Overbidding and Heterogeneous Behavior in Contest Experiments:

A Meta-Comment on Cross-Cultural Differences

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Abstract

We revisit the analyses by Sheremeta (2013) and Chowdhury and Moffatt (2017), who pool experimental data from 30 Tullock contests to explain the phenomenon of overbidding. The authors find that the overbidding rate is positively related to the number of contestants and has an inverted U-shaped relationship with the relative endowment. We reuse their data and extend the analysis in the direction of cross-cultural differences, focusing on ethno-linguistic-religious fractionalization as a country-level measure. The results suggest an increased explanatory power of the model, with fractionalization negatively relating to overbidding. In addition, the extended model shows that in the one-shot game the overbidding rate is significantly higher than in the case of repeated interactions. We discuss possible interpretations of our findings.

Keywords: meta-analysis; contests; experiments; overbidding; fractionalization.
JEL classification codes: C90; D72; D74.

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1 Introduction

Contests are widespread phenomena that concretely take the shape of rent-seeking competitions, patent races, or competitions for promotion, just to name a few (Konrad, 2009). In many environments multiple individuals expend irreversible resources (often called *efforts*) to win a prize, and an individual's probability of winning the prize depends on the individual's expenditure relative to the expenditure of other agents. As pointed out in Chowdhury (2021), the latter description lends itself to defining conflicts as well, fostering the joint analysis of the two phenomena under the same theoretical framework.

Given the notorious difficulty in measuring efforts in real-world contests, lab experiments have traditionally played a crucial role in this literature, allowing scholars to draw causal conclusions.[1] By focusing on contests à la Tullock (1980), Sheremeta (2013) conducts one of the most influential literature reviews of contest experiments in an attempt to investigate two pervasive outcomes observed in a large majority of studies: *overbidding* relative to the standard Nash equilibrium prediction, and *heterogeneous behavior* of the contestants. The author pools experimental data from 30 studies, and runs a regression in which the overbidding rate is found to be positively related to the number of contestants and the relative (to the prize value) size of the endowment. Chowdhury and Moffatt (2017) add to the analysis of Sheremeta (2013), finding evidence for an inverted U-shaped relationship between relative endowment and overbidding. One notable null result in Sheremeta (2013) and Chowdhury and Moffatt (2017) is no effect of repetition in effort allocation, that is, both studies find that the overbidding rate is not different between one-shot and repeated experiments.

Relying on the fact that conflict intensity can be modeled as effort expenditure in a Tullock contest, we aim to extend the analyses of Sheremeta (2013) and Chowdhury and Moffatt (2017) in the direction of cross-cultural differences. Consequently, we further explain the overbidding rate (a proxy for conflict intensity) in Tullock contests by focusing on fractionalization as a country-level measure of culture. Fractionalization is traditionally defined as the probability that two randomly drawn individuals from a population belong to two different groups. It is also a typical identity-related determinant of conflict commonly measured along the ethnic, linguistic, and religious dimensions (Alesina et al., 2003). Reviewing the emerging literature on identity and conflict, Chowdhury (2021) concludes that fractionalization is a significant determinant when the winners of the conflict enjoy a private good reward.

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[1]Indeed, field researchers are only able to observe the performance of contestants, which nevertheless is a function not only of effort, but also of the institutional rules, available information, ability, and luck (Ericsson and Charness, 1994; Chowdhury et al., 2023).

We make two distinct contributions to this literature. First, by reusing the same data as Sheremeta (2013) and Chowdhury and Moffatt (2017) (where the prize is a private good) and including fractionalization statistics as a country-level cultural indicator, we aim to provide preliminary insights into the role played by fractionalization in overbidding. To the best of our knowledge this is the first study in contest theory that, following the same modus operandi as other meta-analyses (Lane, 2016; Marini, 2023, 2022), combines non-experimental with experimental data.

Second, we test whether our extended analysis can replicate the findings of Sheremeta (2013) and Chowdhury and Moffatt (2017) with a particular focus on the null result related to learning in Tullock contests, which contradicts a substantial body of literature (Davis and Reilly, 1998; Fonseca, 2009; Sheremeta, 2010; Mago et al., 2016; Baik et al., 2021).

2 Data and methodology

In a basic Tullock (1980) contest there are N players individually competing for a common-value prize of v. Each player i has an endowment B and invests an effort $e_i \geq 0$. Player i's probability of winning the prize is defined by the Contest Success Function (CSF):

$$p_i(e_i, \mathbf{e_{-i}}) = \begin{cases} \frac{e_i}{e_i + \mathbf{e_{-i}}} & \text{if} \quad e_i + \mathbf{e_{-i}} > 0 \\ \frac{1}{N} & \text{otherwise} \end{cases} \tag{1}$$

where $\mathbf{e_{-i}}$ is the total effort spent by players other than i.

