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Horizontal and Vertical Conflict: Experimental Evidence

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I. INTRODUCTION

For a variety of reasons, citizens often have heterogenous preferences over public policies. At the same time, they all share a common interest in controlling the persons in charge of implementing those public policies. The relationship between horizontal conflicts of interest (different citizens support different policies) and vertical conflicts of interest (those in charge of implementing policies extract rents from the rest of the society) is one of the fundamental issues in political economy. For example, consider the connection between inequality and corruption, or ethnolinguistic heterogeneity and political rents. Even the differences between the progressive and liberal schools of thought are, to some extent, based on how much importance they place on horizontal versus vertical conflict.

Although a great deal of progress has been made by focusing on one or the other of these dimensions, the exact nature of the connections between the two is still one of the hardest nuts that, both theoretically and empirically, has yet to be cracked in the realm of political economy. At the theoretical level, electoral models typically stress horizontal conflict, while principal-agent models typically stress vertical conflict. Few formal models include horizontal and vertical issues simultaneously to study the connections between the two. Polo (1998) and Dixit et al. (1997) are two notable exceptions. Polo (1998) extends Downs' electoral competition model to incorporate endogenous rents. Dixit et al. (1997) extend the principal-agent model by introducing multiple principals who try to influence a common agent. However, the theoretical implications of these models regarding the relationship between the intensity of horizontal conflict and rents have not been fully derived nor empirically tested.

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In this paper, we first set forth that some variations of electoral and common-agency models implicitly predict that more intense horizontal conflict among voters and/or lobby groups is associated with higher rents for candidates and/or government officials. Then, we carefully explain the channels through which horizontal conflict spurs higher rents for those in charge of implementing policies. Finally, we test this theoretical prediction using two laboratory experiments. To the best of our knowledge, this is the first paper that empirically studies the effect of the intensity of horizontal conflict on rents using a randomized controlled trial.

For our first experiment, we used a simple version of the electoral model with endogenous rents presented in Polo (1998). The setup is as follows: There are 8 voters, each with an initial endowment. There is a public good that is paid for by a proportional tax on voters' endowments. Two candidates simultaneously propose a tax rate and a level of the public good in question. The difference between tax receipts and the amount required to pay for the public good is a political rent that will be collected by the candidate who wins the election. Each voter receives extra points if a particular candidate wins the election. The candidates only know the probability distribution of these extra points. We study four treatments. In treatments 1 and 2, all voters have the same endowment, while in treatments 3 and 4, some voters have a larger endowment. In treatments 1 and 3, the variance of the distribution of extra points is low, while in treatments 2 and 4, it is high. According to the theoretical predictions of this model, we expect that, *ceteris paribus*, in those scenarios where there is a higher level of inequality (treatments 3 and 4) or a higher level of electoral uncertainty (treatments 2 and 4), the elected candidate obtains more rents.

We find evidence that supports the electoral model's prediction that higher inequality leads to higher political rents. As is common in laboratory experiments (see, among others, Galiani et al., 2014b for a discussion of this issue), the effects do not fit the model's predictions perfectly in quantitative terms. Indeed, the estimated effects of inequality on rents are smaller than what our baseline model predicts. However, once we enrich the model with more general risk preferences for the candidates, this gap narrows significantly. Regarding electoral uncertainty, we do not find evidence that higher electoral uncertainty induces higher rents. Moreover, we show that the candidates' risk preferences are probably not the reason of this result.

For our second experiment, we used a simple version of the common-agency model as outlined in Dixit et al. (1997). There are two principals and one agent, each with an initial endowment. As in our first experiment, there is a public good that is paid for with the receipts from a proportional tax on endowments. The principals simultaneously offer a schedule of contributions to the agent, who then selects an alternative. We consider three treatments. In treatment 1, all players have the same initial endowment. In treatments 2 and 3, one of the principals has a higher endowment than the other, while the common agent has an

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endowment equal to the average of the two principals' endowments, but in treatment 3, the difference between the endowments of the two principals is greater than it is in treatment 2. Thus, treatment 1 captures a scenario of no horizontal conflict, while treatments 2 and 3 successively increase horizontal conflict between the principals. According to the theoretical predictions of this model, we expect that, in those scenarios where there is greater inequality and, therefore, more intense horizontal conflict between the two principals, the rents for the agent are higher. In other words, we expect higher rents for the agent in treatment 2 than for the agent in treatment 1 and higher rents for the agent in treatment 3 than for the agent in treatment 2.

We find a positive effect for inequality on rents and payoffs when we compare treatment 1 with treatment 2 and treatment 2 with treatment 3. The effects, however, are smaller than we would expect on the basis of the model's predictions. The gap between observed and predicted rents diminishes, but it does not disappear, when we focus on the group of subjects who had a better understanding of the game, as measured by a quiz that we administered before subjects began playing the rounds. We also show that the risk preferences of the principals are probably not the underlying cause of these gaps.

Our findings have important policy implications. For example, anti-corruption programs usually emphasize the role of payment schemes, controls and audits, while our results also suggest mitigating horizontal conflict and improving monitoring in areas with intense horizontal conflict.

The rest of the paper is organized as follows. In Section II we briefly discuss related literature in experimental economics. In section III, we focus on electoral games with endogenous rents. We adapt a model developed by Polo (1998) to the laboratory setting and test its main predictions. In section IV, we focus on common-agency games. We adapt a model developed by Dixit et al. (1997) to the laboratory setting and test its main predictions. In section V, we present our conclusions.

II. RELATED LITERATURE

Three areas of experimental studies are related to our work. First, there is a vast body of experimental literature on electoral games. Second, there are many experimental works that deal with principal-agent games, although not many focus on common-agency games. Finally, there are several experiments that focus on contests and all-pay auctions.

II.1. Electoral Games

Our first experiment is related to the existing experimental literature on electoral competition. McKelvey and Ordeshook (1990) surveyed experiments that

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examine the hypothesis of platform convergence to the median preferred policy in the Downsian model with purely office-motivated candidates. They considered different scenarios and found that platforms converge even when voters are not fully informed. Morton (1993) supplemented those studies by conducting a laboratory experiment to assess the hypothesis that platforms diverge when candidates have policy preferences and there is uncertainty about voters' preferences. He found that platforms do indeed diverge but that, on average, candidate positions are more convergent than the theory predicts, suggesting that the subjects value winning independently of the expected payment. As in the works surveyed by McKelvey and Ordeshook (1990), in our experiment, candidates do not have policy preferences and, hence, their platforms are expected to converge. Analogous to the model in Morton (1993), candidates are uncertain about voter's preferences, which leads to positive political rents in equilibrium. The reason, as discussed in Polo (1998), is that electoral uncertainty lessens candidates' incentives to reduce rents in order to capture more votes.

