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Folktale Narratives and Economic Behavior

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Narratives – stories – prevail in social life, however little is known about their relation to economic behavior and outcomes. We shed light on this issue by studying the association between folktales' motifs and economic behavior across the world. First, we explore possible relations between the prevalence of narratives and the observed behavior in economic experiments by connecting the Berezkin (2015) collection of narratives with individual choices in experiments performed across the world. Second, we construct a motif distance index that approximates the cultural distance between countries. Third, we provide evidence that motif distance is associated with economic performance.

1 Introduction

The important role of narratives for socialization and transmission of worldviews has recently been recognized in economic literature (Akerlof and Snower, 2016; Hoff and Stiglitz, 2016; Shiller, 2017). It seems natural to assume that socialization in an environment, where specific stories are told, shapes beliefs, norms, economic behavior, and, hence, economic outcomes. However, little is known if this relation holds, in particular, on a global level. We fill this gap by introducing a world mythology and folklore database (Berezkin, 2015) to describe differences in economic behavior and outcomes across the world.

We focus on folklore and mythology – folktale narratives – for a number of reasons. Tales have existed in human culture for a long time, long before literal records (da Silva and Tehrani, 2016) and are known to be culturally inherited from ancestral populations to their descendants (Ross et al., 2013). Their longevity suggests that they play a relevant role in human culture and social adaptation (Gottschall, 2012; Zipes, 2006).

By now, folktale narratives are well-documented (starting from the seminal work of Brothers Grimm). Moreover, not simply a collection of stories exist but one can recognize the reoccurring elements of those stories – motifs. Those motifs in folktale narratives are relatively well classified (Aarne and Thompson, 1961; Thompson, 1932; Uther, 2004) and their geographical distribution is known.

The mythology and folklore database that we use, contains information about the geographical distribution of more than 2000 motifs across the whole world (Berezkin, 2015). Inspired by recent literature on "narratives economics" (Akerlof and Snower, 2016; Hoff and Stiglitz, 2016; Shiller, 2017), we conjecture that the motif repertoire in any given location reflects cultural and social norms. Thus, it should be associated with differences (1) in microeconomic behavior and (2) macroeconomic outcomes across the world.

To test microeconomic behavior, we match information about the presence of motifs in a country with human behavior in economic experiments conducted around the world. Specifically, we use data on (a) individual choices in standard dictator game from the comprehensive meta-study by Engel (2011) and (b) individual behavior in the die-in-cup task across societies (Gächter and Schulz, 2016). We use experimental games since they reveal the actual behavior of individuals in standardized setting, and prove to provide a robust measure of behavior (Camerer et al., 2016), that strongly correlate with differences in culture and economic behavior (Henrich and Gil-White, 2001; Engel, 2011; Gächter and Schulz, 2016). We specifically focus on the dictator game (Kahneman et al., 1986) and die-in-cup tasks (Fischbacher and Heusi, 2013) because they are very simple non-strategic games that elicit pro-social behavior (dictator game) and (dis)honest behavior (die-in-cup task) puzzling from the standard economic viewpoint. We rely on machine learning techniques (Efron and Hastie, 2016) to identify associations between motifs and decisions in the economic experiments in case of large-scale hypothesis testing. Specifically, to identify the motifs with the highest predictive power, we use the random forest algorithm (Breiman, 2001).

To test the associations between motif repertoire and macroeconomic outcomes, we construct the motif distance index. This index summarizes differences in the motif repertoire between countries in the world. Similar to Ross et al. (2013) and D'Huy and Berezkin (2017), we use the Jaccard distance to construct this index for all motifs across all world. We provide regression analysis to test if differences in this motif distance index are associated with differences in economic performance between countries. To address endogeneity issues, we take into account that motifs are culturally inherited (Ross et al., 2013; D'Huy and Berezkin, 2017) and use pre-colonial genetic distance as an instrument for motifs distance.

We find that the motif repertoire is associated with microeconomic behavior and macroeconomic outcomes. The motifs that have the highest association with the behavior in economic ex-

periments have meaningful relationships with the situations in those experiments. On the macro level, the motif index predicts economic divergence among countries. This relation proves to be robust to the inclusion of controls, and when instrumented with pre-colonial genetic distance.

2 Datasets

2.1 Narrative Dataset

We use the data set created by Berezkin (2015). The narrative database covers in total 2,156 different motifs, and their prevalence in 928 different societies. The motifs follow a thematic classification. Besides this classification, the database includes a short definition and examples for the interpretation of the motifs in the different societies. For each society, a geographic location (GPS coordinates) is included.

