-character code based on differences in race, skin pigmentation and ethnic origin. Although this includes some major similarities between languages to define distinct cultural groups, which is due to the very closely linked development of genetical and language evolution (Cavalli-Sforza et al., 1988). As those characteristics are closely linked in their development, their role for mutual understanding differs and is treated as cumulative in the subsequent analysis.¹⁵ Analogous to the pure language case, the different levels of ethno-racial classification are summarized in *Table 4*.¹⁶ The broadest classification is along racial lines, with five different races existing. The next level adds a geographical marker (e.g., African or European) to the race distinction. The major culture area adds an additional physiological characteristic, mainly driven by skin pigmentation. Local races are characterized as a “culture area, local breeding population/reproductive isolate and genetically distinct population” (Barrett et al., 2001, V.II, p. 19). To differentiate between larger ethno-racial families and to characterize distinct ethnic groups or ‘microraces’, a final character is assigned as an identifier. On a global scale, the data contains 393 ethno-racial families.

E-L-Code	Description	Similarity level	Number of distinct groups	\bar{s}_{kl}^E
A	Race	1	5	0.01
AU	Geographical race	2	13	0.21
AUG	Major culture area	3	18	0.59
AUG-03	Local race	4	72	0.88
AUG-03-b	Ethno-racial family	5	393	1.00

Table 4: Ethno-racial group and similarity classification according to Barrett et al. (2001)

Taking the same two groups in Afghanistan and comparing their ethno-racial classification enables their similarity value to be derived for this characteristic. Accordingly, the Persians

¹⁵This approach is also followed by de Groot (2009).

¹⁶Whenever ethno-racial classification here is not the unique contribution of Barrett et al. (2001), it closely follows the *Encyclopædia Britannica*.

(CNT-24-f) and Southern Pathans (CNT-24-a) belong to one ethno-racial family and are eventually assigned a mutual similarity value \bar{s}_{kl}^E of 0.88.

Religious classification Religion is undoubtedly a major factor in shaping cultural habits and practices. The existence of different religions is often seen as an important reason for conflicts or general misunderstandings between different groups.

The main challenge here is the assessment of differences. How should the differences between denominations, i.e. between Catholics and Protestants, or between Shias and Sunnis, treated? The same method as the one for language and race could be applied to assess mutual commonalities. For religion, one could rely on shared festivities, common holy books, common saints/prophets, traditions or values (e.g., mercy). There is, however, no source offering a discussion of this, let alone a structured assessment of today’s world religions. This article follows the approach that Bossert et al. (2011) applied in their study. For their partition along ethnic lines, they used a purely categorical assessment, i.e. the mutual similarity values were either one or zero. This approach should be adjusted as better data becomes available.

4 Operationalization of the new diversity index

Based on theoretical considerations, no single characteristic out of the three is deemed to be superior or more sound than the others, all of them seeming to be of equal relevance. For this same reason, Okediji (2005) includes ethnic differentiation alongside racial and religious characteristics.¹⁷ One can argue, though, that the distance between groups increases if more differences exist which would be in line with the cumulative statement of de Groot (2009) and is the approach followed by this article.¹⁸

The most common approach when incorporating different characteristics into a combined index is to assign equal weights to all of its components.¹⁹ Following this method, the *DELFI* is calculated according to *Equation (6)*, whereby the combined \hat{s}_{kl} is the equally weighted average of the similarity values of each ethnicity characteristic:

$$\hat{s}_{kl} = \frac{1}{3} \left[\bar{s}_{kl}^L + \bar{s}_{kl}^E + \bar{s}_{kl}^R \right] \quad (7)$$

¹⁷See, for example, Chandra and Wilkinson (2008) and Barrett et al. (2001). Hofstede (2000) similarly concludes that “the world population has diversified in three ways: in genes, in languages, and in cultures” (Hofstede, 2000, p. 3). Okediji (2005) constructs his social diversity index based on the complementary nature of the three characteristics and also uses *WCE* data. However, he does not take into account the mutual (dis)similarities between the groups.

¹⁸However, single characteristics may be relevant on its own or differently weighted for specific questions. Please see the *Appendix A.1* for all details.

¹⁹The most well-known index calculated utilizing this approach is the UNDP’s Human Development Index (HDI). For an analysis of different operationalization strategies for a broad set of composite development indicators, see Booyesen (2002).

whereby \bar{s}_{kl}^L , \bar{s}_{kl}^E and \bar{s}_{kl}^R are the respective similarity values for the language, ethno-racial and religious classification. The single-characteristic *DELFS* are calculated using the composite similarity measure (\hat{s}_{kl}) of the characteristic-specific similarity values (\bar{s}_{kl}^L , \bar{s}_{kl}^E , \bar{s}_{kl}^R). To decide on the redundancy of the composite index and its components, McGillivray and White (1993) propose two thresholds for correlation values between the components: 0.90 and 0.70. The Spearman rank correlations of the *DELFS* values based on the components (labeled with a respective subscript for (L)anguage, (E)thno-culture and (R)eligion) and the composite *DELFS* index are shown in *Table 5*.

	<i>DELFS</i>	<i>DELFS_L</i>	<i>DELFS_E</i>	<i>DELFS_R</i>
<i>DELFS</i>	1			
<i>DELFS_L</i>	0.904	1		
<i>DELFS_E</i>	0.714	0.537	1	
<i>DELFS_R</i>	0.665	0.529	0.195	1

Table 5: Rank correlation for the composite *DELFS* and its components

The correlations between the single components are no higher than 0.54, falling clearly below both thresholds. Thus, any form of double counting by using collinear indicators can be neglected. As the composite index is partly matched to its components, the resulting correlations are naturally higher. By correlating the components with reduced forms of the *DELFS* (by excluding the respective component), most correlations again fall below both thresholds (McGillivray and White, 1993; Ogwang and Abdou, 2003).²⁰

To come up with the composite *DELFS*, an equal weighting scheme has, to date, been applied. Following an extensive critique on the rather simplistic equal weighting of composite indices (Cahill, 2005; McGillivray and White, 1993), the call for a more elaborate weighting scheme, or at least a better foundation, is understandable. One approach widely discussed is the principal component analysis (PCA).²¹ Principal components are calculated as linear combinations of the original variables (in this case the single-characteristic *DELFS* values) as a way of explaining the largest part of its variation. The first principal component explains most of the variance, followed by the second and third principal component. In doing so, principal component analysis transforms correlated variables into uncorrelated ones and all principal components are orthogonal. The assigned loading factors can then be used to weight the sub-indices.²²

The very high correlation of 0.99 between the *DELFS* and the index based on PCA calculations (*DELFS_{PCA}*) is seen in the upper part of *Table 6*. This suggests that one can

²⁰The correlation between *DELFS_L* and the reduced *DELFS* by excluding *DELFS_L* shows a value of 0.69. The respective values for excluding *DELFS_E* and *DELFS_R* are 0.48 and 0.43, all falling below both thresholds.

²¹For a discussion and how it is applied, mainly to the HDI, see Jolliffe (1973), Ram (1982), Ogwang (1994), Noorbakhsh (1998) or Ogwang and Abdou (2003).

²²The results of the PCA and further details can be obtained from the author.

resign from using the more complex weighting schemes, and it underlines that none of the components dominates the other components in a problematic way.²³

		<i>DELF</i>	<i>DELF_{PCA}</i>	<i>DELF_{Geo}</i>	<i>DELF_{Pc}</i>
<i>DELF</i>	<i>DELF</i>	1			
	<i>DELF_{PCA}</i>	0.999	1		
	<i>DELF_{Geo}</i>	0.963	0.963	1	
	<i>DELF_{Pc}</i>	0.994	0.994	0.959	1
<i>ELF</i>	ANM	0.698	0.697	0.707	0.736
	Alesina	0.569	0.569	0.548	0.605
	Annett	0.630	0.630	0.651	0.671
	Fearon	0.607	0.606	0.626	0.621
	Garcia-Montalvo (ELF)	0.617	0.616	0.637	0.663
	Garcia-Montalvo (POL)	0.433	0.433	0.430	0.428

Table 6: Rank correlation matrix for differently weighted *DELF* values and the most common ELF and POL indices

Having discussed the possible redundancy of the components and methods to assign their weights, there are two ways to aggregate the components: using the arithmetic or the geometric mean.²⁴ Using a geometric mean does, however, ‘penalize’ high dissimilarity in one of the components. This is often used in composite indices for various inequality measures, e.g., poverty, in which case the direct compensation of one component through another is not desired. Two individuals from the same ethno-racial and language backgrounds, who adhere to different religions, would be completely different in the case of a geometric mean because the religious component would be zero. That a certain similarity still prevails between both individuals/groups is obvious. Thus, for the application here, a form of compensation between components seems reasonable. In connection with the discussion above, the interpretation of the cumulative nature of the characteristics is more perspicuous and, additionally, argues in favor of an arithmetic mean. Due to these very different attributes, it is not surprising that the *DELF_{Geo}* has a lower, yet still very high correlation to all the other *DELF* values.

As an alternative, the introduction of a certain non-linearity of compensation between characteristics might be reasonable. This is, for example, promoted by Branisa et al. (2009). To allow for a certain compensation, the components are squared before the calculation of the arithmetic mean. This leads to an adjusted value of *DELF_{Pc}*. In line with Nardo et al. (2005), the weights are interpreted as trade-offs and not as importance coefficients.