Other studies have experimented with variations of the standard electoral models. For example, Aragones and Palfrey (2004) reported experimental results concerning the effects of exogenous quality differences in the candidates (i.e., valence asymmetries) on the location of the equilibrium policies in a one-dimensional policy space. In general, they found support for theoretical predictions (e.g., the better candidate adopts more centrist policies than the worse candidate does). Drouvelis et al. (2014) conducted a theoretical and experimental study on the set of Nash equilibria of a classical one-dimensional electoral game with two candidates who are interested in power and ideology, but who place values on these two factors that are not necessarily identical. They also found that experimental evidence supports the theoretical predictions. One difference between Aragones and Palfrey (2004) and our experiment is that political rents in Polo (1998) work as endogenous quality differences between the candidates. In Drouvelis et al. (2014), there is a more opportunistic candidate who places more weight on winning the election. However, this is not equivalent to vertical conflict between the candidates and the voters. More importantly, none of these works provides predictions on the connection between horizontal heterogeneity in voters' preferences and candidates' rents.

II.2. Principal-Agent Games

Our second experiment is related to several studies which have experimented with principal-agent games. Many authors have conducted experiments with principal-agent games in which there is a single principal. For example, Güth et al. (1998) conducted an experiment with a multi-period principal-agent game in which the principal has to offer linear profit-sharing contracts to the agent. Fehr and Schmidt (2004) experimented with a two-task principal-agent game

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in which only one task can be contracted out. Keser and Willinger (2007) conducted a laboratory experiment with a principal–agent game involving moral hazard. Unfortunately, these studies focus entirely on vertical conflict and cannot be used to gain an understanding of the connections between horizontal and vertical conflicts.

The study conducted by Kirchsteiger and Prat (2001), who considered a common-agency game, is closer to our work. The standard equilibrium concept for common-agency games is a truthful equilibrium (Dixit et al., 1997). Kirchsteiger and Prat identify a new class of equilibria, which they called "natural equilibria". In their scenario, each principal offers a positive contribution on at most one collective decision. They conducted a laboratory experiment using a common-agency game for which the two notions of equilibria predict a different equilibrium outcome. They found that the natural equilibrium is chosen in 65% of the matches, while the truthful equilibrium is chosen in less than 5% of the matches. This is not an issue in our experiment, since the existence of different types of equilibria does not affect the comparative static predictions of the common-agency model, which is the focus of our work.

II.3. Contests and All-Pay Auctions

Our experiments are also related to the literature on contests and all-pay auctions. Hillman and Riley (1989) developed a model of politically contestable rents and transfers in which all players make payments in order to exert political influence, regardless of the final outcome. When players' valuations are asymmetric, these authors show that only the two players with the highest valuations enter the contest and total expected payments are lower than the value of the politically allocated prize. Moreover, as the ratio of the highest to the second-highest valuations increases, total expected payments decrease (Corollary 1 in Hillman and Riley, 1989). Thus, in contrast to our experiments, in the all-pay auction model of political influence, horizontal heterogeneity reduces political rents. Several experimental studies with all-pay auction models have been conducted. For example, Shogren and Baik (1991) reported on experimental behavior in Tullock's efficient rent-seeking game and found outcomes consistent with predicted behavior and rent dissipation. Davis and Reilly (1998) reported the result of an experiment with an all-pay auction game with four players. Potters et al. (1998) reported on experiments that used both the Tullock probabilistic and highest-bid (discriminating or all-pay auction) contest success functions. Gneezy and Smorodinsky (2006) experimented with a repeated all-pay auction game with complete information, perfect recall and common values. However, to the best of our knowledge, there is no experimental study employing all-pay auction models that has tested the hypothesis that expected political rents are lower when asymmetry in the two highest valuations increases.

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III. ELECTORAL COMPETITION WITH ENDOGENOUS RENTS

In this section, we study the connections between income inequality and political rents in the context of electoral competition. In section III.1, we briefly describe a model of electoral competition with endogenous rents due to Polo (1998). In section III.2, we use this model to derive experimental treatments. In section III.3, we describe the laboratory experiment. In section III.4, we show that subjects understood the electoral competition game and that the randomization was balanced. In section III.5, we present descriptive statistics and, in section III.6, we formally test theoretical predictions using regression analyses and then discuss the results.

III.1. Electoral Model with Endogenous Rents

Polo (1998) developed a model of electoral competition with endogenous rents. In the model, there are I citizens indexed by i and two candidates who simultaneously decide on their platforms. Let (τ^j, g^j) be the platform proposed by candidate j = 1, 2. A platform consists of an income tax rate $\tau^j \in [0, 1]$ and a per capita level of public goods $g^j \geq 0$. The government budget constraint is given by $\tau^j y = g^j + \frac{r^j}{I}$, where $y = \frac{\sum_{i=1}^{I} y^i}{I}$ is the average income in the society and $r^j \geq 0$ are the rents that candidate j will obtain if s/he is elected. If candidate j wins the election, his/her payoff is given by $v^{C,\,j} = r^j$. The payoff for voter i from the platform of candidate j is given by:

$$v^{V,i} = \left(1 - \tau^j\right)y^i + H\left(g^j\right) + \beta^j,$$

where y^i is the income of voter i, H is a strictly increasing, strictly concave and twice continuously differentiable function; and β^j is the valence shock of candidate j. Moreover, assume $\beta = \beta^2 - \beta^1$is distributed with a normal distribution with mean 0 and standard deviation σ, i.e., $\beta \sim N(0, \sigma^2)$.

The timing of event is as follows. First, candidates simultaneously and independently select their platforms. Second, the valence shock for each candidate is realized and observe by voters. Third, voters cast their vote. That is, when candidates select their platforms, they only know the distribution function of $\beta = \beta^2 - \beta^1$, but they don't observe the realization of β. Voters, on the other hand, observe the realization of β before casting their votes.

To characterize the equilibrium of the model, it is useful to employ backward induction. Suppose that candidates have selected the platforms (τ^1, g^2) and (τ^2, g^2) and the realization of the valence shocks is such that $\beta = \beta^2 - \beta^1$. Then, voter i votes for candidate 1 if and only if $(\tau^2 - \tau^1)y^i + H(g^1) - H(g^2) > \beta$. Therefore, candidate 1 wins the election if and only $(\tau^2 - \tau^1)y^m + H(g^1) - H(g^2) > \beta$,

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where y^m is the median income. When candidates choose their platforms, the valence shock β has not been yet realized. Thus, from the perspective of the candidates, the probability that candidate 1 wins the election is given by $F(H(g^1) - H(g^2) - (\tau^1 - \tau^2)y^m)$,where F is the cumulative distribution function of β. Hence, when the platforms are (τ^1, g^1) and (τ^2, g^2), the expected payoff for candidates 1 and 2 are:

$$\mathbf{E}\left[v^{C,1}\right] = I\left(\tau^1 y - g^1\right)F\left(H\left(g^1\right) - H\left(g^2\right) - \left(\tau^1 - \tau^2\right)y^m\right),$$
$$\mathbf{E}[v^{C,2}] = I(\tau^2 y - g^2)[1 - F(H(g^1) - H(g^2) - (\tau^1 - \tau^2)y^m)],$$

respectively. It only rest to characterize the equilibrium platforms chosen by the candidates, given that candidate j selects (τ^j, g^j) to maximize $\mathbf{E}[v^{C,j}]$. Following Polo (1998), it is possible to find conditions under which there is a unique symmetric Nash equilibrium (see Appendix A.1 for details). Proposition 1 summarizes the results.