We applied several steps of pre-processing to the narrative database. Since the data covers societies and not countries, we aggregated the data on the country level. For each county, the appearing motifs are a bundle of motifs appearing in the societies that are located in present-day country borders (according to the GPS coordinates). After aggregating the motifs on the country level, we are able to link the database to several economic databases with country-level information.

For the first part of the analysis, we use data from two different economic experiments. While the experimental data exists for several countries, not all countries are covered. This leads to identical co-occurrences of motifs. In these cases, several motifs occur in patterns. Therefore, the correlation between the outcome variables and the appearance of the motifs cannot be attributed to a single motif. In these cases, we decided to treat the respective motifs as a group of motifs. The limited number of countries represented in the experimental data causes some motifs to be always or never present. Again, correlations between the outcome variable and the appearance of motifs would not gain any additional information. Therefore, we

decided to exclude these motifs from the dataset.

2.2 Economic experiments.

We use two datasets for economic experiments: (a) a meta-study of the dictator game by Engel (2011) and (b) the die-in-cup task by Gächter and Schulz (2016). For comparability, we use only the standard dictator game. The matched standard dictator game dataset covers 23 countries and 1806 different motifs. In case of the die-in-cup task, the same experimental protocol was implemented by Gächter and Schulz (2016) in 23 countries resulting in 2568 individual choices. The matched die-in-cup task dataset covers 22 countries and 1024 different motifs.

2.3 Genetic Distance

We use F_{ST} pairwise genetic distance across countries from Spolaore and Wacziarg (2016b) that is constructed for the 16th century(1500 year).

2.4 Economic Variables

We use the average GDP per capita (1990-2000) based on data of the International Monetary Fund from Gächter and Schulz (2016). We take the measure of constraints on executives and absolute latitude used by Acemoglu et al. (2000) from (Gächter and Schulz, 2016). Additionally, we construct six continental dummies: Asia, Africa, North America, South America, Europe, and Australia.

3 Results

3.1 Experimental Games and Narratives

To see if behavior in economic experiments has a meaningful relationship with motifs in the countries, where the experiment is conducted, we use individual choices from two simple games

that are played in different countries: (a) the standard dictator game and (b) the die-in-cup task. In the standard dictator game, one of the players (the "dictator") decides whether to give a certain amount of their endowment or nothing to another player. That is, this player decides how benevolent to be towards the other. In the die-in-cup task, subjects can pretend that they obtain a high value in rolling a dice to get a higher payoff. Thus, they can deceive the experimenter to get higher payoffs. The experimenter does not know who lied, but deviation from a uniform distribution of reported values indicate deceptive behavior.

To identify correlations between the outcomes in these experiments and the appearance of a certain motif in a country, we use the random forest algorithm that is commonly used in genome-wide association studies (Efron and Hastie, 2016). We use 10-fold 10 cross-validation procedure stratifying sampling on the country level. The five motifs with the highest variable importance are presented in Table 1.

The results are astonishing. In two distinct cases and among a large number of motifs (ranging from "the sun pursues the moon" to "hungry fingers"), the motifs that strongly correlate with in-game behavior also describe it. Namely, we find a strong positive association of giving behavior, pro-social behavior in standard dictator game and the "Stairs of stones/Girl-Helper" motif (MSE $p = 0.0099$; linear model $p = 3.245 \times 10^{-39}$ corrected for multiple comparisons with FDR [False Discovery Rate] procedure). In this narrative, a girl tells a young man to dismember her in order to help him get an object in a remote place. Afterwards, he should collect her parts. In the end, she comes to life again.

In the Swedish version of this narrative, a demon gives hard tasks for the young boy. One of them is to get griffin's eggs. To achieve this, the young woman tells the boy to dismember her and make a ladder out of her parts. When he comes back, he collects her again, but her little finger is missing.