Given the CSF, the expected payoff for player i is

$$E(\pi_i(e_i, \mathbf{e_{-i}})) = p_i(e_i, \mathbf{e_{-i}})v + [B - c(e_i)] \tag{2}$$

where $c(e)$ is the cost of applying effort level e with standard properties.

Under the assumptions that costs are linear and the players are risk-neutral, the unique Nash equilibrium effort level for each player (Szidarovszky and Okuguchi, 1997; Chowdhury and Sheremeta, 2011) is given by

$$e^* = \frac{(n-1)}{n^2}v$$

Sheremeta (2013) pools 39 observations from 30 experimental studies that implement this game in the laboratory, thereby defining the outcome variable o as the average *Overbidding_rate* for each observation:

$$o = (e - e^*)/e^*$$

The number of observations from a single study ranges from one to five, as shown in Table 1 of Sheremeta (2013) that reports the full dataset and list of included studies. It is worth pointing out that this exercise (and, by extension, our re-elaboration) does not fully comply with best practices in meta-analysis, nevertheless it can be regarded as a thought-provoking example to inform more systematic meta-studies.[2]

As to the choice of regressors, Sheremeta (2013) codes *Number_of_players* participating in the contest and *Rel_endowment*, namely, the amount of experimental currency at subjects' disposal divided by the prize value (B/v). After observing a positive effect of both variables on overbidding, the author puts forward a possible explanation in terms of bounded rationality captured by Quantal Response Equilibrium (QRE) (Sheremeta, 2011; Chowdhury et al., 2014; Lim et al., 2014).

Sheremeta (2013) also investigates the role of learning by means of dummies: *One-shot_game*, and matching protocol (*Partner_matching* versus *Stranger_matching*). In this regard, although in the presence of the partner matching protocol (i.e., when players face the same opponents in all rounds) one may expect lower expended efforts out of collusion, this theory is not supported by the data. Similarly, there is no evidence from this model that the feedback from repeated interactions helps subjects better understand the incentives underlying the game, as compared with the one-shot game.

Adding to the analysis of Sheremeta (2013), Chowdhury and Moffatt (2017) include the *Rel_endowment_squared* among the regressors and find an inverted U-shaped relationship between relative endowment and overbidding, which the authors interpret in terms of a wealth effect above a certain level of endowment. In other words, at low values of the relative en-

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[2]For instance, overbidding rates are not weighted through WLS due to unavailability of related standard errors and sample sizes. These deviations from best practices are extensively discussed in Chowdhury and Moffatt (2017).

dowment, an increase in the endowment implies larger strategy space and greater scope for mistakes, resulting in higher average bids. However, if the endowment is too large, subjects perceive it as wealth and reduce their own bids due to lower marginal utility of winning the prize (Baik et al., 2020).

In the same fashion as in other meta-analyses (Lane, 2016; Marini, 2023, 2022), we also code country-level *Fractionalization* as the average of the ethnic, linguistic, and religious dimensions provided by Alesina et al. (2003). Therefore, *Fractionalization* measures the probability that any two citizens of a country belong to a different ethno-linguistic-religious group. The 30 included studies take place in five different countries (USA, UK, Germany, Netherlands, and Italy). In addition, given that *Fractionalization* is a country-level aggregate indicator, we also control for additional country-level cultural variables such as *Individualism*, *Masculinity*, and *Uncertainty_avoidance* from the Hofstede Centre (Hofstede, 2001).

3   Analysis and results

As a prelude to the main analysis, in Figure 1 we construct a scatterplot illustrating the relationship between *Fractionalization* and *Overbidding_rate*. Given that the related Lowess smoother appears to be mostly flat, Table 1 introduces four OLS regression models by which we seek to shed light on the role played by such cross-cultural differences in contest experiments.

Column (1) simply replicates equation (4) of Sheremeta (2013) and finds that the overbidding rate is positively predicted by the relative endowment and the number of contestants ($p = 0.044$ and $p < 0.001$, respectively). In relation to this model, where standard errors are not clustered and the Adjusted R-squared amounts to 44.86%, the author speculates that subjects increasingly make errors out of confusion not only as the initial endowment and the strategy space become larger, but also as competition intensifies.

Column (2) reports the model by which Chowdhury and Moffatt (2017) add to the analysis in their Table 1. This specification builds on the previous conclusions by including the square of relative endowment as an additional regressor, whose negative significant coefficient ($p = 0.015$) provides evidence for an inverted U-shaped relationship between relative endowment and overbidding. Bringing about an increase of approximately 9% in the Adjusted R-squared, this finding originates from a model with standard errors clustered at the study level, and is then interpreted in terms of a wealth effect (Baik et al., 2020).