Proposition 1. *Suppose that $\beta \sim N(0, \sigma^2)$ and $g^m < y - \frac{y\sigma\sqrt{2\pi}}{2y^m}$, where g^m is the unique solution to $H'(g^m) = \frac{y^m}{y}$. Then, the electoral competition game has a unique symmetric local Nash equilibrium characterized by $g^1 = g^2 = g^m$ and $\tau^1 = \tau^2 = \frac{\sigma\sqrt{2\pi}}{2y^m} + \frac{g^m}{y}$. In equilibrium, each candidate wins with a probability of 1/2 and equilibrium rents are $r = I\frac{y\sigma\sqrt{2\pi}}{2y^m}$.* ***Proof****: see Appendix A.1.* ∎

The intuition behind Proposition 1 is as follows. Voters do not like the idea of government rents because, from their point of view, they are simply excessive taxation. This suggests that electoral competition will tend to eliminate political rents. Indeed, this is the case, when there is no electoral uncertainty ($\sigma = 0$ implies $r = 0$). However, electoral uncertainty lessens the competitive pressures on candidates because a candidate who proposes a platform with positive rents still has a positive chance of winning the election. Besides this crucial difference, the model shares all the features of a standard Downsian electoral competition model. In particular, in equilibrium, candidates converge to the same platform, which is the level of public good provision preferred by the median voter ($g^1 = g^2 = g^m$) and a tax rate equal to the tax rate favored by the median voter in an environment without electoral uncertainty ($\tau^m = g^m/y$) plus the share of political rents on aggregate income ($\tau^1 = \tau^2 = \tau^m + r/Iy$).[1]

From Proposition 1 we can deduce a relationship between income distribution, electoral uncertainty and political rents. To see the connection between income

[1]An important implicit assumption to obtain convergence on equilibrium platforms is that no candidate has an electoral advantage. In our setting, after the valence shock is realized, if $\beta = \beta^2 - \beta^1 < 0$ (>0) candidate 1 (2) enjoys an electoral advantage. However, ex-ante, i.e., when candidates choose their platforms, β has not yet been realized. Moreover, both candidates have the same chances of obtaining an electoral advantage/disadvantage. More formally, $\beta = \beta^2 - \beta^1$ follows a symmetric distribution with mean equal to 0.

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distribution and political rents, take the derivative of the equilibrium values of g^j, $\tau^j Iy$, and r with respect to y/y^m:

$$\frac{\partial g^j}{\partial\left(\frac{y}{y^m}\right)} = \frac{-\left(H'(g^m)\right)^2}{H''(g^m)} > 0, \frac{\partial(\tau^j Iy)}{\partial\left(\frac{y}{y^m}\right)} = \frac{I\sigma\sqrt{2\pi}}{2} - \frac{I\left(H'(g^m)\right)^2}{H''(g^m)} > 0, \frac{\partial r}{\partial\left(\frac{y}{y^m}\right)} = \frac{I\sigma\sqrt{2\pi}}{2} > 0$$

Thus, as income inequality, measured by the ratio of the mean to the median income, rises, the equilibrium level of public good provision, tax revenue and political rents increase.[2] Intuitively, when the median voter is poorer (relative to mean income), voters' demand for redistribution becomes more intense (note that the public good benefits all citizens equally, but it is financed with a proportional income tax). Candidates react offering platforms with more public good provision and higher taxes. They also capture higher rents because the median voter is more willing to accept unnecessary taxes as long as public good provision is expanded. Indeed, given the proportional income tax, as the median voter is poorer, any increase in the tax rate is less burdensome for the median voter.

To see the connection between electoral uncertainty and political rents, take the derivative of r with respect to σ:

$$\frac{\partial g^j}{\partial \sigma} = 0, \frac{\partial(\tau^j Iy)}{\partial \sigma} = \frac{\mathrm{I}\sigma\sqrt{2\pi}}{2} > 0, \frac{\partial \mathrm{r}}{\partial \sigma} = \frac{I\sqrt{2\pi}y}{2y^m} > 0$$

Thus, as electoral uncertainty increases, there is no effect on public good provision, and total tax revenue and political rents increase. Intuitively, electoral uncertainty makes competition between the candidates less intense, which allow them to capture higher rents.

Next, we develop a simple laboratory setting to test these implications.

III.2. Treatments and Expected Outcomes

To implement the electoral competition game in the laboratory, consider that there are only 8 voters and the income of voter i is given by $y^i = \left(\frac{3-\theta}{3}\right)8$ for $i = 1, 2, 3, 4, 5, 6$, and $y^i = 8\theta$ for $i = 7, 8$, which implies that $y^m = \left(\frac{3-\theta}{3}\right)8$ and $y = 6$. In addition, we impose that $H(g) = 2\sqrt{g}$. Then, from Proposition 1, the

[2]For some distribution functions, there is a tight connection between y/y^m and other measures of income inequality such us Lorenz dominance and the Gini coefficient. For example, for a Pareto distribution with parameter $\alpha > 1$, we have: $\frac{y}{y^m}(\alpha) = \frac{\alpha}{(\alpha-1)(2)^{1/\alpha}}$, the Lorenz's curve is $L(x,\alpha) = 1-(1-x)^{\frac{\alpha-1}{\alpha}}$ for all $x \in [0, 1]$, and the Gini coefficient is $G(\alpha) = \frac{1}{2\alpha-1}$. It is easy to verify the following four statements are equivalent: (i)$\alpha^1 > \alpha^2 > 1$; (ii) $\frac{y}{y^m}(\alpha^2) > \frac{y}{y^m}(\alpha^1)$; (iii) $L(x,\alpha^1) = 1-(1-x)^{\frac{\alpha-1}{\alpha}} > L(x,\alpha^2) = 1-(1-x)^{\frac{\alpha-1}{\alpha}}$ for all $x \in (0, 1)$; and (iv) $G(\alpha^2) > G(\alpha^1)$. Thus, for a Pareto distribution, the ratio of the mean to the median income (y/y^m), Lorenz dominance and the Gini coefficient all generate the same inequality-ranking for a pair of income distributions.