In the case of the die-in-cup task, which aims to measure dishonesty, we find that "Brides

Table 1: Correlated Motives with Experimental Behavior

(a) Giving in Standard Dictator Game

	Motif	MSE	p-val. MSE	INP	p-val. INP	Name
1	j51a_10	12.46459	0.0099	0.43564	0.0099	Stairs of stones/Girl-Helper
2	m153a_11	5.17437	0.0099	0.08617	0.0099	The clean pig
3	m128_11	5.27887	0.01188	0.08518	0.01089	Variegated animals
4	k145_10	5.18681	0.0099	0.08353	0.01089	The predestined death ...
5	j26_10	5.67942	0.01287	0.04651	0.01881	Babies come out of the water

(b) Claims in Dice-in-Cup Task

	Motif	MSE	p-val. MSE	INP	p-val. INP	Name
1	f5_5	10.05715	0.0099	20.27287	0.0099	Brides for first men
2	m198_11	7.68308	0.0099	13.11126	0.0099	Smart Brothers
3	i51a_3	6.31013	0.0099	9.57922	0.0099	Cosmic mammal
4	c5a_3	6.29513	0.0099	8.63876	0.0099	Bird-scouts
5	i32a_5	5.62439	0.0099	7.05773	0.0099	Tree of the babies

Note: The table presents the five motifs with the highest average node importance. A detailed description of the motifs can be found online: http://www.ruthenia.ru/folklore/berezkin/.

for first men" motif has the strongest association with deceptive behavior (MSE $p = 0.0099$; linear model $p = 0.039$ corrected for multiple comparisons with FDR procedure). This motif depicts the situation when the main character transforms animals or pretends that animals are girls and that they can be married. However, after marriage, the truth about the wives' animal nature is revealed.

For instance, the Mari people (Russia) folktale version that includes this motif is the following: The parents of a single daughter consistently agree to the proposals of three suitors; the mother turns a dog and a cat into girls; after the wedding, one son-in-law complains that his wife scratches at night, and the other one that the wife bites.

3.2 Motif Distance Index

We detect a meaningful relation between motifs and behavior in the experiment despite the large potential noise in the data. The results point to a potential relation between the motifs present in a country and the economic behavior of its inhabitants. However, can one claim any relation between motifs as a proxy for social norms, and economic performance in countries?

To answer this question, we construct a motif distance index that captures the difference between countries in their motif repertoire. Specifically, we calculate the Jaccard distance coefficient in motif repertoire between each pair of countries:

$$D^M(v_i, v_j) = \frac{|v_i \cap v_j|}{|v_i \cup v_j|}, \tag{1}$$

where v_i - vector of motifs presence in country i.

We use the Jaccard index as it is a simple distance measure between two vectors of binary variables (vector of motif presence in a country). This distance index is easy to interpret as it can range from 0 (all elements indentical) to 1 (no elements identical). Descriptive characteristics of the motif index for all pairs of countries are in online appendix table A1 (Please, see the map of motif similarity ($1 - D^M$) between countries for Europe, Western Asia, Africa in appendix fig. A2-A4). We see that countries can be rather similar in motif repertoire ($\min D^M = 0.317$), but we observe large heterogeneity ($\overline{D^M} = 0.897$, $\sigma_{D^M} = 0.092$). Since ancestral populations transmit the motifs to their descendants (da Silva and Tehrani, 2016; Ross et al., 2013), we conjecture that genetic difference will be associated with motifs distance. We test this conjecture next.

We assess the relationship between motifs distance and genetic distance across countries, where the latter provides – a measure of genetic divergence between countries (Spolaore and Wacziarg, 2016a). Specifically, we look at the association between the genetic distance between

countries in the pre-colonial age (16th century) and motif distance. We focus on the genetic distance in pre-colonial age since the motif repertoire in a country largely consist of the folktales of its indigenous population. We assess a bilateral relations between genetic and motif distance for European countries and all pairs of countries (table 2). We use two-way clustering as suggested by Cameron et al. (2011) for pair-wise measures. The results are reported in table 2.

We observe highly statistically significant correlation between genetic and motif distance both for European countries ($p = 2.073 \times 10^{-20}$; $t = 9.351$; $\beta_{F_{ST}^{16}} = 3.758$) and for all pairs of countries ($p = 6.366 \times 10^{-23}$; $t = 9.886$; $\beta_{F_{ST}^{16}} = 2.283$). One has to note that a larger proportion of variance is explained for European countries ($R^2 = 0.449$) as compared to the whole world ($R^2 = 0.351$). This is not surprising given that narratives are better classified for Indo-European groups.

This result provides additional evidence that folktales are transmitted vertically (culturally inherited), but, more importantly, it validates motif index as a tool that captures the relevant distance in motif repertoires between countries.