²³Additionally, the variances of the sub-indices are rather similar. So none of the sub-indices would significantly bias the equally weighted index. For details on key statistical attributes of the single sub-indices, see *Table 7*.

²⁴An additional aggregation for the *DELF_{PCA}* index is not necessary because, by construction, the distance vector of the first principal components contains the weights and aggregation implicitly.

Finally, the *DELFL* index should contain different information to that of other indices trying to measure ethnic fragmentation or diversity. Thus, the redundancy considerations regarding the components can be applied as a comparison to existing ELF indices.²⁵ The results are found in the lower part of *Table 6*. All rank correlations between the most common ELF indices and the new *DELFL* fall below both redundancy thresholds. Although already alluded to in the theoretical discussion, in which it became apparent that both indices measure different things (fragmentation versus diversity), the statistical results provide additional confirmation.

The arithmetical average between the single characteristics is therefore the most straightforward way to operationalize the composite *DELFL* index. Furthermore, it has compensatory attributes between the characteristics which reflects their complementarity. This is not the case when using the geometric mean, for example. By using the part-compensation method and principal components, the results found are comparable and similarly adequate to those of the simple arithmetic mean. As their correlation is rather high, the method used here follows the principle of keeping it as simple as possible.²⁶

5 Diversity index results

For each country, a similarity matrix is calculated, containing all \hat{s}_{kl} . The size of the respective $K \times K$ matrices for each country is defined by the number of groups K found in it, ranging from 3 to 884. The group similarity calculations are comparable to the ones within a country and the ones for the difference between countries.

5.1 Diversity measure within countries

Religious and language homogeneity, in particular, are spread differently across regions. This is why the adjustments also vary significantly between them. In Latin-America,²⁷ Spanish is the dominant language, although there are different ethno-racial and/or religious groups. The language similarities add to a higher affinity between the groups and, in turn, lower the *DELFL* values. *Table 8* summarizes the mean values for different ELF and *DELFL* specifications across regions. Additionally, it compares the average ranks of the countries in the respective groups. A rank of one is assigned to the most heterogeneous countries, i.e. the countries with the highest ELF or *DELFL* values. Comparing both ranks gives a good indication of how large the adjustments in the *DELFL* calculation are compared to the standard ELF values.

²⁵The correlation with ethnic polarization values of Garcia-Montalvo and Reynal-Querol (2005b) is a reference for the analyses in section 6.

²⁶A detailed discussion of the superiority of the equal weighting scheme is found in McGillivray and Noorbakhsh (2004) who conclude that more elaborate weighting schemes “produce values which are generally indistinguishable from values of the equally weights index” (McGillivray and Noorbakhsh, 2004, p. 15). de Groot (2009) uses the same approach in his ethno-linguistic affinity index.

²⁷Includes the Caribbean.

Index	Observations	Mean	Std. Dev.	Min.	Max.
ELF	210	0.563	0.270	0.019	0.982
<i>DELFL</i>	210	0.252	0.157	0.006	0.636
<i>DELFL_L</i>	210	0.353	0.243	0.008	0.942
<i>DELFL_E</i>	210	0.255	0.176	0.002	0.708
<i>DELFL_R</i>	210	0.148	0.188	0.000	0.648

Table 7: Main statistical characteristics of *DELFL* values, decomposed for all ethnicity characteristics

Sub-Saharan Africa (SSA) demonstrates a much higher heterogeneity when measured by the ELF compared to the *DELFL*, resulting in a negative rank delta. As seen earlier, this region includes countries with the highest number of groups, mirrored by high ELF values. However, if one takes the similarity between the groups into account, the ranks decrease. Eastern Europe, by contrast, shows a greater diversity when considering the *DELFL* value rather than the ELF value.

The decomposition of the *DELFL* into its single characteristics is even more interesting. In terms of the language characteristic, Latin America has the most homogeneous countries, whereas Sub-Saharan Africa again shows the most heterogeneous ones. Taking into account only the ethno-racial aspect, Latin America shows the highest level of diversity. This might stem from the interbreeding of the native Indian population with the high number of descendants from the Western colonial powers and the resulting Mestizo progeny. The region with the most homogeneous countries in this regard is Eastern Europe, a region where outside powers have interfered less. The religious characteristic again demonstrates the expected distribution. Sub-Saharan Africa has the most religiously heterogeneous countries and Western and Latin American countries, with their high numbers of Christians, host the most homogeneous ones. The Middle Eastern and Northern African (MENA) countries also show values indicating rather homogeneous religious characteristics which is not surprising considering the high proportion of Muslims in these areas. Most countries that have a majority religion, i.e. more than 60% of the population either adhere to Christianity (133 countries) or to Islam (43 countries), exhibit rather low religious *DELFL* values. All other countries, where there is either no majority religion or it is made up of another denomination, show significantly higher religious *DELFL* values. Also, their average overall *DELFL* rank is substantially higher than when only the number of groups in the ELF value is taken into account.

The single-country perspective shows an even higher degree of variation. The ELF and *DELFL* values of each country are listed in *Table 14* of the *Appendix*. The countries are ordered according to their ELF values in descending order, from the most heterogeneous country to the most homogeneous one. The third column depicts their corresponding *DELFL* values and *DELFL* ranks. The difference between the ELF and *DELFL* ranks is shown in column four. The next column outlines the *DELFL* values, decomposed for each characteristic, which helps to better illustrate the differences.

	Obs.	Mean values					Rank <i>ELF</i>	Rank <i>DELFL</i>	Delta Rank
		<i>ELF</i>	<i>DELFL</i>	<i>DELFL_L</i>	<i>DELFL_E</i>	<i>DELFL_R</i>			
Asia	40	0.608	0.290	0.435	0.240	0.194	93.3	90.8	2.5
E. Europe	29	0.389	0.197	0.261	0.204	0.126	145.9	125.0	20.8
L. America	38	0.509	0.227	0.220	0.386	0.075	121.3	114.5	6.8
MENA	21	0.558	0.249	0.358	0.275	0.114	108.1	107.0	1.2
SSA	49	0.741	0.319	0.490	0.219	0.248	62.6	81.2	-18.6
W. Count.	33	0.465	0.184	0.279	0.206	0.066	128.7	130.9	-2.2
World	210	0.563	0.252	0.353	0.255	0.148	–	–	–
Muslim	43	0.571	0.262	0.389	0.271	0.127	105.6	100.7	4.9
Christian	133	0.519	0.208	0.299	0.251	0.076	115.7	121.2	-5.7
Other	34	0.729	0.407	0.519	0.249	0.454	65.6	50.1	15.5

Table 8: Mean *ELF* and *DELFL* values and ranks for all regions and countries with main majority religions

Based on the additional aspect of accounting for the differences between groups, the *DELFL* leads to significant differences between a country’s *ELF* and *DELFL* values. *Figure 1* shows the ranks of all countries depending on its *ELF* and *DELFL* values, whereby the highest values correspond with the rank of one. Changes in the heterogeneity ranking of more than 30 places (indicated by the dotted lines) are quite common. Countries such as Zambia, the Republic of Congo, and Zimbabwe seem to be more homogeneous when using their *DELFL* rather than their *ELF* values. Contrarily, Kazakhstan, Bahrain or the Sudan turn out to be more diverse than fragmented.

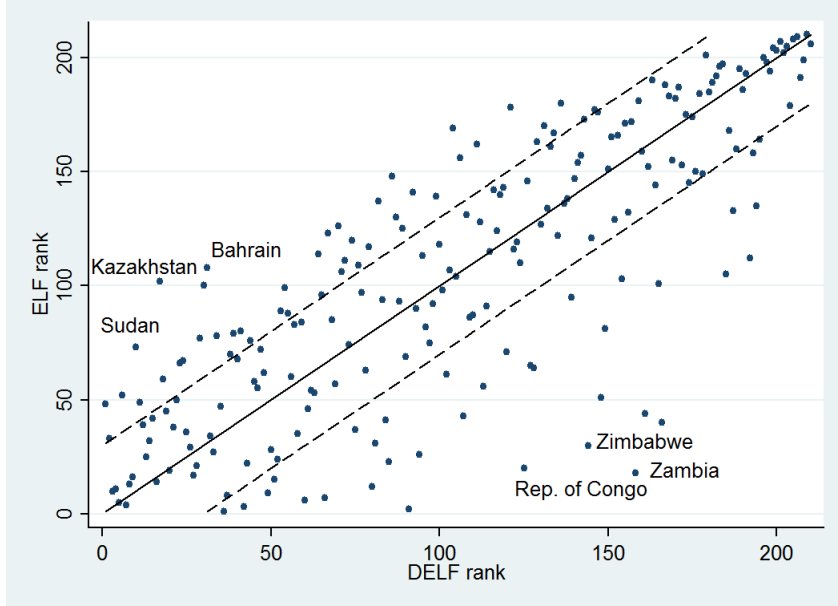


Figure 1: Scatter plot of *ELF* and *DELFL* rank values

5.2 Similarity measure between countries

To date, most authors have focused on the assessment of ethnicity within a country, as has this article. This also holds true for the analysis of a country’s growth or conflict incidence. De Groot (2009) expands upon this and proposes his index of ethno-linguistic affinity (ELA) to measure the similarities between two neighboring countries. He shows that conflict spillovers are more likely between contiguous countries sharing stronger ethnic similarities. The extended calculation for the *DELFL* between countries is nearly identical to *Equation 6*, and is defined through:

$$DELFL_{ij} = 1 - \sum_{k=1}^K \sum_{m=1}^M p_{ik} p_{jm} \hat{s}_{km} \quad (8)$$

where country i hosts groups $k = 1, \dots, K$, and country j groups $m = 1, \dots, M$, respectively. The distance between the two groups k and m is given through \hat{s}_{km} . The result is the expected dissimilarity between two individuals randomly drawn from each country.²⁸ The 210 countries analyzed here give a matrix containing over 150 million similarity values and nearly 44,000 dyadic relations between countries.