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Table 1

Treatments and Predicted Outcomes (Electoral Competition Game)

Treatments	Inequality (1)	Electoral Uncertainty (2)	Theoretical Predictions (3)
T1	θ = 3/4 (None) $\frac{y}{y^m}$ = 1 and *Gini* = 0	σ = 1/2	Low Rents ($2\sqrt{2\pi}$)
T2	θ = 3/4 (None) $\frac{y}{y^m}$ = 1 and *Gini* = 0	σ = 1	Intermediate Low Rents ($4\sqrt{2\pi}$)
T3	θ = 9/4 (High) $\frac{y}{y^m}$ = 3 and *Gini* = 1/2	σ = 1/2	Intermediate High Rents ($6\sqrt{2\pi}$)
T4	θ = 9/4 (High) $\frac{y}{y^m}$ = 3 and *Gini* = 1/2	σ = 1	High Rents ($12\sqrt{2\pi}$)

equilibrium is given by $g^1 = g^2 = g^m = \frac{y}{y^m} = \frac{9}{4(3-\theta)}$ and $\tau^1 y = \tau^2 y = \frac{9+18\sqrt{2\pi}\sigma}{8\sqrt{2\pi}\sigma(3-\theta)}$ and equilibrium rents are given by $r = I\frac{9\sqrt{2\pi}\sigma}{8(3-\theta)}$.[3]

For the experiment, we consider four different treatments (see Table 1). Each treatment differs in the level of inequality (a change in θ) and/or the level of electoral uncertainty (a change in σ). Note that the theoretical predictions imply more rents before higher levels of θ and/or σ. For our parametrizations, predicted rents triple when we increase inequality (from T1 to T3 and from T2 to T4) and double when we increase electoral uncertainty (from T1 to T2 and from T3 to T4).

III.3. The Laboratory Experiment

The experiment was conducted between February and May 2015 at Xiamen University, China. We recruited undergraduate and graduate students from any field of study and conducted 10 sessions with 20 subjects each, for a total of 200 participants. Subjects were allowed to participate in only one session. In each treatment, subjects played the electoral competition game with the values of θ and σ in Table 1. The experiment was programmed and conducted using z-Tree software (Fischbacher, 2007). Each session lasted approximately 105 minutes. The experiment proceeded as follows (for details, please refer to Appendix A.2):

Assignment to Computer Terminals. Before each session began, the subjects were randomly assigned to computer terminals.

Instructions. After the subjects were at their terminals, they received the instructions, which were also explained by the organizers. Subjects then had time to read the instructions on their own and ask questions. Appendix A.2.1 contains an English translation of the instructions. This was the last opportunity that subjects had to pose any questions.

[3]In order to avoid a corner solution we need $y = 6 > 3\left[\frac{1+\sqrt{2\pi}}{\sqrt{2\pi}}\right] \approx 4.20$.

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Quiz. In order to check whether participants understood the rules of the game, we asked them to take a five-question quiz. The quiz was administered after we had given the instructions, but before the rounds began. Subjects were paid approximately US$ 0.10 per correct answer, but we never informed them which ones they had answered correctly. An English translation of the quiz questions can be found in Appendix A.2.2.

Rounds. After the subjects finished the quiz, they began playing rounds, during which they interacted only through a computer network using z-Tree software. Subjects played 20 rounds of the game. The first 4 rounds were for practice, and the last 16 rounds were for pay. At the end of each round, the subjects received a summary of the decisions taken by both themselves and their partners, including payoffs per round, their own accumulated payoffs for paid rounds and nature's decision.

Matching. There were 20 participants in each session. In each round, players were randomly divided into two groups of 10 players. In odd rounds, one group played treatment 1 (T_1) and the second group played treatment 3 (T_3). In even rounds, one group played treatment 2 (T_2) and the other, treatment 4 (T_4). In each round, two players in each group were randomly chosen to play the role of candidates. The rest played the role of voters. After roles were assigned, each player was informed of his/her role.

Questionnaire. Finally, just before leaving the laboratory, all the subjects were asked to complete a questionnaire, which was designed to enable us to test the balance across experimental groups and to control for their characteristics in the econometric analysis. Appendix A.2.3 contains an English translation of the questionnaire.

Payments. All subjects were paid privately, in cash. After the experiment was completed, a password appeared on each subject's screen. The subjects then had to present this password to the person who was running the experiment in order to receive their payoffs. Subjects earned, on average, US$ 8.87, which included a US$ 1.61 show-up fee, US$ 0.10 per correct answer on the quiz and US$ 0.10 for each point they received during the paid rounds of the experiment.

III.4. Understanding of the Game and Randomization Balance

Table 2 shows that, on average, the subjects had a satisfactory understanding of the rules of the game. In fact, 75.5% of the subjects answered 4 or 5 questions correctly, while only 3.5% obtained a correct score on just 1 question or did not answer any of the questions correctly. In all, question 1 was answered

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Table 2

Balance Across Players

	All Subjects			Candidates			Electors				
	N (1)	Mean (2)	SD (3)	N (4)	Mean (5)	SD (6)	N (7)	Mean (8)	SD (9)	Dif (10)	P Value (11)
Characteristics of Subjects											
Gender (male=1)	3200	0.40	0.49	640	0.38	0.49	2560	0.40	0.49	-0.02	0.22
Age (years)	3200	22.52	2.28	640	22.36	2.09	2560	22.56	2.32	-0.20	0.09*
Years at University	3200	4.09	1.65	640	4.05	1.65	2560	4.10	1.65	-0.06	0.43
Major in Economics (=1)	3200	0.47	0.50	640	0.46	0.50	2560	0.47	0.50	-0.01	0.64
Studied Game Theory (=1)	3200	0.32	0.47	640	0.29	0.46	2560	0.33	0.47	-0.04	0.01***
Lives in City(=1) or Rural Area(=0)	3200	0.71	0.45	640	0.70	0.46	2560	0.72	0.45	-0.02	0.44
Religion (=1)	3200	0.07	0.26	640	0.07	0.26	2560	0.07	0.25	0.00	0.74
Income of Father	3200	5504.05	6169.87	640	5365.31	5549.18	2560	5538.73	6316.06	-173.42	0.65
Income of Mother	3200	4083.00	5747.95	640	4026.56	5052.34	2560	4097.11	5909.89	-70.55	0.77
Father Went to University (=1)	3200	0.44	0.50	640	0.43	0.49	2560	0.45	0.50	-0.02	0.19
Mother Went to University (=1)	3200	0.38	0.49	640	0.38	0.49	2560	0.39	0.49	-0.01	0.61
Understanding of the Experiment											
Answered correctly: Question 1	3200	0.88	0.32	640	0.88	0.33	2560	0.89	0.32	-0.01	0.56
Answered correctly: Question 2	3200	0.94	0.25	640	0.93	0.26	2560	0.94	0.24	-0.01	0.56
Answered correctly: Question 3	3200	0.83	0.38	640	0.80	0.40	2560	0.84	0.37	-0.03	0.18
Answered correctly: Question 4	3200	0.56	0.50	640	0.55	0.50	2560	0.57	0.50	-0.02	0.37
Answered correctly: Question 5	3200	0.83	0.38	640	0.81	0.39	2560	0.83	0.37	-0.02	0.31