Table 2: Genetic Distance in 16th Century and Motifs Distance

	Dependent variable:	
	Motifs Distance	
	Only Europe	All World
	(1)	(2)
Genetic Distance in pre-colonial age, F_{ST}^{16}	3.76***	2.28***
	(0.40)	(0.23)
Constant	0.74***	0.80***
	(0.02)	(0.01)
Two-way Clustered Standard Errors		X
Observations	2,202	8,514
R^2	0.45	0.35
Note:	*p<0.1; **p<0.05; ***p<0.01	

3.3 Motif Distance and Economic Differences

Spolaore and Wacziarg (2016a) show that genetic distance is associated with differences in economic development. They interpret this finding as genetic distances summarize differences between populations in genealogically transmitted characteristics, e.g. customs and habits, that affects economic performance. We take another path by using motifs distance as a direct proxy for social and cultural norms.

We examine if motif distance, as a measure for social and cultural norms, is associated with differences in economic performance between countries. To do this we evaluate if the motif distance correlates with average difference in log GDP per capita (in PPP) for 10 years (between 1990 and 2000) for all pairs of countries. Namely, we estimate pairwise regression of the following form:

$$|\log GDP_i - \log GDP_j| = \beta_0 + \beta_{D^M} D^M_{i,j} + \beta^{'}_X X_{i,j} + u_{i,j}, \tag{2}$$

where $\log GDP_i$ is the logarithm of GDP per capita (in PPP) for 10 years (between 1990 and 2000), $X_{i,j} = |X_i - X_j|$ - is set of absolute difference in control characteristics for each pair of countries, $u_{i,j}$ - error term. The results are reported in table 3.

We see a positive association between motif distance and difference in income across the world (see column 1 of the table 3). The correlation is highly significant ($p = 9.487 \times 10^{-6}$; $t = 4.431$;) and positive ($\beta_{D^M} = 1.138$). Put differently, we identify the following association: The more countries differ in their motif repertoire, the more their economic performance differ.

However, this association can be driven by non-cultural factors such as climate (Gallup et al., 1999; Bloom et al., 1998). To account for this potential bias, we introduce a set of controls (see column 2 of the table 3). We use absolute value of latitude of the country's capital city, measure of distance from the equator (Acemoglu et al., 2000). Specifically, we use ab-

Table 3: Motifs, and Relative GDP

	Dependent variable:	
	Δ Log GDP (1990-2000)	
	(1)	(2)
Motifs Distance, D^M	1.14***	0.76***
	(0.26)	(0.28)
Abs. Latitude Difference		1.21***
		(0.29)
Abs. Diff. in Const. on Executives		0.17***
		(0.03)
Constant	0.37*	0.47**
	(0.21)	(0.22)
Continetal Dummies		X
Two-way Clustered Standard Errors	X	X
Observations	8,128	6,903
Adjusted R^2	0.01	0.18
Note:	*p<0.1; **p<0.05; ***p<0.01	

solute latitude differences between each pair of countries as a control for climate differences. Another widely discussed predictor of economic performance is the quality of institutions. In particular, constraints on executives influence economic development (Acemoglu et al., 2000). Therefore, we include the absolute difference in the level of constraints on executives as proxy for divergence in institutions. Finally, one can argue, the association between motifs and GDP is due to the difference in economic development on different continents. Large bodies of water, e.g. oceans, hamper the spread of motifs and economic interactions. Hence, we might see an association between motifs and GDP due to this geographic difference. We address this issue by controlling for six continental dummies (see column 2 of the table 3). The association between motif distance and economic performance remains after including above mentioned controls ($p = 0.006$; $t = 2.723$; $\beta_{D^M} = 0.755$).

These results suggest a (potential causal) link between cultural and social norms, measured by motif distance, and economic performance. We conjecture that stories reflect cultural and social norms that are transmitted from generation to generation. In turn, those norms determine

economic performance. However, the association might be driven by simultaneous interaction of different factors. For instance, the quality of institutions and culture could co-evolve determining economic performance.

To address the potential endogeniety issue and further assess possible causal link, we use exogenous variation in 16th century genetic distance between countries as an instrument for motif distance. Namely we estimate the next two-stage regression:

$$|\log GDP_i - \log GDP_j| = \beta_0 + \beta_{D^M} D^M_{i,j} + \beta'_X X_{i,j} + u_{Gi,j} \tag{3}$$

$$D^M_{i,j} = \beta_0 + \beta_F F^{16}_{ST\,i,j} + \beta'_X X_{i,j} + u_{Di,j} \tag{4}$$

, X is set of geographic and institutional controls similar to estimations from table 3. We report the results in table 4.