A regional aggregation also offers some remarkable insights. For the calculation of the regional averages, the *DELFL* values between countries are adjusted for the different population sizes of the respective country pairs.²⁹

The regional level of diversity plays an important role in the European Union (EU). The success of European integration is often questioned due to the EU’s high level of cultural diversity. This was heavily debated before the last enlargement, when the EU grew from 15 to 25 and shortly after that to 27 member states, and will, no doubt, become an increasingly controversial issue for future enlargement plans. With the above approach, developments regarding the level of diversity can easily be traced.

Figure 2 shows the diversity level of the EU for each wave of enlargement. The predecessor of today’s EU was initiated in 1952, which included Belgium, France, Germany, Italy, Luxembourg and the Netherlands. This ‘core Europe’, as it is often referred to, displayed a regional *DELFL* value of 0.37. The next two enlargement waves added nearly 25% to the total population. These countries were not, however, overly different from the existing group and were internally rather homogeneous. Hence, the *DELFL* only slightly increased. The addition of Portugal and Spain in 1986, two populous and very homogeneous countries, slightly decreased the overall level of diversity, whereas the huge enlargement

²⁸In general, the interpretation of the *DELFL* value between countries ranging between zero and one is comparable to the case of *DELFL* values within countries. Two countries consisting of groups that share not a single common characteristic show a mutual *DELFL* value of one as they are completely different. Lower *DELFL* values correctly indicate countries that share more characteristics and are thus more ‘similar’. However, the theoretical country set-up maximizing the similarity between two countries (minimizing the *DELFL* value) deviates in its limit from the generally understood meaning of the word ‘similar’. This is discussed in more detail in Kolo (2012). I would like to thank Walter Zucchini for this important comment.

²⁹For the weighting, population data averages from the *World Development Indicators* World Bank (2011) for 2005–2010 were used.

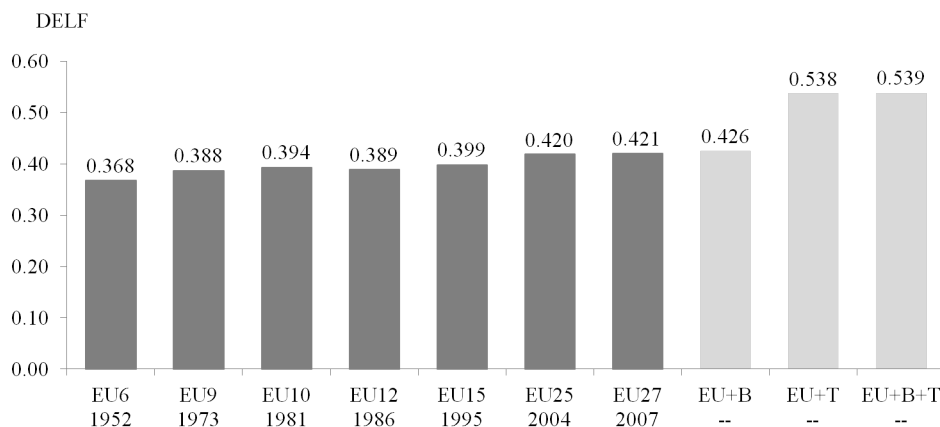


Figure 2: Average *DELF* values of the EU per enlargement wave

of 10 countries in 2004, and of two more in 2007, again increased the *DELF* level significantly. Looking at potential future enlargements, the admission of mainly Balkan states, as well as Iceland (EU+B), would not change the status quo in a major way. The highest increase in diversity within the EU would result from admitting Turkey (EU+T). The increased cultural diversity Turkey would bring to the EU cannot, per se, be judged as good or bad. It does, however, offer an easy target for the exploitation of these differences and political agitation – the potential here being far greater than during the earlier of enlargement, which only displayed marginal diversity increases.

Finally, the *DELF* values are compared with the most widely used measure of cultural distance between countries, genetic distance. Matching these with the detailed data on genetic diversity compiled by Spolaore and Wacziarg (2009), yields only a very limited correlation. The rank correlation of genetic distance and the composite *DELF* is only 0.25, and thus fails to meet both of the redundancy thresholds discussed above.³⁰ This comparison underlines that the genetic distance data is hardly a good proxy for the ‘cultural’ differences between countries.

6 Empirical applicability

Implications of ethnic diversity on conflict The correlation of ethnic division and conflict is probably the most researched field regarding a possible impact of ethnicity. More opportunities to hide in mountainous regions, the possibility of gaining higher amounts of natural resources, and lower opportunity costs for an impoverished population are brought forward as arguments. However, oppression by the ruling regime raises the probability of revolts. Not only oppression but also marginalization and the intentional underdevelopment of groups not belonging to the ruling clan may raise tensions, which might, in turn,

³⁰As expected from the characteristic definition, the highest correlation of the genetic data is with the ethno-racial *DELF* values at 0.70. For the language and the religion *DELF* the values are 0.48 and 0.02 respectively.

develop into conflicts. In line with greed and opportunity theories (Collier and Hoeffler, 2004), a broad strand of literature relying on the ELF index has not found strong empirical evidence for a relationship between ethnic fragmentation and any of the conflict measures (Fearon and Laitin, 2003).³¹ Apparently the mere number of groups is not that relevant for conflict.

These arguments led Garcia-Montalvo and Reynal-Querol (2002) to develop the polarization index (POL) as a more relevant measure of the relationship between ethnic division and conflict. They argue that deviation from the situation of two equally strong groups, that might both seize power over the whole country, is more relevant for the incidence of conflicts than the fractionalization of a country. In general, polarization is indeed more robustly associated with conflict measures.

In a theoretical contribution, Caselli and Coleman (2008) stress the importance of potential excludability of the defeated party from economic or political gains. The possibility to exclude another group based on obvious barriers (physiognomic, language, ethnic) between them, increases the incentives to start a conflict. The distance between groups, as mirrored in the *DELFL* index, could be a relevant factor for the consideration of whether or not a war is started.

Garcia-Montalvo and Reynal-Querol (2005b) test the applicability of ethnic and religious polarization against the respective fractionalization indices in the incidence of wars. They use data from the Peace Research Institute of Oslo (PRIO), which includes intermediate and high-intensity armed conflicts. A range of standard control variables (*GDP/capita*, *Population*, *Primary exports*, *Mountains*, *Contingency*, and *Democracy*) are included in all the regressions. The regressions in *Table 9* are replications of the ones in the original article and use a logit model for the incidence of civil wars based on five-year periods. The ethnic polarization variable (*Ethnic pol.*) clearly outperforms the fractionalization variable (*Ethnic frac.*) as regards the level of significance.³² All control variables carry the expected sign.

The regressions in *Table 10* now rebuild the approach of Garcia-Montalvo and Reynal-Querol (2005b). However, the fractionalization indices are replaced by the composite *DELFL* and the *DELFL_R*.³³ The higher significance of the polarization measure (*Ethnic pol.*) fades and gives way to the composite *DELFL*. The coefficients for the control variables and their significances remain more or less unchanged. It is apparent that the *DELFL*, covering differences between groups, contains important information regarding the incidence of conflicts. In line with the contribution of Caselli and Coleman (2008), obvious barriers should be relevant for the decision to enter a conflict. The fact that

³¹See also Collier and Hoeffler (2004) and Collier et al. (2009).

³²The ethnic variables that Garcia-Montalvo and Reynal-Querol (2005b) use are also based on data from the *World Christian Encyclopedia* (Barrett et al., 2001), whereas the religious measures are mainly built based on data from the *L'Etat des Religions dans le Monde* (Clévenot, 1987).

³³To be consistent, the fractionalization indices were also taken from the same data source as the one used for *DELFL*, i.e. the *WCE*.

	(1)	(2)	(3)	(4)	(5)
	Conf.	Conf.	Conf.	Conf.	Conf.
Ethnic frac.	1.19* (1.89)		0.18 (0.19)		0.05 (0.05)
Ethnic pol.		2.38*** (2.97)	2.29** (2.23)		2.09** (2.03)
Rel. frac.				-4.97* (-1.65)	-4.45 (-1.39)
Rel. pol.				3.90** (1.97)	3.29 (1.59)
Ln (GDP/capita)	-0.29 (-1.27)	-0.44** (-1.99)	-0.42* (-1.79)	-0.33 (-1.13)	-0.38 (-1.33)
Ln (Population)	0.35** (2.18)	0.41** (2.40)	0.40** (2.21)	0.44*** (3.01)	0.44*** (2.72)
Primary exp.	-0.91 (-0.52)	-1.01 (-0.54)	-1.07 (-0.57)	-0.35 (-0.21)	-0.90 (-0.48)
Mountains	0.00 (0.49)	-0.00 (-0.25)	-0.00 (-0.19)	0.00 (0.29)	-0.00 (-0.16)
Non contiguous	0.08 (0.13)	0.30 (0.49)	0.29 (0.48)	0.31 (0.49)	0.48 (0.79)
Democracy	0.08 (0.21)	0.03 (0.09)	0.03 (0.09)	0.02 (0.05)	-0.03 (-0.09)
Constant	-5.82** (-2.06)	-6.23* (-1.93)	-6.30** (-2.01)	-6.90** (-2.26)	-7.47** (-2.32)
Observations	846	846	846	846	846
Pseudo R^2	0.101	0.122	0.122	0.110	0.134

Cluster robust t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 9: Original logit regression for the incidence of civil wars as found in Garcia-Montalvo and Reynal-Querol (2005b)

the composite $DEL F$, covering all characteristics, has a more significant impact than the $DEL F$ solely based on religion, confirms their theoretical arguments. In most cases, religious identification may not be an obvious enough characteristic to rule out future assimilation.