Note: "N" is the number of observations, "Mean" is the sample mean and "SD" is the standard deviation for the corresponding variable in each line. Columns (1)-(3) indicate the values for the complete sample, columns (4)-(6) for the subjects who played the role of candidates and columns (7)-(9) for the subjects who played the role of electors. Column (10) indicates the mean difference between subjects who played the role of electors and subjects who played the role of candidates, while column (11) shows the p-value of the difference of means test. (Standard errors were clustered by session.) * indicates that the test is significant at 10%; ** significant at 5%; ***significant at 1%.

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correctly by 88% of the subjects, question 2 by 94%, question 3 by 83%, question 4 by 56% and question 5 by 83%. It therefore appears that the subjects found question 4 to be the most difficult.

Table 2 also shows the randomization balance across player roles (candidates vs. voters). Note that all characteristics and the understanding of the rules of the game are well balanced across roles, as the mean difference between candidates and voters is not significantly different from zero either for subject characteristics or for their understanding of the game. The only exception is the variable that indicates if the subjects have studied game theory in the past. However, this does not affect the average understanding of the game between groups.

Tables 3 and 4, which compare the four treatments, show that all characteristics and levels of understanding of the game were perfectly balanced between T1 and T3. In other cases, there is a slight imbalance in some covariates such as gender, age, number of years at university, whether the subjects have studied game theory or not, or whether they have a religion. However, this did not affect the average understanding of the game between groups.

III.5. Descriptive Analysis

Table 5 shows descriptive statistics for the main decisions taken by the subjects. For each treatment, Table 5 indicates the total number of observations, the sample mean and the standard deviation for the corresponding variable in each column. Column (1) reports the income tax rate τ; column (2) gives the per capita level of public goods g; column (3) shows the payoff or rent of the elected candidate; column (4) lists the payoffs for the voters.[4,5]

As predicted by the theory, tax rates and the level of public goods increase with inequality. The average tax rates are 0.40 and 0.42 for T1 and T2 (the treatments with low levels of inequality), while they are 0.81 and 0.73 points for T3 and T4 (the treatments with high levels of inequality). On average, the levels of the public good are 1.63 and 1.77 points for T1 and T2 and 3.69 and 3.32 for T3 and T4. With higher taxes and more public goods when inequality is high, what happens with rents is not exactly, clear, but, as the model predicts, rents do increase with inequality. Column 3 in Table 5 shows that, on average, the elected candidates obtained 6.79 points in T1 and 6.42 points in T2, while they got 9.40 and 8.67 points in T3 and T4, respectively. Contrary to theoretical predictions, on average, elected candidates obtained less for treatments with higher levels of electoral uncertainty. Average rents were lower in T2 than in T1 and in T4 than in T3.

[4]We computed the utilities for the voters and found that 86.7% of them maximized their utility. Moreover, if we focus on the group that answered all the quiz questions correctly, 88.94% of the voters maximized their utility.

[5]In Appendix A.3.1 we show that the distributions of τ and g selected by each candidate are very similar, suggesting that candidates played a symmetric Nash equilibrium.

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Table 3

Balance Across Treatments I

	All Subjects			T1		T2		T3		T4	
	N (1)	Mean (2)	SD (3)	Mean (4)	SD (5)	Mean (6)	SD (7)	Mean (8)	SD (9)	Mean (10)	SD (11)
Characteristics of Subjects											
Gender (male=1)	3200	0.40	0.49	0.40	0.49	0.38	0.49	0.40	0.49	0.42	0.49
Age (years)	3200	22.52	2.28	22.45	2.25	22.44	2.19	22.59	2.31	22.60	2.36
Years at University	3200	4.09	1.65	4.03	1.66	4.03	1.61	4.15	1.63	4.15	1.69
Major in Economics (=1)	3200	0.47	0.50	0.49	0.50	0.47	0.50	0.46	0.50	0.47	0.50
Studied Game Theory (=1)	3200	0.32	0.47	0.33	0.47	0.30	0.46	0.32	0.47	0.35	0.48
Lives in City(=1) or Rural Area(=0)	3200	0.71	0.45	0.69	0.46	0.73	0.45	0.74	0.44	0.70	0.46
Religion (=1)	3200	0.07	0.26	0.08	0.28	0.05	0.23	0.06	0.23	0.09	0.28
Income of Father	3200	5504.05	6169.87	5484.70	6038.45	5512.94	5868.41	5523.40	6304.16	5495.16	6462.80
Income of Mother	3200	4083.00	5747.95	4189.00	5971.39	3915.38	5213.99	3977.00	5519.05	4250.63	6236.82
Father Went to University (=1)	3200	0.44	0.50	0.44	0.50	0.44	0.50	0.45	0.50	0.45	0.50
Mother Went to University (=1)	3200	0.38	0.49	0.39	0.49	0.38	0.49	0.38	0.49	0.39	0.49
Understanding of the Experiment											
Answered correctly: Question 1	3200	0.88	0.32	0.88	0.32	0.89	0.31	0.89	0.31	0.88	0.33
Answered correctly: Question 2	3200	0.94	0.25	0.94	0.25	0.93	0.25	0.94	0.25	0.94	0.24
Answered correctly: Question 3	3200	0.83	0.38	0.81	0.39	0.84	0.36	0.85	0.36	0.82	0.39
Answered correctly: Question 4	3200	0.56	0.50	0.56	0.50	0.56	0.50	0.57	0.50	0.57	0.50
Answered correctly: Question 5	3200	0.83	0.38	0.82	0.38	0.84	0.37	0.84	0.37	0.82	0.38

Note: "N" is the number of observations, "Mean" is the sample mean and "SD" is the standard deviation for the corresponding variable in each line. Columns (1)-(3) indicate the values for the complete sample, columns (4)-(6) for the subjects who played treatment 1, columns (6)-(7) for those who played treatment 2, columns (8)-(9) for those who played treatment 3 and columns (10)-(11) for those who played treatment 4. Note that there were 800 observations of each of the variables in each treatment.