Next, we further extend the analysis in the direction of cross-cultural differences in model (3), where the addition of ethno-linguistic-religious *Fractionalization* entails an increased ex-

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Figure 1: Lowess smoother
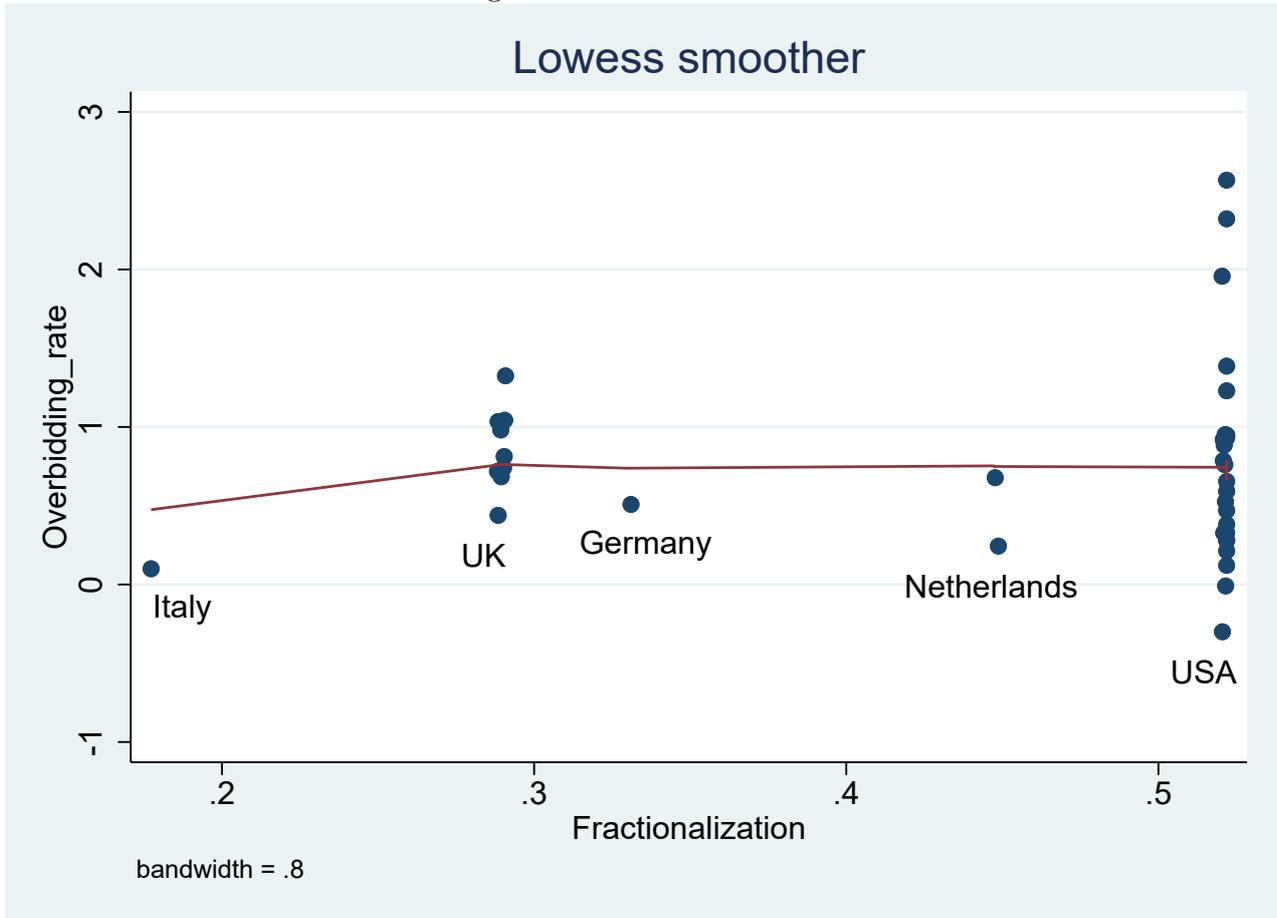
planatory power of the model, with the Adjusted R-squared rising from 53.828% to 60.628%. Note that this means the subjects from relatively more fractionalized countries tend to place significantly lower bids ($p = 0.005$). This result turns out to be robust to the inclusion of *Individualism*, *Masculinity*, and *Uncertainty_avoidance* in the fourth model.[3]

Result 1. *The overbidding rate is negatively related to fractionalization.*

This represents preliminary evidence for an active role of fractionalization in contest experiments. While at first glance this result may seem surprising, it is actually a plausible one in light of previous studies that detect a non-monotonic relationship between fraction-

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[3]Because of multicollinearity problems, it was not possible to add further country-level cultural controls nor the square of *Fractionalization*.

alization and conflict. Indeed, both theoretical and empirical contributions agree that the intensity of conflict appears to be maximized at a moderate level of fractionalization (Collier and Hoeffler, 1998; Esteban and Ray, 2008; Chowdhury, 2021). However, only five levels taken by this variable in our dataset may not allow us to fully capture such a nonlinear relationship.