Implications of ethnic diversity on growth The second most prominent question of ethnicity's role is whether and how it affects economic growth. This was the starting point for the seminal paper of Easterly and Levine (1997) who concluded that Africa's lower growth rate can, to a large extent, be explained by its higher ethnic fragmentation. Their approach was extended and updated with new ELF data by Alesina et al. (2003) which covered more countries. Subsequently, Schüler and Weisbrod (2010) added an additional decade of observation and thus based their analysis on a broader foundation.³⁴ They all very much confirm the negative effect of the ELF on a country's growth rate. For

³⁴Whereas Alesina et al. (2003) covered the period from 1960 to 1989, Schüler and Weisbrod (2010) expand the data to cover the period from 1960 to 1999.

	(1)	(2)	(3)	(4)	(5)
	Conf.	Conf.	Conf.	Conf.	Conf.
DELF	2.40*		2.55**		4.25**
	(1.87)		(2.05)		(2.31)
Ethnic pol. (WCE)		0.45	0.74		0.28
		(0.39)	(0.64)		(0.22)
<i>DELF_R</i>				-9.59	-12.48
				(-1.38)	(-1.53)
Rel. pol. (WCE)				5.98	6.43
				(1.35)	(1.30)
Ln (GDP/capita)	-0.35	-0.47*	-0.40	-0.42*	-0.47
	(-1.48)	(-1.87)	(-1.50)	(-1.75)	(-1.64)
Ln (Population)	0.39***	0.40**	0.39**	0.42***	0.45***
	(2.59)	(2.56)	(2.54)	(2.75)	(3.37)
Primary exp.	-0.96	-0.27	-1.00	0.07	-0.46
	(-0.48)	(-0.16)	(-0.50)	(0.04)	(-0.26)
Mountains	0.00	0.00	0.00	0.00	0.00
	(0.54)	(0.30)	(0.41)	(0.34)	(0.17)
Non contiguous	0.10	0.12	0.21	0.05	0.13
	(0.16)	(0.18)	(0.31)	(0.08)	(0.18)
Democracy	0.03	0.08	0.02	0.06	-0.02
	(0.09)	(0.22)	(0.05)	(0.16)	(-0.07)
Constant	-6.17**	-4.94*	-6.10**	-5.58*	-6.52**
	(-2.15)	(-1.70)	(-2.09)	(-1.92)	(-2.35)
Observations	833	833	833	833	833
Pseudo R^2	0.108	0.092	0.110	0.101	0.128

Cluster robust t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 10: Logit regression for the incidence of civil wars, based on Garcia-Montalvo and Reynal-Querol (2005b)

more developed countries with better education and infrastructure, this effect is found to be less detrimental (Alesina and La Ferrara, 2005). Ethnic diversity might even be a driver of innovation for these countries and should thus affect growth in a positive way. Nevertheless, cooperation is apparently more difficult in heterogeneous countries so it is natural to question the *DELF*'s role in economic growth. As the data compiled by Schüler and Weisbrod (2010) offers the widest range of observations, it seems obvious to replicate their analyses.

Table 11 shows, in regressions (1) and (2), replications of the original growth regressions of Schüler and Weisbrod (2010). The regressions here are run, in line with Schüler and Weisbrod (2010), using seemingly unrelated regressions (SUR). SUR is used to allow for country random effects to be correlated across decades, in order to increase the efficiency of the estimators.³⁵ Regression (1) contains only limited control variables that are supposed to influence the economic development of countries. Both regional dummies, for *Africa*

³⁵Comparing the results to a model run with robust OLS regressions and decade dummies displays nearly no differences. Thus, the decade correlations seem to be very limited.

	(1)	(2)	(3)	(4)
	Growth	Growth	Growth	Growth
Africa	-0.009** (-2.66)	-0.014*** (-3.47)	-0.012*** (-3.67)	-0.016*** (-4.27)
La. America	-0.016*** (-5.93)	-0.014*** (-4.63)	-0.018*** (-6.60)	-0.016*** (-5.08)
Ln (GDP/cap.)	0.041*** (2.71)	0.027 (1.46)	0.045*** (2.89)	0.030 (1.59)
(Ln (GDP/cap.)) ²	-0.003*** (-2.99)	-0.003** (-2.47)	-0.003*** (-3.08)	-0.003*** (-2.61)
Ln (Schooling)	0.011*** (3.40)	0.003 (0.66)	0.011*** (3.36)	0.003 (0.66)
Assassinations		-21.103** (-3.48)		-19.766** (-2.18)
Financial depth		0.009** (2.14)		0.010** (2.00)
Black market premium		-0.021*** (-5.34)		-0.021*** (-5.31)
Fiscal surplus/GDP		-0.000** (-1.81)		-0.000* (-1.91)
Ln (Telephones/worker)		0.016*** (3.15)		0.017*** (3.34)
ELF (Alesina)	-0.019*** (-3.86)	-0.012** (-2.20)		
<i>DELTA</i>			-0.017** (-2.34)	-0.005 (-0.58)
Observations	82/88/ 94/92	38/67/ 74/80	81/87/ 93/91	38/67/ 74/79
<i>R</i> ²	0.24/0.24/ 0.36/0.16	0.46/0.45/ 0.49/0.30	0.21/0.20/ 0.35/0.12	0.46/0.44/ 0.48/0.27

Robust *t* statistics in parentheses; observation and *R*² values are decade specific
* *p* < 0.10, ** *p* < 0.05, *** *p* < 0.01
Growth is measured as annual growth rate of per capita GDP

Table 11: Influence of ethnic diversity on economic growth, based on Schüler and Weisbrod (2010)

and *Latin America*, are negative and significant at the 5% and 1% levels. The income level (*GDP/cap.*) at the beginning of each decade shows a catch-up effect, at a slightly diminishing rate as its squared term is negative but with a very small coefficient. As expected, *Schooling* has a significant effect on increasing growth.³⁶ Finally, ethnic fractionalization (ELF), based on the data compiled by Alesina et al. (2003), reveals a detrimental growth effect. A completely homogeneous country can expect an annual growth rate that is almost 2% higher than that of a completely fractionalized country. Thus, the different level of ethnic fractionalization between Korea and Côte d'Ivoire is responsible for roughly 1.6% of their growth rate differential.³⁷ Regression (2) now includes a broad set of variables

³⁶ Measured as the average years of total school attainment at the start of the decade.

³⁷ In the data of Alesina et al. (2003), Korea has an ELF of 0.002, whereas Côte d'Ivoire has an ELF of 0.82.

affecting growth. The number of *Assassinations*, the *Black market premium* and the *Fiscal surplus* all negatively affect growth, at highly significant levels of 1%. Financial depth and the number of *Telephones per worker* are used as proxies for the level of infrastructure in a country, both of which show a growth-enhancing potential and are highly significant. As ethnic fractionalization, per se, can hardly impact upon growth, all of these variables are meant to be channels through which ethnic fragmentation affects growth. This is supported by a high correlation between the ELF and these variables. Indeed, Easterly and Levine (1997) and Alesina et al. (2003) find a vanishing effect of the ELF as the number of co-variables included in the regressions increases, until it becomes equally insignificant. By including data from the 1990s, Schüler and Weisbrod (2010) find a robust, albeit smaller, negative effect of the ELF on growth, controlling for all other variables. This, therefore, still confirms that the ELF potentially works through affecting these variables.³⁸

Regression (3) now exchanges the ELF values with *DELFL* values. Nearly all of the coefficients and significance levels remain relatively unchanged and, interestingly, the *DELFL* displays nearly the same coefficient as the ELF. However, it loses its significant impact when all controls are included in regression (4), as in the articles of Easterly and Levine (1997) and Alesina et al. (2003). Although the coefficients look similar, their economic impact differs. Whereas an increase of one standard deviation in the ELF reduces growth by 0.56 percentage points, the same increase in the *DELFL* would only lead to a reduction in growth of 0.29 percentage points.³⁹ Comparing Korea and Côte d'Ivoire again, the difference in their respective *DELFL* levels is responsible for slightly less than one percentage point of their growth rate differential.⁴⁰ Thus, ethnic diversity seems to be less detrimental to economic growth than the ELF. As both affect growth through different variables (channels), a more detailed analysis of ELF and *DELFL* effects is deemed necessary here. However, for these basic regressions, the sheer number of groups is more robust than when their differences are additionally taken into account.⁴¹

Despite the finding that heterogeneity affects economic growth negatively, whether or not this holds true for all country settings can be questioned, as is the case in a range of articles analyzing metropolitan regions and companies. They often find that ethnic heterogeneity has a positive effect on innovation and productivity.⁴²

With data very comparable to the data above, Alesina and La Ferrara (2005) try to prove this positive effect in a large-scale cross-country analysis. They show that the

³⁸If the ELF index based on the same data as the *DELFL* (*WCE* data) is used, its effect remains highly significant in regression (1) but fades in regression (2).