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Table 4

Balance Across Treatments II

	T1/T2 (1)	T2/T3 (2)	T3/T4 (3)	T1/T3 (4)	T1/T4 (5)	T2/T4 (6)
Characteristics of Subjects						
Gender (male=1)	0.02*	-0.02	-0.02*	0.00	-0.02*	-0.02*
Age (years)	0.01	-0.14*	-0.01	-0.13	-0.14*	-0.15
Years at University	0.00	-0.12*	0.00	-0.12	-0.12*	-0.12
Major in Economics (=1)	0.01	0.02	-0.01	0.03	0.02	0.00
Studied Game Theory (=1)	0.03	-0.02	-0.03	0.01	-0.02	-0.04**
Lives in City(=1) or Rural Area(=0)	-0.03	-0.01	0.03	-0.04	-0.01	0.02
Religion (=1)	0.03***	0.00	-0.03***	0.03	0.00	-0.03**
Income of Father	-28.24	-10.46	28.24	-38.70	-10.46	17.77
Income of Mother	273.63	-61.63	-273.63	212.00	-61.63	-335.25
Father Went to University (=1)	0.00	-0.01	0.00	-0.02	-0.01	-0.01
Mother Went to University (=1)	0.02	0.00	-0.02	0.02	0.00	-0.02
Understanding of the Experiment						
Answered correctly: Question 1	-0.01	0.00	0.01	-0.01	0.00	0.01
Answered correctly: Question 2	0.00	0.00	0.00	0.00	0.00	0.00
Answered correctly: Question 3	-0.03	0.00	0.03	-0.04	-0.01	0.03
Answered correctly: Question 4	0.00	-0.01	0.00	-0.01	-0.01	-0.01
Answered correctly: Question 5	-0.01	0.00	0.01	-0.01	0.00	0.02

Note: Each entry indicates the mean difference between the two treatments in the column for the corresponding variable in each line. * indicates that the difference of means test is significant at 10%; ** significant at 5%; *** significant at 1%. Standard errors were clustered by session.

Table 5

Decisions across Treatments (Descriptive Statistics)

	τ (1)	g (2)	v^C (3)	v^E (4)
T1				
N	80	80	80	640
Mean	0.41	1.63	6.79	6.12
SD	0.17	0.91	4.08	0.73
T2				
N	80	80	80	640
Mean	0.43	1.77	6.42	6.31
SD	0.20	1.06	3.85	0.83
T3				
N	80	80	80	640
Mean	0.81	3.69	9.40	5.00
SD	0.24	1.41	4.63	2.24
T4				
N	80	80	80	640
Mean	0.73	3.32	8.67	5.39
SD	0.28	1.46	4.59	2.87

Note: Column (1): Income tax rate, τ. Column (2): per capita level of public goods, g. Column (3): Payoff for the elected candidate, *vc*. Column (4): Payoff for the electors, *vE*.

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III.6. Results

In order to formally test the hypothesis that higher levels of inequality and/or electoral uncertainty lead to higher rents, we estimate the following regression model:

$$Rentec_{ips} = \alpha + \beta_1 DT + \beta_2 X_{ips} + \sum_{s=1}^{10} \beta_3 D\Theta_s + \varepsilon_{ips},$$

where i indexes subjects, $p = 1, 2, 3, \ldots, 16$ indexes experimental rounds, and $s = 1, 2, 3, \ldots, 10$ indexes experimental sessions. $Rentec_{ips}$ is the dependent variable and indicates the rents of the elected candidate ?. The explanatory variable of interest is DT, a dummy variable indicating treatment status (Tj for $j = 1, 2, 3, 4$). In some specifications, we also include control variables. We control for individual characteristics $Xips$ (gender, age, number of years at university, whether his or her major is in economics, whether s/he has taken a course in game theory, whether s/he has a religion, the income of the father, the income of the mother, whether his or her father has gone to university, whether his or her mother has gone to university and the number of correct answers on the quiz) and for session fixed effects ($D\theta s$). According to our theoretical predictions, we should expect β_1 to be positive when comparing T1 with T2 and T3 with T4 (more electoral uncertainty in T2 and T4, respectively), T1 with T3 and T2 with T4 (more inequality in T3 and T4, respectively), T1 with T4 (more electoral uncertainty and more inequality) and T2 with T3, since there is an increase in inequality and a decrease in electoral uncertainty, but the effect of inequality should be dominant. Table 6 shows the empirical results.[6]

Economic Inequality and Rents. As expected, an increase in inequality leads to higher rents. By comparing T1 with T3 and T2 with T4, we find a positive and statistically significant estimate for all the specifications. The estimated increase in rents from T1 to T3 is 2.618 points (2.532 points when we include controls), while from T2 to T4 it is 2.256 points (2.239 points when we include controls). These estimations are consistent with the qualitative comparative static predictions in Table 1.

Quantitatively, the estimations are lower than expected. Based on the data shown in Table 1, we would expect that a move from no inequality to a Gini coefficient of ½ when the standard deviation of valence is 1/2 (i.e., going from T1 to T3) induces an increase in rents of $4\sqrt{2\pi}\approx 10$ points. The same variation in inequality when the standard deviation of valence is 1 (i.e., going from T2 to T4) should lead to an increase in rents of $8\sqrt{2\pi}\approx 20$ points. This suggests that candidates are offering platforms that entail lower rents than predicted by the model.

[6]In Appendix A.3.2 we replicate Table 6 only using observations for paid rounds. Results do not change.

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Table 6

Regressions (Rents of the Elected Candidate)

	(1)	(2)
More Electoral Uncertainty		
(a) Treatment 1 (=0) vs Treatment 2 (=1)		
$\widehat{\beta}_1$	-0.368	-0.648
S.e. clustered by session	(0.304)	(0.355)
R-squared	0.002	0.072
N	160	160
(b) Treatment 3 (=0) vs Treatment 4 (=1)		
$\widehat{\beta}_1$	-0.730	-0.781
S.e. clustered by session	(0.722)	(0.697)
R-squared	0.006	0.066
N	160	160
More Inequality		
(c) Treatment 1 (=0) vs Treatment 3 (=1)		
$\widehat{\beta}_1$	2.618**	2.532**
S.e. clustered by session	(0.909)	(0.898)
R-squared	0.084	0.176
N	160	160
(d) Treatment 2 (=0) vs Treatment 4 (=1)		
$\widehat{\beta}_1$	2.256***	2.239***
S.e. clustered by session	(0.657)	(0.672)
R-squared	0.067	0.161
N	160	160
More Electoral Uncertainty and Inequality		
(e) Treatment 1 (=0) vs Treatment 4 (=1)		
$\widehat{\beta}_1$	1.888**	1.654*
S.e. clustered by session	(0.721)	(0.744)
R-squared	0.046	0.140
N	160	160
More Inequality, Less Electoral Uncertainty		
(f) Treatment 2 (=0) vs Treatment 3 (=1)		
$\widehat{\beta}_1$	2.986**	3.109***
S.e. clustered by session	(0.965)	(0.917)
R-squared	0.111	0.248
N	160	160
Controls	No	Yes

Note: *significant at 10%; **significant at 5%; ***significant at 1% (using standard errors clustered by session). Controls: (i) Individual characteristics: gender, age, years at university, whether his/her major is economics, whether s/he has ever taken a course in game theory, whether s/he lives in a city, whether s/he has a religion, income of the father, income of the mother, whether his/her father has gone to university, whether his/her mother has gone to university; (ii) Level of understanding of the game: number of correct answers; and (iii) fixed effects, by session.