Table 1: OLS regressions

		Dependent variable: Overbidding_rate		
	(1) Sheremeta	(2) Chowdhury and Moffatt	(3) Extended model	(4) Extended model with controls
Rel_endowment	0.431**	2.373***	3.065***	3.089***
	(0.206)	(0.792)	(0.662)	(0.766)
Rel_endowment_squared		-0.815**	-1.123***	-1.137***
		(0.315)	(0.277)	(0.304)
Number_of_players	0.204***	0.199***	0.212***	0.208***
	(0.041)	(0.031)	(0.036)	(0.038)
Partner_matching	-0.078	0.019	-0.007	-0.024
	(0.169)	(0.142)	(0.118)	(0.136)
One-shot_game	0.293	0.341*	0.449***	0.445***
	(0.198)	(0.170)	(0.145)	(0.153)
Fractionalization			-1.664***	-1.070**
			(0.554)	(0.504)
Constant	-0.411	-1.472***	-1.121***	0.474
	(0.271)	(0.466)	(0.347)	(0.732)
Cultural controls	No	No	No	Yes
R-squared (%)	50.664	59.903	66.845	67.507
Adj. R-squared (%)	44.860	53.828	60.628	57.423
No. of observations	39	39	39	39

Coefficient estimates from OLS regression models, with standard errors in parentheses that are clustered at the study level in models (2), (3), and (4). *Stranger_matching* is the omitted category. The label "Cultural controls" includes *Individualism*, *Masculinity*, and *Uncertainty_avoidance*.
***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively.

Another interesting finding concerns the fact that, after cultural variables are taken into account and standard errors are clustered, experience reduces overbidding. Indeed, the positive coefficient of the dummy *One-shot_game* in columns (3) and (4) reaches statistical significance at the 1% level ($p = 0.004$ and $p = 0.007$, respectively). As noted in Sheremeta (2013) and Chowdhury and Moffatt (2017), this tallies with the idea that players in the one-shot game end up overbidding largely since they cannot reap the benefits of learning. Also, we can fully ascribe the outcome to inexperience, given that it results from a comparison with the omitted category *Stranger_matching*, namely, a case where collusion is infeasible as players face different opponents over rounds.[4]

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[4]Coherently, a linear restriction test performed on regression coefficients finds that in the one-shot game

Result 2. *In one-shot contests the overbidding rate is higher than in repeated contests.*

4 Conclusions

We revisit the analyses by Sheremeta (2013) and Chowdhury and Moffatt (2017) who pool experimental data from 30 studies for the purpose of explaining overbidding in Tullock contests. In this note we reuse their data and extend the analysis in the direction of cross-cultural differences, focusing on ethno-linguistic-religious fractionalization as a country-level measure.

Once we include fractionalization as an additional regressor, the results suggest an increased explanatory power of the model, with fractionalization negatively relating to overbidding. In other words, subjects from relatively more fractionalized countries tend to place significantly lower bids. Note that the 30 experiments were run in five Western countries where, unlike in other parts of the world, fractionalization has not led to meaningful level of violent conflict in recent years. Moreover, lower conflict intensity in relatively more fractionalized countries may result from out-group exposure. Indeed, it is known that such exposure reduces conflict between different ethnic groups (Hooijsma and Juvonen, 2021), and hence this may be reflected in bidding behavior. Also, the only five levels taken by this variable in our dataset do not allow us to capture the full spectrum of the nonlinear relationship detected by previous studies. Accordingly, we prefer to caution against early interpretations and in this regard we call for further research relying on a greater number of countries.

Compared to Sheremeta (2013) and Chowdhury and Moffatt (2017), the extended model also discovers that in the one-shot game the overbidding rate is significantly higher than in the case of repeated interactions, which is in line with a substantial body of literature. This outcome can be fully ascribed to inexperience and poor understanding of the game incentives, whereas we find no evidence that players reduce their expended efforts over periods out of collusion. The latter point alludes to the chance of using the partner matching in place of the random matching protocol, with ensuing advantages in terms of independent observations.

Finally, the current dataset does not allow for full compliance with best practices in meta-analysis, nevetheless the related results are supposed to inform more systematic and conclusive meta-studies, which will enrich our knowledge in this area by virtue of higher heterogeneity in cross-cultural factors and explanatory variables.

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subjects place higher bids than in the presence of the partner matching protocol ($p = 0.015$ and $p = 0.019$ in models (3) and (4), respectively).

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