³⁹The standard deviation of ELF is 0.27, whereas it is only 0.16 for the *DELFL*. For the annual growth rate, the standard deviation is 0.027.

⁴⁰Korea has a *DELFL* of 0.032, whereas Côte d'Ivoire has a *DELFL* of 0.586.

⁴¹The static nature of both the ELF and the *DELFL* calls for an important caveat. Kolo (2011) shows that the level of ethnic heterogeneity in a country changes and makes education, inter alia, responsible for this. Although the ethnic set-up of a country does not change quickly, an analysis covering four decades, with a single static ethnic measure, requires some caution.

⁴²See for example Florida (2004), Hong and Page (1998), Niebuhr (2010), Ottaviano and Peri (2005), Ozgen et al. (2011), Prat (2002), Sparber (2010) or Watson et al. (1993)

	(1)	(2)	(3)	(4)	(5)
	Growth	Growth	Growth	Growth	Growth
Africa	-0.012*** (-2.66)	-0.016*** (-4.02)	-0.010** (-2.32)	-0.015*** (-3.83)	-0.012*** (-2.66)
La. America	-0.017*** (-5.25)	-0.018*** (-5.78)	-0.017*** (-5.32)	-0.018*** (-5.79)	-0.016*** (-4.80)
Ln (GDP/cap.)	0.017 (0.79)	0.026 (1.37)	0.023 (1.19)	0.033* (1.73)	0.031 (1.58)
(Ln (GDP/cap.)) ²	-0.002** (-1.99)	-0.003*** (-2.73)	-0.003** (-2.27)	-0.003*** (-2.89)	-0.003*** (-2.68)
Ln (Schooling)	0.002 (0.32)	0.002 (0.35)	-0.000 (-0.03)	-0.002 (-0.43)	-0.003 (-0.55)
Assassinations	-18.945** (-1.99)	-17.614* (-1.83)	-19.129** (-2.02)	-17.434* (-1.82)	-20.922** (-2.19)
Financial depth	0.008* (1.65)	0.007* (1.52)	0.008 (1.65)	0.007 (1.55)	0.008* (1.80)
Black market premium	-0.020*** (-5.02)	-0.020*** (-4.90)	-0.021*** (-5.08)	-0.020*** (-4.99)	-0.020*** (-4.98)
Fiscal surplus/GDP	-0.000* (-1.85)	-0.000* (-1.93)	-0.000* (-1.93)	-0.000* (-1.95)	-0.000* (-1.74)
Ln (Telephones per worker)	0.014** (2.44)	0.014*** (2.41)	0.014*** (2.50)	0.014*** (2.48)	0.013*** (2.25)
HDI	0.025 (1.19)	0.033 (1.55)	0.009 (0.38)	0.015 (0.69)	0.011 (0.51)
ELF (Alesina)	-0.066 (-1.56)		-0.034** (-2.70)		-0.011 (-0.61)
ELF * Ln (GDP/cap.)	0.006 (1.31)				
ELF * HDI			0.038** (1.74)		-0.016 (-0.52)
DELFF		-0.125* (-1.84)		-0.042** (-2.01)	-0.044 (-1.64)
DELFF * Ln (GDP/cap.)		0.015* (1.82)			
DELFF * HDI				0.070** (2.10)	0.109** (2.22)
Observations	38/65/ 71/76	38/65/ 71/75	38/65/ 71/76	38/65/ 71/75	38/65/ 71/75
R^2	0.44/0.43/ 0.51/0.34	0.46/0.41/ 0.49/0.34	0.43/0.43/ 0.51/0.34	0.44/0.41/ 0.50/0.35	0.44/0.42/ 0.50/0.40

Robust t statistics in parentheses; observation and R^2 values are decade specific

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Growth is measured as annual growth rate of per capita GDP

Table 12: Influence of ethnic diversity on economic growth depending on economic and human development levels, based on Alesina and La Ferrara (2005)

detrimental effect of ethnic heterogeneity does indeed fade in the case of more economically developed countries. The original paper, however, relies on a limited data set from 1960–1989.

Table 12 replicates the analysis of Alesina and La Ferrara (2005) with the extended data of Schüler and Weisbrod (2010). Following the argumentation of Alesina and La Ferrara (2005) that richer countries are less prone to the ELF's detrimental effect, the heterogeneity measures (ELF and *DEL*F) are both interacted with the countries' income levels (*GDP/cap.*). The negative effects for ELF and *DEL*F remain in regressions (1) and (2), although they are no longer or only marginally significant at conventional levels. The same is true for the interaction terms of the heterogeneity measures (ELF/*DEL*F) and the level of initial income (*GDP/cap.*). Thus, the finding of Alesina and La Ferrara (2005) cannot be confirmed for the extended time period and it is, in any case, questionable whether a higher income level can be the sole basis for diversity to be beneficial to a country. Instead, countries need to establish a common base that allows the different groups to interact in a productive way.⁴³ An indicator reflecting a broader perspective of development is the Human Development Indicator (HDI). Regression (3) and (4) include the HDI level and an interaction term with the heterogeneity indices, replacing the income level used beforehand.⁴⁴ The ELF and *DEL*F again enter the regression with the familiar significant negative effect, although the *DEL*F is slightly less significant. More interestingly, the interaction terms reveal a new result. Both the ethnic fractionalization and ethnic diversity indices show a positive impact for more developed countries. Regression (5) includes both the ELF and the *DEL*F indices as well as their interaction terms. Whereas most ethnicity variables are now insignificant, the interaction term of *DEL*F with the HDI remains positive and significant, albeit at a reduced level of 10%. In the case of regression (4), the *DEL*F exhibits a positive impact for an HDI level of 0.6 and above. This corresponds with countries like Indonesia or the Philippines.⁴⁵ For regression (5), the threshold for a positive implication begins at 0.4. A positive and significant effect (at the 5% level) is found for an HDI level of 0.7 and above. For example, Paraguay, Tunisia, and Turkey exhibited this level of development for the 1990s. This result confirms the expectation that ethnic diversity, as opposed to mere heterogeneity, has a positive impact on the economic growth of a country.

When using the broader data from Schüler and Weisbrod (2010), Alesina and La Ferrara's (2005) result as regards the positive impact of ethnic heterogeneity, depending on a country's income level, cannot be confirmed. However, a new insight is generated by this broader approach that takes into account a country's level of development. Countries ranking higher in the HDI may well benefit from the positive effects of ethnic diversity. This is an important finding as it is a good basis for challenging the common understanding that ethnic diversity generally has negative consequences in an economic context. Under the right conditions, it seems to support a country's economic success. This potential for

⁴³This is comparable to multicultural companies needing to enforce a common understanding between their diverse employees in order to benefit from the different backgrounds.

⁴⁴Besides purely economic measures, the HDI includes differences in its educational and health levels. The data is taken from UNDP - United Nations Development Programme (1994).

⁴⁵These HDI values correspond to the latest decade in the data, starting with 1990.

innovative power can, however, only unfold in countries that are able to cope with its adversary effects.

Implications of ethnic diversity on trade There are two main channels through which cultural affinity between nations is able to promote trade (Combes et al., 2005). Higher cultural affinity is aligned with better mutual understanding and knowledge. For trade, this translates into reduced transaction costs as both agents better understand the conditions in the other country, and access to information on legal restrictions, consumer behavior, or the practices of their local business partners is less costly. The second channel promotes trade via preferences, i.e. migrants often import their preferences for goods and services from their home country. Spreading these new products throughout their new host countries expands demand beyond their own migrant group, and intensifies mutual trade flows. Both channels are boosted by a higher stock of immigrants, as well as generally higher cultural affinity and understanding between respective nations.⁴⁶

The trade-increasing effect of cultural proximity is the focus of Felbermayr and Toubal (2010). In a standard gravity trade model, they show that trade volumes are increased through higher cultural affinity between both nations. Their sample consists of 32, mainly European, countries and covers the period from 1965 to 2003. Felbermayr and Toubal (2010) proxy cultural affinity by using the mutual voting behavior of the Eurovision Song Contest (ESC).⁴⁷ The major advantage of using ESC voting as a cultural affinity measure is that it does not necessarily need to be symmetric between two countries. Indeed, it seldom is. Additionally, it may vary over time as the contest is held on a yearly basis. Other conventional measures lack these features.

Again, the main findings of Felbermayr and Toubal (2010) are reproduced in *Table 13*. As the ESC data is time-variant and not symmetric between countries, Felbermayr and Toubal (2010) can apply more elaborate econometric models to take advantage of this additional information. As the *DELF* lacks this additional information, all regressions in *Table 13* are performed in a slightly limited way by using cluster robust OLS models with importer and year fixed effects.⁴⁸

The first four regressions use aggregate imports as the dependent variable. Regression (1) includes standard control variables for trade costs and a set of cultural affinity variables. Transportation costs are covered in the controls for geographical proximity (*Distance* between main cities and a *Common border* dummy), and the formal trade policy

⁴⁶In general, most papers find a positive correlation between migration and trade. See, for example, Rauch (2001) or Combes et al. (2005). Wagner et al. (2002) compare a broader set of articles and outline their different approaches, leading to different elasticities of migration regarding trade.

⁴⁷The ESC is an annual song competition during which each country votes for the song from other countries to determine the winner of the competition.

⁴⁸In their gravity models, Felbermayr and Toubal (2010) use a complete set of interaction terms for importer/exporter and year fixed effects. Indeed, they show that standard OLS regression would significantly underestimate the effect of cultural proximity. If anything, applying more standard econometric strategies is likely to underestimate the results. As a consequence, the discussed results here are not an exact replication, but adapted regressions.