One possible explanation is that the model assumes risk-neutral candidates. If candidates are risk-averse, then we would expect them to be more willing to have a greater chance of obtaining a low rent than a smaller chance of obtaining a high rent, which prompts them to propose relatively lower rents. In Appendix A.1.2 we show that introducing risk aversion significantly reduces the gap between quantitative theoretical predictions and estimated effects. It is also possible that candidates value winning the election independently of the expected utility of

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rents. This, however, reduces predicted rents by a fixed amount in all treatments and, hence, has no effect on the differences between two treatments (see Appendix A.1.3 for details).

Electoral Uncertainty and Rents. We did not find that an increase in electoral uncertainty had any effect on rents. In both cases, when we compare T1 with T2 and T3 with T4, the estimates are negative and not statistically significant. Thus, keeping inequality constant, an increase in the standard deviation of valence from ½ to 1 does not produce any effect on equilibrium rents. Note that neither risk preferences nor candidates who value winning the election per se could be the explanation for this. Indeed, for any nonnegative and concave utility function, if in equilibrium candidates converge to the same platforms, rents must be increasing in electoral uncertainty (see Appendix A.1.4 for details).

A more plausible explanation is that subjects did not fully understand how electoral uncertainty affects their electoral chances. In fact, if we focus on candidates who correctly answered all the quiz questions, we obtain a positive, though nonsignificant, estimation when we compare T1 with T2 (in all specification) and T3 with T4 (only for the specification with no controls). Specifically, after restricting the sample to those candidates who scored 100% on the quiz the estimated change in rents from T1 to T2 is 0.444 points (0.692 points when we include controls), while from T3 to T4 it is 0.077 points (-0.229 points when we include controls) (see Appendix A.3.3 for details).

Inequality, Electoral Uncertainty and Rents. Finally, if we compare T1 with T4 (a scenario with more inequality and more electoral uncertainty), we obtain the predicted outcome, namely, a positive and statistically significant effect on rents, while, when we compare T2 with T3 (more inequality but less electoral uncertainty), we also obtain the positive predicted effect on rents.

Summing up, we find evidence that supports the prediction of the electoral model with endogenous rents that higher inequality leads to higher political rents. Quantitatively, the effects are smaller than expected. The risk preferences of the candidates may be one of the reasons for this gap. For the whole sample, we do not find evidence that higher electoral uncertainty induces higher rents. However, when we restrict the analysis to subjects who scored 100% on the quiz, we obtain a positive effect for electoral uncertainty on rents.

IV. COMMON-AGENCY GAME

In this section we study the connections between inequality and political rents in the context of special interest politics. In section III.1, we briefly describe a common-agency model employed by Dixit et al. (1997). In section III.2, we use this model to derive experimental treatments. In section III.3, we describe

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the laboratory experiment. This general description covers the experiment's monetary payoffs, the number of sessions and rounds, the matching procedure and the instructions received by the subjects. In section III.4, we show that subjects understood the common-agency game and that the randomization was balanced. In section III.5, we present descriptive statistics. Finally, in section III.6, we formally test theoretical predictions using regression analyses and discuss the results.

IV.1. Common-Agency Model

Dixit et al. (1997) developed a model in which several principals try to influence a single agent. The principals are interpreted as special interest groups and the agent as the government or a government agency in charge of selecting a policy. In particular, suppose that the payoff for principal $i = 1, 2$ is given by:

$$v^{P,i} = (1-\tau)y^{P,i} + H(g) - C^{P,i}(\tau, g),$$

where $\tau \in [0, 1]$ is the income tax rate; $g \geq 0$ is the level of per capita public goods; $y^{P,\,i} > 0$ is the income of principal i; H is a strictly increasing, strictly concave, twice continuously differentiable function that satisfies $\lim_{g\to 0} H^{'}(g) = \infty$ and $\lim_{g\to y} H^{'}(g) < 1$; and $C^{P,\,i}(\tau, g) \geq 0$ is the contribution that principal i pays to the agent when the policy implemented is (τ, g). The payoff for the agent is given by:

$$v^{A} = (1-\tau)y^{A} + H(g) + \textstyle\sum_{i=1,2} C^{P,i}(\tau, g),$$

where $y^A > 0$ is the income of the agent and $\sum_{i\,=\,1,\,2} C^{P,\,i}(\tau, g)$ is the contributions received by the agent. The government budget constraint is given by $\tau y = g$, where $y = (y^A + y^{P,\,1} + y^{P,\,2})/3$ is the average income. Once we introduce it into the payoff functions we obtain $v^{P,\,i} = (1 - \tau)y^{P,\,i} + H(\tau y) - C^{P,\,i}(\tau)$ and $v^A = (1 - \tau)y^A + H(\tau y) + \sum_{i\,=\,1,\,2} C^{P,\,i}(\tau)$, where $C^{P,\,i}(\tau)$ is the contribution that principal i pays to the agent when the policy implemented is $\tau \in [0, 1]$.

The timing of events is as follows. First, the principals simultaneously announce a schedule of contributions, i.e., a menu in which each principal specifies how much s/he pledges to pay the agent if the policy that is implemented is τ.[7] Second, the agent selects a policy τ and collects the associated contributions. A couple of remarks apply. Note that the principals commit to pay the contributions and each principal offers a contribution for each possible $\tau \in [0, 1]$ that the agent decides to choose. Also note that the agent collects the contributions made by both principals.

[7]A contribution schedule can also be seen as a take-it-or-leave-it offer whereby, if the agent implements τ, then the principal pays a contribution of $C(\tau)$.

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Dixit et al. (1997) propose the notion of truthful equilibrium (a refinement of subgame perfect Nash equilibrium) as the solution concept for this common-agency game.[8] In a truthful equilibrium, each principal employs a schedule of truthful contributions, meaning that each principal offers to pay the agent the change in the principal's welfare (formally, the compensating variation) associated with each change in the agent's decision (see Appendix B.1.1 for details). Proposition 2 fully characterizes the truthful equilibrium of the common agency game.