The relevancy assumption of instrumental variable is satisfied: Motif and genetic distance in the 16th century highly correlates (see table 2 and the F-statistic for excluded instrument in table 4) and ample evidence suggests that stories are transmitted from ancestral populations to descendants (da Silva and Tehrani, 2016). We argue that it is unlikely that genetic differences in 16th century have a direct link with economic performance in the 20th century. Thus, it indicates that the exclusion restriction assumption for genetic distance is satisfied.

We observe a relation between motifs distance and the difference in economic performance. The effect is positive and statistically significant (table 4, column 1: $p = 0.005$; $t = 2.824$; $\beta_{D^M} = 1.632$). This relation is robust to including the set of controls (see table 4, column 2: $p = 0.003$; $t = 2.923$; $\beta_{D^M} = 2.214$).The results are robust to alternative specifications (see in appendix, table A2). Taking together, the regression results indicate a relation between differences in cultural and social norms, measured by motif distance, and differences in income between countries.

Table 4: Motifs, Relative GDP, and Genetic Distance

	Dependent variable:	
	Δ Log GDP (1990-2000)	
	(1)	(2)
Motifs Distance	1.63***	2.21***
	(0.58)	(0.76)
Abs. Latitude Difference		0.90***
		(0.31)
Abs. Diff. in Const. on Executives		0.17***
		(0.03)
Constant	-0.08	-0.66
	(0.49)	(0.60)
Instrument: Pre-colonial Genetic Distance	X	X
Continetal Dummies		X
Two-way Clustered Standard Errors	X	X
F-test of excluded instrument	97.73	122.95
Observations	7,875	6,670
Adjusted R^2	0.01	0.16
Note:	*p<0.1; **p<0.05; ***p<0.01	

4 Conclusion

In a nutshell, heterogeneity of human behavior across the world and its persistence are well-documented (Henrich, 2000; Henrich et al., 2001; Gächter and Schulz, 2016; Pascual-Ezama et al., 2015; Mazar and Aggarwal, 2011). Moreover, evidence points out to the importance of cultural and social norms for economic prosperity (Gorodnichenko and Roland, 2016; Tabellini, 2010; Falk et al., 2018). However, the channel of transmission of cultural and social norms has remained as a block box. We shed light on this issue by pointing towards socialization (Bisin and Verdier, 2011; Dohmen et al., 2012) through exposure to specific narratives as a transmission channel of social norms and economic behavior.

We show that countries' motif repertoires are associated with microeconomic behavior and macroeconomic outcomes. We apply machine learning techniques to show that individual choices in economic experiments are related to the stories present in the country of experiment.

Moreover, we provide evidence that differences in economic performance are associated with differences in motif repertoire across countries. This relation remains stable when we include a set of control variables and instrument motif distance with pre-colonial genetic distance.

Our study opens up an avenue for further research on motif repertoires as a proxy for cultural and social differences, and their relation to economic outcomes. One can explore the association between specific motifs and pro-social behavior, happiness, or gender issues. Furthermore, one can test in lab or field experiments if motifs that highly correlate with certain behavior across the world have an impact on these types of behavior. In a nutshell, this study makes a first step to promote the exploration of world folktale narratives for understanding of economic behavior.

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Online Appendix for Folktale Narratives and Economic Behavior

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1 Supplementary Text

This section discusses the evidence presented in the supplementary tables and figures.

Distribution of choices conditional on the presence of the motif in the country. Figure A1 depicts the cumulative distribution of giving a share in dictator game (left) and claims in the die-in-cup task (right) conditional on the presence of the motif in the country.

In case of dictator game (left), in countries where the motif "Stairs of stones/Girl-Helper" is present (red dotted line), the cumulative distribution function tends to be below the cumulative distribution function from the countries without this motif (black line). That is, we observe that subjects have the tendency to give more, exhibit more pro-social behavior in countries, where the motif "Stairs of stones/Girl-Helper" is present.

In case of die-in-cup task (right), we observe that cumulative distribution function in countries with the motif "Brides for first men" (red dotted line) is shifted toward the right as compared countries without this motif (black line). Thus, we observe that subjects tend to make more often high claims in countries where "Brides for first men" motif is present or deviate more from the full honest benchmark.

Motif Distance Index. Table A1 shows the descriptive characteristics of the motif distance index based on all pairs of countries.