	Aggregate imports			Homogeneous goods			Differentiated goods			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Ln (Distance)	-0.578*** (-6.33)	-0.570*** (-6.19)	-0.522*** (-4.87)	-0.517*** (-4.79)	-0.835*** (-6.92)	-0.824*** (-6.69)	-0.822*** (-6.65)	-0.606*** (-8.76)	-0.544*** (-7.26)	-0.540*** (-7.18)
Common border	-0.175 (-0.88)	-0.162 (-0.82)	-0.266 (-1.27)	-0.253 (-1.21)	0.184 (0.73)	0.178 (0.71)	0.187 (0.74)	-0.272 (-1.45)	-0.275 (-1.47)	-0.262 (-1.41)
Common FTA	0.454*** (5.34)	0.454*** (5.34)	0.392*** (4.73)	0.396*** (4.78)	0.531*** (4.71)	0.517*** (4.54)	0.518*** (4.55)	0.254*** (3.05)	0.187*** (2.26)	0.190*** (2.30)
Common legal origin	-0.021 (-0.17)	-0.023 (-0.19)	-0.072 (-0.58)	-0.076 (-0.62)	0.393** (2.51)	0.397** (2.54)	0.396** (2.53)	0.080 (0.79)	0.095 (0.93)	0.089 (0.87)
Common language	-0.115 (-0.46)	-0.134 (-0.53)	-0.216 (-0.85)	-0.237 (-0.93)	0.252 (0.98)	0.267 (1.03)	0.254 (0.99)	0.002 (0.01)	0.031 (0.18)	0.013 (0.07)
Ethnic ties (Migration stock)	0.623*** (34.02)	0.621*** (33.73)	0.631*** (33.35)	0.629*** (33.14)	0.442*** (15.06)	0.443*** (15.09)	0.442*** (15.06)	0.541*** (28.57)	0.541*** (28.55)	0.540*** (28.53)
Religious proximity	0.283 (1.52)	0.270 (1.45)	0.019 (0.10)	0.011 (0.06)	-0.421 (-1.59)	-0.454* (-1.67)	-0.459* (-1.69)	0.022 (0.13)	-0.148 (-0.86)	-0.157 (-0.91)
ESC_{ij}		0.163*** (2.83)		0.146*** (2.65)	0.088 (1.17)		0.083 (1.12)	0.107** (2.07)		0.083* (1.69)
ESC_{jt}		-0.000 (-0.01)		0.017 (0.33)	-0.007 (-0.12)		-0.010 (-0.17)	0.082** (2.00)		0.069* (1.75)
<i>DEL_F</i>			-0.844** (-2.45)	-0.825** (-2.43)		-0.179 (-0.48)	-0.168 (-0.45)		-0.873*** (-3.28)	-0.856*** (-3.25)
Constant	14.738*** (18.46)	14.658*** (18.17)	14.885*** (18.24)	14.803*** (17.96)	13.942*** (12.61)	14.012*** (12.76)	13.975*** (12.66)	15.366*** (23.68)	15.431*** (23.94)	15.385*** (23.70)
Observations	10457	10457	9547	9547	7135	7135	7135	7792	7792	7792
Adjusted R ²	0.772	0.773	0.777	0.777	0.634	0.634	0.634	0.826	0.828	0.828
RMSE	1.19	1.19	1.17	1.17	1.45	1.45	1.45	1.00	1.00	1.00

Dependent variable is measured as Ln(Value of bilateral imports)

Cluster robust *t* statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 13: Cultural affinity factors and bilateral trade volumes (imports) based on Felbermayr and Toubal (2010)

is covered by the joint participation in a free trade area (*Common FTA*). A higher distance lowers the volume of bilateral trade, but this is not to say that two nearby countries necessarily trade more. FTA membership shows a significant effect on aggregate imports, whereas a *Common legal origin* does not. The included standard set of cultural affinity variables is meant to account for the reduced transaction costs in more proximal countries. A *Common language* is not significant, whereas *Ethnic ties*, as expected, promote trade, at a 1% level of significance. *Religious proximity* does not exhibit any impact.

Regression (2) then includes the core measure for cultural affinity used by Felbermayr and Toubal (2010), the ESC scores. As they are not symmetric, both voting behaviors are included. ESC_{ij} is thus the voting behavior of the importing country towards the exporting country, and ESC_{ji} depicts the reverse situation. In contrast to the set of cultural affinity variables in regression (1), the mutual ESC scores are attributed to the second channel influencing trade volume, i.e. in the form of higher preferences (Felbermayr and Toubal, 2010). Due to the standard regression methods used, the ESC variables turn out to be less significant than in the original regressions of Felbermayr and Toubal (2010) and only ESC_{ij} is significant, at the 1% level. A higher affinity measured by higher ESC_{ij} voting behavior does, nevertheless, increase aggregate trade volumes. All other variables are only marginally affected. Finally, regression (3) includes the *DELFL* measure. As the *DELFL* measures the cultural distance between countries, instead of the affinity between them, the resulting opposite sign is in line with what is expected. A higher cultural distance lowers aggregated imports. The *DELFL* and the ESC scores are conjointly included in regression (4). The coefficients and significance levels are only marginally affected, if at all. Both variables measuring cultural affinity are jointly relevant, whereas neither *Common language* nor *Religious proximity* are significant. The stock of migrants, however, is still highly significant and remains so throughout all the regressions. The trade-reducing effect of a higher diversity between two countries is sizeable. A one standard deviation higher *DELFL* value (0.22) is associated with nearly 30% lower imports.⁴⁹

Regressions (5)-(7) and (9)-(11) re-run the estimations (2)-(4), this time splitting imports into homogeneous and differentiated goods. Homogeneous goods are traded through organized exchanges that partly overcome information and transaction costs, differences in preferences being irrelevant for these kinds of goods. A *Common FTA* remains highly significant and a *Common legal origin* increases imports. This suggests that these variables influence on the transaction cost channel (translating/ contracting) rather than the channel based on preferences (Felbermayr and Toubal, 2010). The *DELFL* index, on the other hand, has no significant effect on the trade of homogeneous goods at conventional levels; nor do the ESC scores. For differentiated goods, the *DELFL* becomes highly significant at the 1 % level. Also, both ESC variables impact imports significantly, albeit at a lower significance level of 5%. Additionally, the beta coefficient for the *DELFL* variable is more

⁴⁹For example, the *DELFL* between Germany and Switzerland is 0.31, whereas it is 0.50 between Germany and Cyprus.

than seven times the size of any of the two ESC variables. The *Common legal origin* variable again becomes insignificant at conventional levels. This performance of the *DELFL* underlines that it indeed seems to be a more accurate measure of cultural proximity, in the form of common preferences, compared to the other variables applied here. In addition, the *DELFL* data has the considerable advantage of allowing researchers to expand their analyses onto a global scale, going beyond the small set of countries participating in the Eurovision Song Contest.

The results of Felbermayr and Toubal’s (2010) replication show that the *DELFL* index does indeed covers the cultural distance between two countries very well, in a way that reflects its influence on preferences. These preferences, in turn, are one of the main reasons why cultural proximity increases trade volumes.

7 Conclusion

Taking the mutual (dis)similarities between ethnic groups into account, the new *DELFL* index covers a new and very important aspect of ethnicity—its diversity. The differences to other indices suggest that it indeed measures different aspects of ethnicity, which might have a contrasting effect on the socio-economic problems under investigation. Additionally, the possibility to analyze the single-characteristic *DELFL* for very specific questions offers new room for investigation.⁵⁰

Research focusing on dissimilarity between countries can equally benefit from employing the *DELFL* between countries as it offers a far more comprehensive data set for ‘cultural’ affinity between nations. It is not always necessarily the geographical or genetic distance that matters. The *DELFL* values between countries offer an excellent and valid extension of the analysis into spillover effects between countries.

There are, however, some caveats that cannot be overlooked. As the data source used is somewhat unique in its combination of characteristics, only limited robustness checks with other sources are possible. Secondly, the weighting of the three sub-indices is debatable, as is the case for most composite index calculations. Finally, there might be country- or region-specific characteristics influencing cultural diversity that are not covered in the (globally comparable) three characteristics treated in this article. The caste system in India would be one example. Nevertheless, the diligent composition and new insights gained by applying the *DELFL* outweighs these constraints.

Its applicability is verified in selected empirical analyses as regards its influence on conflicts, growth and trade. In terms of conflicts, it is obvious to assume that, besides the sheer number of groups (fractionalization), the differences between these groups also play a role. The *DELFL* was tested for the incidence of conflict in a replication of Garcia-Montalvo and Reynal-Querol (2005b). It shows a stronger significance for the assertion

⁵⁰Akdede (2010), for example, shows the different implications of ethnic and religious fractionalization on democratic institutions.

of conflict onset in Garcia-Montalvo and Reynal-Querol (2005b) than the polarization index. The possible discrimination of outside groups during and after a war determines the potential for economic and political power. This information, included in the *DELFL*, seems to affect the decision to start a civil conflict.

As regards economic growth, ethnic fractionalization and diversity reveal a similarly negative effect. This effect disappears, however, when a set of other control variables is included. An extension of the established analyses reveals that this negative impact is not universal, but depends on a country's level of development. Countries with a higher level of human development (HDI) are not affected in a negative way. As this effect only shows up within the *DELFL* and not the ELF, these countries can apparently benefit from the positive impact ethnic diversity has in terms of innovation and an increase in productivity.