Maps of motif similarity between countries. Figure A2-A4 plot the relation between countries in Europe (Fig. A2), Western Asia(Fig. A3), Africa (Fig. A4) based on similarity of motif repertoire between them ($1 - D^M$). The presence of connecting red line indicates that the level of similarity is above one standard deviation from the world average of similarity of motif repertoire. The thickness of the line indicates the level: Thicker the lines more similar countries in their motif repertoire (higher similarity).

Robustness check. Table A2 provide robustness check of alternative model specifications that estimate relation between motif distance index and relative GDP instrumented by genetic distance in 16th century. One can see that relation between motif distance index and relative economic performance holds in those specifications as well.

2 Tables and Figures

Table A1: Motif Distance Index, D^M

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
Motif distance, D^M	9,315	0.90	0.09	0.32	0.86	0.96	1.00

Table A2: Motifs, Institutions, and GDP

	Dependent variable:			
	Δ Log GDP (1990-2000)			
	(1)	(2)	(3)	(4)
Motifs Distance	1.47**	3.02***	1.38***	2.60***
	(0.58)	(0.92)	(0.49)	(0.70)
Absolute Latitude Difference	1.35***	1.06***		
	(0.32)	(0.35)		
Abs. Diff. in Const. on Executives			0.19***	0.18***
			(0.03)	(0.03)
Constant	-0.22	-1.04	-0.26	-0.79
	(0.50)	(0.72)	(0.43)	(0.59)
Instrument: Pre-colonial Genetic Distance	X	X	X	X
Continetal Dummies		X		X
Two-way Clustered Standard Errors	X	X	X	X
F-test of excluded instrument	122.95	116.41	96.32	82.13
Observations	6,903	6,903	7,260	7,009
Adjusted R^2	0.07	0.07	0.12	0.13
Note:				*p<0.1; **p<0.05; ***p<0.01

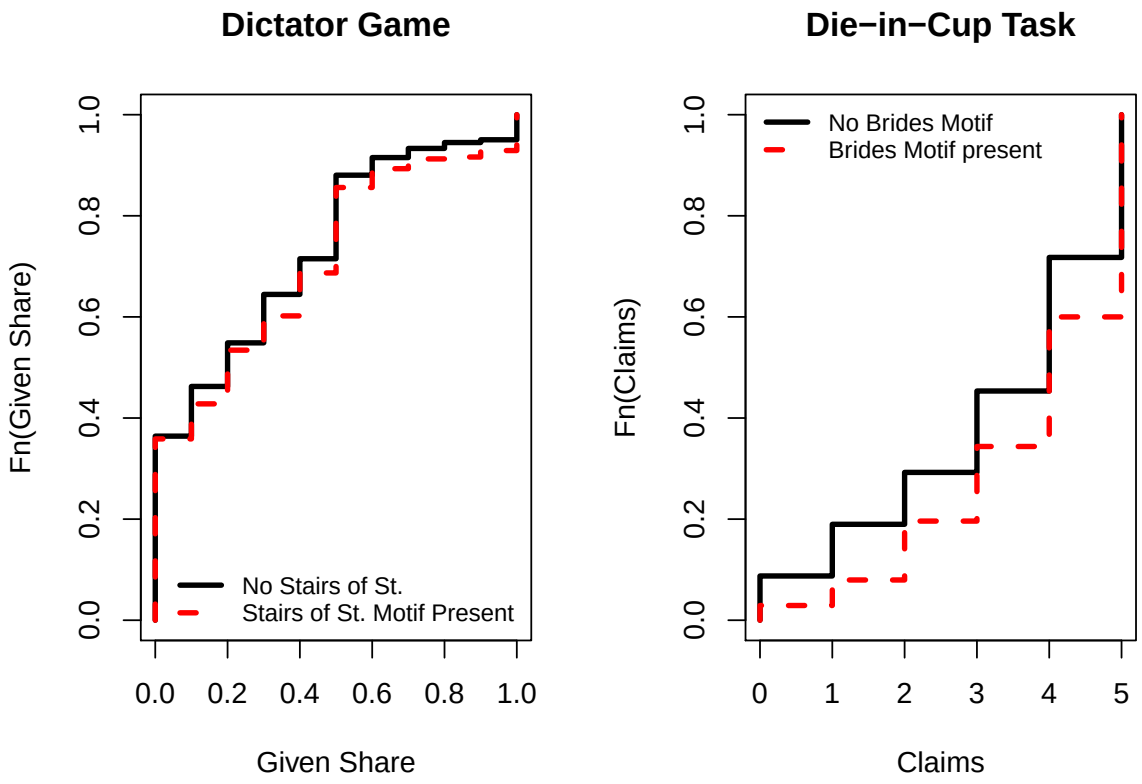

Figure A1: Cumulative distribution of Giving in dictator game (left) and claims in the die-in-cup task (right) conditioned on presence of motif in the country.