The last analysis employs a study by Felbermayr and Toubal (2010). The *DELFL* index reveals a significant positive effect on imports. The study additionally shows that this effect is more prominent for heterogeneous than for homogeneous goods. Higher cultural proximity is reflected in more aligned preferences which increase the trade volume between these countries, especially of more differentiated goods. Overall, the *DELFL* is a good substitute for a range of cultural affinity factors. As both studies focus on European trade flows, their validity for global trade flows still needs to be proven. In contrast to most of the other cultural affinity factors tested by the above articles, the *DELFL* offers global coverage and is thus well-suited for further research in this field.

This article introduces the appropriate index of ethnic diversity. It does not, however, render the ELF and POL indices irrelevant, but advocates the additional importance of the diversity aspect in many settings. The considerable advantage of the *DELFL* data set is its wide coverage of countries. As this allows for research on a global scale, it goes far beyond the limited scope of most recent papers. Future research is especially encouraged to follow this route and expand these analyses to examine their broader validity.

A Appendix

A.1 Detailed DELF data per country

Table 14: ELF and DELF values and ranks for 210 countries

Country	ELF	Rank	DELF	Rank	Delta	DELF _L	DELF _E	DELF _R
Papua New Guinea	0.982	1	0.441	36	-35	0.942	0.360	0.021
Congo, Dem. Rep.	0.977	2	0.258	91	-89	0.545	0.208	0.021
Solomon Islands	0.971	3	0.402	42	-39	0.845	0.349	0.013
Cameroon	0.966	4	0.553	7	-3	0.809	0.354	0.497
Chad	0.963	5	0.564	5	0	0.876	0.277	0.540
Tanzania	0.962	6	0.340	60	-54	0.307	0.181	0.533
India	0.958	7	0.326	66	-59	0.513	0.200	0.266
Central African Republic	0.953	8	0.437	37	-29	0.703	0.208	0.399
Vanuatu	0.948	9	0.386	49	-40	0.740	0.388	0.030
Cote d'Ivoire	0.943	10	0.586	3	7	0.867	0.243	0.648
United Arab Emirates	0.939	11	0.580	4	7	0.737	0.654	0.350
Mozambique	0.927	12	0.288	80	-68	0.278	0.102	0.485
Liberia	0.921	13	0.553	8	5	0.774	0.307	0.578
Singapore	0.917	14	0.501	16	-2	0.715	0.201	0.586
Nigeria	0.917	16	0.551	9	7	0.861	0.240	0.553
Kenya	0.917	15	0.382	51	-36	0.621	0.279	0.246
Ghana	0.915	17	0.458	27	-10	0.740	0.147	0.488
Zambia	0.914	18	0.127	158	-140	0.272	0.077	0.031
Togo	0.913	19	0.484	20	-1	0.723	0.099	0.629
Congo, Rep.	0.910	20	0.192	125	-105	0.367	0.201	0.007
Timor-Leste	0.904	21	0.458	28	-7	0.546	0.596	0.231
Israel	0.903	22	0.402	43	-21	0.738	0.116	0.352
Uganda	0.901	23	0.275	85	-62	0.570	0.219	0.036
Benin	0.885	29	0.460	26	3	0.671	0.115	0.593
South Africa	0.898	24	0.374	52	-28	0.520	0.478	0.123
Guinea-Bissau	0.898	25	0.521	13	12	0.814	0.201	0.548
Madagascar	0.892	26	0.255	94	-68	0.188	0.070	0.507
Mali	0.887	27	0.453	33	-6	0.814	0.407	0.139
Namibia	0.886	28	0.385	50	-22	0.575	0.539	0.041
Zimbabwe	0.884	30	0.148	144	-114	0.233	0.147	0.065
Ethiopia	0.863	34	0.453	32	2	0.721	0.127	0.512
Philippines	0.875	31	0.281	81	-50	0.457	0.210	0.177
Bhutan	0.869	32	0.512	14	18	0.619	0.425	0.491
Fiji	0.868	33	0.591	2	31	0.713	0.570	0.491
Indonesia	0.855	37	0.303	75	-38	0.501	0.140	0.269
Iran, Islamic Rep.	0.855	35	0.344	58	-23	0.536	0.483	0.014
Burkina Faso	0.855	36	0.462	25	11	0.703	0.193	0.489
New Caledonia	0.855	38	0.480	21	17	0.686	0.691	0.065
Sierra Leone	0.845	39	0.531	12	27	0.780	0.348	0.466
Angola	0.845	40	0.116	166	-126	0.199	0.113	0.035
Micronesia, Fed. Sts.	0.840	41	0.278	84	-43	0.580	0.229	0.026
Malaysia	0.836	42	0.510	15	27	0.685	0.231	0.614
Gabon	0.835	43	0.227	107	-64	0.453	0.189	0.039
Italy	0.829	44	0.122	161	-117	0.224	0.094	0.047
Qatar	0.828	45	0.484	19	26	0.572	0.651	0.230
Senegal	0.824	46	0.339	61	-15	0.734	0.181	0.101
United States	0.823	47	0.448	35	12	0.589	0.657	0.097

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Table 14 – continued from previous page

Country	ELF	Rank	DEL F	Rank	Delta	DEL F_L	DEL F_E	DEL F_R
Suriname	0.818	48	0.636	1	47	0.657	0.660	0.592
Lao PDR	0.816	49	0.536	11	38	0.649	0.458	0.500
Niger	0.782	58	0.396	45	13	0.728	0.353	0.108
Brunei Darussalam	0.809	50	0.480	22	28	0.679	0.143	0.620
Malawi	0.807	51	0.138	148	-97	0.154	0.062	0.197
Mauritius	0.807	52	0.560	6	46	0.609	0.518	0.551
Peru	0.803	53	0.336	63	-10	0.421	0.576	0.010
France	0.802	54	0.336	62	-8	0.453	0.355	0.202
N. Mariana Islands	0.798	55	0.396	46	9	0.775	0.385	0.028
Thailand	0.793	56	0.216	113	-57	0.304	0.155	0.189
Belgium	0.782	57	0.314	69	-12	0.560	0.290	0.091
Belize	0.779	59	0.494	18	41	0.677	0.708	0.096
Kuwait	0.777	60	0.363	56	4	0.446	0.434	0.209
Pakistan	0.777	61	0.243	102	-41	0.410	0.299	0.021
Gambia, The	0.774	62	0.390	48	14	0.745	0.311	0.113
Afghanistan	0.774	63	0.297	78	-15	0.500	0.388	0.003
Morocco	0.770	64	0.187	128	-64	0.464	0.097	0.002
Monaco	0.765	65	0.190	127	-62	0.296	0.228	0.045
Oman	0.759	66	0.474	23	43	0.634	0.574	0.212
Guinea	0.753	67	0.464	24	43	0.647	0.233	0.512
Canada	0.751	68	0.419	40	28	0.632	0.455	0.171
Mauritania	0.750	69	0.265	90	-21	0.412	0.378	0.004
Bolivia	0.749	70	0.431	38	32	0.678	0.572	0.043
Spain	0.745	71	0.195	120	-49	0.313	0.240	0.032
Nepal	0.744	72	0.390	47	25	0.446	0.388	0.336
Sudan	0.738	73	0.538	10	63	0.664	0.534	0.417
Ecuador	0.737	74	0.307	73	1	0.282	0.627	0.013
Latvia	0.728	75	0.250	97	-22	0.510	0.226	0.014
Eritrea	0.721	76	0.398	44	32	0.508	0.189	0.498
Guyana	0.707	77	0.457	29	48	0.248	0.600	0.522
Nauru	0.705	78	0.449	34	44	0.690	0.432	0.226
Myanmar	0.699	79	0.420	39	40	0.589	0.264	0.408
Trinidad and Tobago	0.698	80	0.410	41	39	0.188	0.559	0.483
Andorra	0.693	81	0.137	149	-68	0.213	0.164	0.034
Cayman Islands	0.686	82	0.253	96	-14	0.237	0.480	0.043
Bosnia and Herzegovina	0.686	83	0.351	57	26	0.273	0.281	0.499
Guam	0.679	84	0.343	59	25	0.645	0.325	0.061
Switzerland	0.677	85	0.317	68	17	0.572	0.274	0.106
Colombia	0.677	86	0.224	109	-23	0.050	0.609	0.012
Montenegro	0.671	87	0.223	110	-23	0.219	0.167	0.283
Guatemala	0.668	88	0.364	55	33	0.571	0.522	0.000
New Zealand	0.667	89	0.366	53	36	0.505	0.491	0.103
French Polynesia	0.661	90	0.258	93	-3	0.447	0.325	0.001
Brazil	0.660	91	0.216	114	-23	0.048	0.591	0.008
Mexico	0.658	92	0.249	98	-6	0.168	0.575	0.005
Equatorial Guinea	0.655	93	0.266	88	5	0.543	0.214	0.042
Djibouti	0.644	94	0.279	83	11	0.619	0.180	0.037
Algeria	0.635	95	0.156	139	-44	0.401	0.065	0.003
Iraq	0.633	96	0.326	65	31	0.454	0.489	0.036
Estonia	0.631	97	0.299	77	20	0.449	0.437	0.010
Luxembourg	0.620	98	0.248	101	-3	0.468	0.250	0.028
Panama	0.616	99	0.366	54	45	0.465	0.584	0.048

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Table 14 – continued from previous page

Country	ELF	Rank	DEL F	Rank	Delta	DEL F_L	DEL F_E	DEL F_R
Macedonia, FYR	0.613	100	0.456	30	70	0.578	0.332	0.459
Grenada	0.611	101	0.116	165	-64	0.156	0.193	0.000
Kazakhstan	0.603	102	0.499	17	85	0.513	0.487	0.498
St. Lucia	0.600	103	0.133	154	-51	0.197	0.168	0.033
China	0.594	104	0.234	105	-1	0.223	0.035	0.445
Egypt, Arab Rep.	0.589	105	0.065	185	-80	0.086	0.099	0.008
Georgia	0.586	106	0.311	71	35	0.506	0.272	0.155
Greenland	0.581	107	0.241	103	4	0.385	0.338	0.000
Bahrain	0.576	108	0.455	31	77	0.548	0.522	0.296
Nicaragua	0.575	109	0.301	76	33	0.371	0.524	0.008
Bermuda	0.574	110	0.192	124	-14	0.138	0.438	0.001
Virgin Islands (U.S.)	0.570	111	0.309	72	39	0.437	0.470	0.020
Comoros	0.567	112	0.041	192	-80	0.057	0.025	0.042
Mongolia	0.506	125	0.266	89	36	0.191	0.083	0.523
Turkey	0.560	113	0.255	95	18	0.328	0.430	0.006
Mayotte	0.545	114	0.335	64	50	0.495	0.492	0.019
Netherlands	0.542	115	0.215	115	0	0.261	0.237	0.147
Venezuela, RB	0.542	116	0.194	122	-6	0.059	0.484	0.040
Kyrgyz Republic	0.539	117	0.291	79	38	0.334	0.297	0.242
Albania	0.539	118	0.248	100	18	0.334	0.140	0.272
Ireland	0.539	119	0.194	123	-4	0.488	0.073	0.020
Australia	0.534	120	0.305	74	46	0.381	0.354	0.178
Sri Lanka	0.503	126	0.312	70	56	0.440	0.060	0.437
Bahamas, The	0.523	121	0.146	145	-24	0.220	0.215	0.002
Germany	0.518	122	0.165	135	-13	0.242	0.156	0.096
Tajikistan	0.510	123	0.325	67	56	0.467	0.449	0.058
St. Vincent & the Gr.	0.508	124	0.199	117	7	0.210	0.272	0.113
Sweden	0.503	127	0.179	130	-3	0.255	0.207	0.074
Chile	0.500	128	0.219	112	16	0.213	0.439	0.004
Norway	0.492	129	0.133	152	-23	0.202	0.124	0.072
Cape Verde	0.488	130	0.270	87	43	0.446	0.364	0.000
Liechtenstein	0.485	131	0.225	108	23	0.300	0.211	0.165
Dominican Republic	0.481	132	0.130	156	-24	0.048	0.340	0.003
Tuvalu	0.471	133	0.058	187	-54	0.141	0.033	0.000
United Kingdom	0.470	134	0.176	132	2	0.244	0.183	0.101
Bangladesh	0.341	153	0.098	172	-19	0.050	0.039	0.204
Botswana	0.462	136	0.158	137	-1	0.175	0.137	0.162
Tunisia	0.464	135	0.038	194	-59	0.107	0.006	0.002
Cuba	0.449	137	0.281	82	55	0.018	0.417	0.407
Puerto Rico	0.446	138	0.157	138	0	0.048	0.419	0.005
Argentina	0.444	139	0.249	99	40	0.245	0.412	0.089
Moldova	0.444	140	0.198	118	22	0.395	0.173	0.027
Palau	0.437	141	0.258	92	49	0.401	0.373	0.000
Netherlands Antilles	0.426	142	0.200	116	26	0.337	0.233	0.029
Saudi Arabia	0.420	143	0.197	119	24	0.263	0.243	0.086
Libya	0.415	144	0.117	164	-20	0.172	0.139	0.039
Ukraine	0.403	145	0.094	174	-29	0.115	0.110	0.057
Aruba	0.399	146	0.191	126	20	0.222	0.337	0.013
Uzbekistan	0.375	147	0.155	140	7	0.207	0.180	0.078
Russian Federation	0.374	148	0.271	86	62	0.328	0.272	0.215
Somalia	0.372	149	0.079	178	-29	0.147	0.063	0.026
Jamaica	0.364	150	0.087	176	-26	0.081	0.130	0.050

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Table 14 – continued from previous page

Country	ELF	Rank	DEL F	Rank	Delta	DEL F_L	DEL F_E	DEL F_R
Costa Rica	0.363	151	0.136	150	1	0.083	0.308	0.018
Bulgaria	0.337	156	0.232	106	50	0.228	0.278	0.190
Turkmenistan	0.344	152	0.121	162	-10	0.151	0.136	0.076
Syrian Arab Republic	0.340	154	0.152	141	13	0.217	0.204	0.033
Dominica	0.337	155	0.110	169	-14	0.199	0.129	0.002
Austria	0.332	157	0.151	142	15	0.221	0.145	0.085
Belarus	0.329	158	0.041	193	-35	0.053	0.057	0.013
Barbados	0.324	159	0.122	160	-1	0.107	0.236	0.024
Jordan	0.321	160	0.057	188	-28	0.082	0.066	0.023
Serbia	0.318	161	0.171	133	28	0.214	0.194	0.106
Vietnam	0.309	162	0.221	111	51	0.265	0.149	0.250
Paraguay	0.308	163	0.179	129	34	0.269	0.252	0.016
Lesotho	0.308	164	0.034	195	-31	0.061	0.039	0.002
American Samoa	0.307	165	0.135	151	14	0.277	0.115	0.014
Uruguay	0.305	166	0.133	153	13	0.085	0.279	0.034
Greece	0.304	167	0.166	134	33	0.261	0.132	0.104
Swaziland	0.304	168	0.064	186	-18	0.098	0.078	0.016
Lebanon	0.302	169	0.239	104	65	0.276	0.259	0.183
Hungary	0.290	170	0.178	131	39	0.223	0.285	0.026
Lithuania	0.284	171	0.132	155	16	0.269	0.120	0.008
Honduras	0.270	172	0.129	157	15	0.124	0.257	0.006
West Bank and Gaza	0.266	173	0.150	143	30	0.155	0.052	0.243
Antigua and Barbuda	0.262	174	0.093	175	-1	0.072	0.198	0.008
Croatia	0.248	175	0.097	173	2	0.150	0.121	0.021
Slovak Republic	0.247	176	0.142	147	29	0.207	0.217	0.001
Azerbaijan	0.244	177	0.145	146	31	0.177	0.173	0.086
Cambodia	0.233	178	0.195	121	57	0.219	0.203	0.163
Isle of Man	0.222	179	0.027	204	-25	0.015	0.064	0.002
Kosovo	0.220	180	0.163	136	44	0.214	0.099	0.175
Romania	0.216	181	0.124	159	22	0.173	0.191	0.008
El Salvador	0.215	182	0.104	170	12	0.106	0.204	0.001
Marshall Islands	0.210	183	0.111	168	15	0.122	0.210	0.000
Samoa	0.210	184	0.086	177	7	0.207	0.051	0.000
Yemen, Rep.	0.195	185	0.074	180	5	0.137	0.063	0.023
Slovenia	0.192	186	0.054	190	-4	0.079	0.046	0.037
Finland	0.177	187	0.101	171	16	0.146	0.142	0.015
Cyprus	0.173	188	0.112	167	21	0.170	0.123	0.042
Portugal	0.173	189	0.074	181	8	0.056	0.144	0.023
Denmark	0.165	190	0.117	163	27	0.144	0.122	0.086
San Marino	0.164	191	0.010	207	-16	0.029	0.002	0.000
St. Kitts and Nevis	0.153	192	0.073	182	10	0.066	0.105	0.049
Sao Tome and Principe	0.153	193	0.052	191	2	0.058	0.098	0.000
Rwanda	0.147	194	0.032	198	-4	0.013	0.044	0.039
Iceland	0.141	195	0.054	189	6	0.107	0.052	0.004
Malta	0.119	196	0.073	183	13	0.110	0.108	0.001
Seychelles	0.117	197	0.070	184	13	0.087	0.110	0.014
Czech Republic	0.109	198	0.033	197	1	0.050	0.042	0.006
Haiti	0.108	199	0.010	208	-9	0.008	0.021	0.001
Poland	0.102	200	0.033	196	4	0.065	0.035	0.001
Armenia	0.100	201	0.077	179	22	0.099	0.090	0.042
Burundi	0.099	202	0.028	202	0	0.022	0.038	0.025
Tonga	0.094	203	0.031	200	3	0.055	0.035	0.004
Korea, Rep.	0.059	204	0.032	199	5	0.045	0.009	0.041

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Table 14 – continued from previous page

Country	ELF	Rank	<i>DEL</i> F	Rank	Delta	DEL _L F	DEL _E F	DEL _R F
Maldives	0.059	205	0.028	203	2	0.043	0.018	0.022
Faeroe Islands	0.058	206	0.006	210	-4	0.010	0.009	0.000
Channel Islands	0.055	207	0.029	201	6	0.053	0.029	0.005
Kiribati	0.050	208	0.021	205	3	0.050	0.014	0.000
Japan	0.048	209	0.019	206	3	0.032	0.011	0.014
Korea, Dem. Rep.	0.019	210	0.007	209	1	0.015	0.006	0.000

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