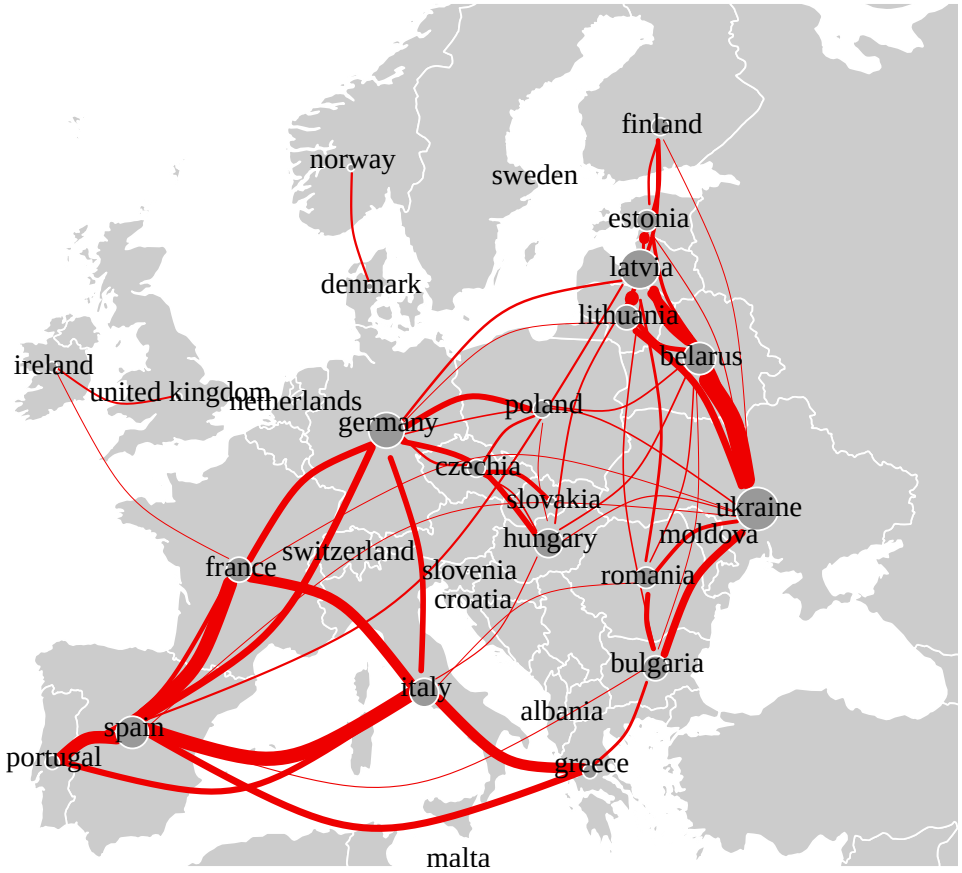

Figure A2: Motifs similarity ($1 - D^M$) above one standard deviation of the mean for European countries.

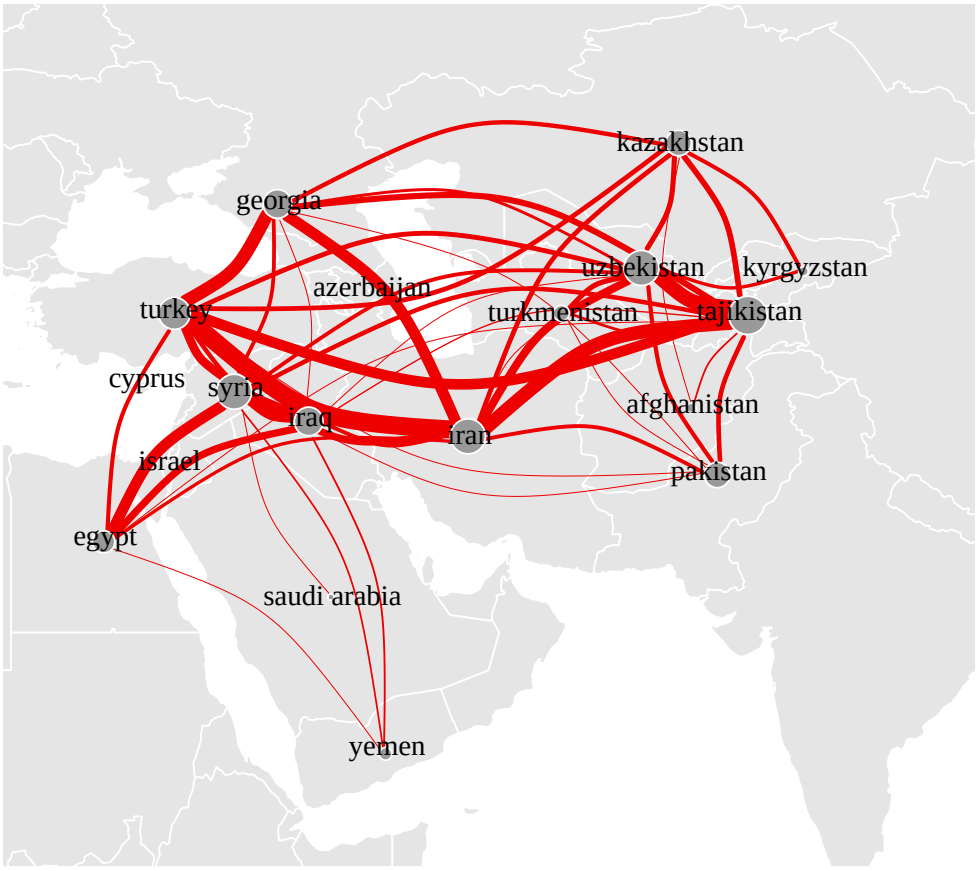

Figure A3: Motifs similarity ($1 - D^M$) above one half of standard deviation of the mean for Western Asian countries.

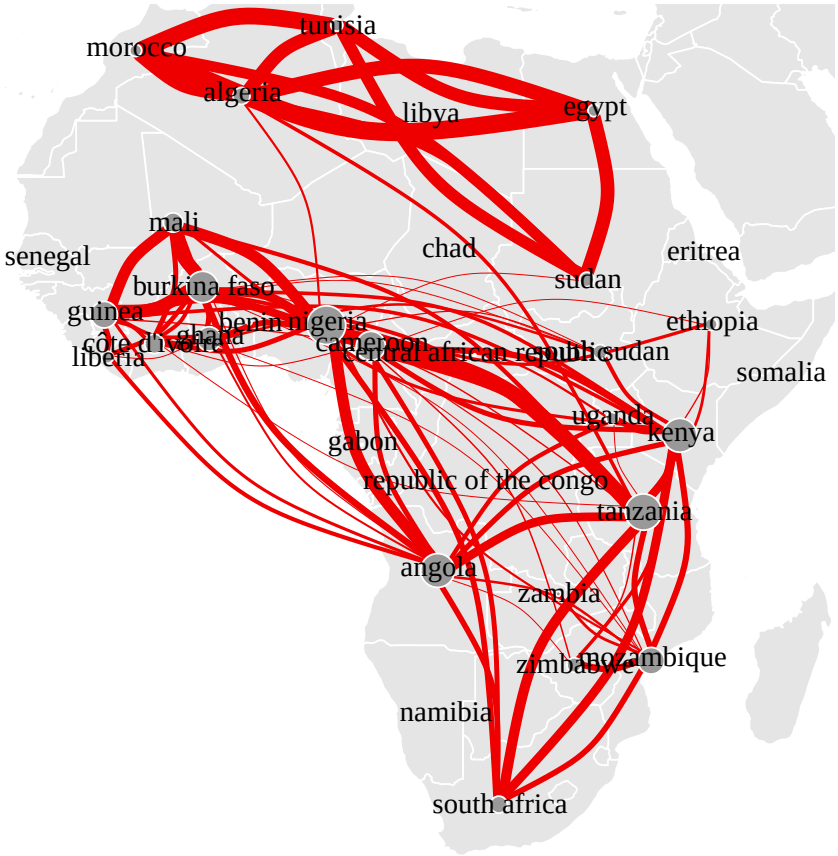

Figure A4: Motifs similarity ($1 - D^M$) above one standard deviation of the mean for African countries.