Proposition 2. *Suppose a common-agency game with only two principals. Then, the game has a truthful equilibrium, which is characterized by:*

i. The agent will implement $\tau^* \in (0, 1)$ given by $H'(\tau^* y) = 1$;
ii. *Principal 1 will pay the agent* $C^{P,1,*} = (\tau^* - \tau^{2,*})(y^{P,2} + y^A) - 2[H(\tau^* y) - H(\tau^{2,*} y)]$, *where* $\tau^{2,*} = \underset{\tau\in[0,1]}{\operatorname{argmax}}\{(1-\tau)(y^{P,2} + y^A) + 2H(\tau y)\}$;
iii. *Principal 2 will pay the agent* $C^{P,2,*} = (\tau^* - \tau^{1,*})(y^{P,1} + y^A) - 2[H(\tau^* y) - H(\tau^{1,*} y)]$, *where* $\tau^{1,*} = \underset{\tau\in[0,1]}{\operatorname{argmax}}\{(1-\tau)(y^{P,1} + y^A) + 2H(\tau y)\}$. ***Proof***: *see Appendix B.1.1.* ∎

The intuition behind Proposition 2 is as follows. Each principal tries to push the agent in the direction of her preferred tax rate. To do so, each principal offers to pay the agent her willingness to pay for each movement in the tax rate. As a consequence, the agent internalizes the preferences of the principals and, hence, in equilibrium, the agent implements a tax rate that maximizes aggregate welfare. For our simple specification with quasilinear preferences, this implies that $\tau^* = \underset{\tau\in[0,1]}{argmax}\{3(1-\tau)y + 3H(\tau y)\}$, which is independent of the contributions offered by the principals.

Regarding equilibrium contributions, consider the situation of principal 1. Principal 1 takes the contribution schedule of principal 2 as given, which implies that the outside option of the agent is the maximum utility the agent would obtain if principal 1 contributes 0 and principal 2 selects her equilibrium contribution schedule. Formally, the agent would obtain $v^{A,*} = \max_{\tau\in[0,1]}\{v^A = (1-\tau)y^A + H(g) + C^{2,*}(\tau)\}$. The solution to this optimization problem is $\tau^{2,*}$, i.e., a tax rate that completely ignores the preferences of principal 1. Thus, to convince the agent to move in her preferred direction, principal 1 must offer a contribution that gives the agent at least $v^{A,*}$. The situation of principal 2 is analogous. Then, in equilibrium, each principal offers a contribution that makes the agent indifferent with the agent outside option. For principal 1 this means that the agent must be indifferent between $(\tau, C^{P,1}, C^{P,2}) = (\tau^{2,*}, 0, C^{P,2,*})$ and $(\tau, C^{P,1}, C^{P,2}) = (\tau^*, C^{P,1,*}, C^{P,2,*})$, while for principal 2, it means that the agent must be indifferent between $(\tau, C^{P,1}, C^{P,2}) = (\tau^{1,*}, C^{P,1,*}, 0)$ and $(\tau, C^{P,1}, C^{P,2}) = (\tau^*, C^{P,1,*}, C^{P,2,*})$.

[8]The notion of truthful equilibrium does not imply any suboptimal behavior with respect to information revelation for the simple reason that players have nothing to hide. The common agency model is a game with complete information.

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From Proposition 2 we can deduce a relationship between income inequality and the contributions received by the agent. To do so, suppose that $y^A = y$, $y^{P,1} = 2(1 - \theta)y$ and $y^{P,2} = 2\theta y$, respectively, with $\theta \geq 1/2$. Thus, principal 1 is poorer than principal 2, the agent has an intermediate position between the two principals, and θ measures income inequality. Then (see Appendix B.1.2 for details):[9]

$$\frac{\partial\left(C^{P,1,*} + C^{P,2,*}\right)}{\partial\theta} = 2\left(\tau^{1,*} - \tau^{2,*}\right)y > 0$$

Intuitively, as income inequality increases, the tension between the principals amplifies and, as a consequence, each principal is more willing to pay contributions in order to influence the agent's decision.

Next, we develop a simple setting to test this implication in the laboratory.

IV.2. Treatments and Predicted Outcomes

To implement the common-agency game in the laboratory, consider that the incomes of the agent and the two principals are $y^A = y = 2$, $y^{P,1} = 4(1 - \theta)$ and $y^{P,2} = 4\theta$, respectively, with $\theta \geq 1/2$. We also impose that $H(g) = 2\sqrt{g}$. Finally, we restrict the contribution schedules that the principals can use to influence the agent. Each principal is allowed to select one contribution for each of the following tax rates $\tau = 0.25, 0.5, 0.75$. Note that $\tau = \tau^* = 0.50$ is the tax rate associated with the truthful equilibrium. Thus, we allow the principals to select contributions for $\tau = 0.50$ and two other tax rates symmetrically located to the left and to the right of $\tau = 0.50$. One key advantage of this formulation is that the agent can collect contributions from both principals when selecting one policy. This is crucial in the common-agency model, but it can be easily violated in the laboratory if more general contribution schedules are permitted. Consider, for example, the biases that can emerge if principals use any contribution schedule. Suppose that one principal plays the equilibrium strategy, i.e., a positive contribution for $\tau = 0.50$ and 0 otherwise, while the other principal makes a slight calculation error and offers a positive contribution for $\tau = 0.49$ and 0, otherwise. In this case, the agent cannot collect both contributions. Another advantage of this formulation is that the agent's calculations are simpler. To evaluate his or her options, the agent only needs to add up the two contributions for three possible tax rates.

For the experiment, we consider three different treatments, which are summarized in Table 7 (see Appendix B.1.3 for details on how to compute theoretical predictions).

[9] $\theta \geq 1/2$ implies that $\tau^{1,*} > \tau^* > \tau^{2,*}$. Thus, the poor principal prefers a higher tax rate than the agent, who prefers a higher tax rate than the rich principal.

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Table 7

Treatments and Predicted Outcomes (Common-Agency Game)

Treatments	Inequality (1)	Theoretical Predictions (2)
T1	$\theta = 1/2$ (None) *Gini* = 0	Zero Rents for the Agent ($C^{P,1,*} + C^{P,2,*} = 0$)
T2	$\theta = 3/4$ (Low) *Gini* = 1/4	Intermediate Rents for the Agent ($C^{P,1,*} + C^{P,2,*} = 0.227$)
T3	$\theta = 1$ (High) *Gini* = 1/2	High Rents for the Agent ($C^{P,1,*} + C^{P,2,*} = 0.727$)

IV.3. The Laboratory Experiment

The experiment was conducted between February and May 2015 at Xiamen University, China. We recruited undergraduate and graduate students from any field of study. We conducted 5 sessions with 18 subjects each, for a total of 90 participants. Subjects were allowed to participate in only one session. In each treatment, subjects were asked to play a common-agency game. The experiment was programmed and conducted using z-Tree software (Fischbacher, 2007). Each session lasted approximately 90 minutes. The experiment proceeded as follows (for details, please refer to Appendix B):

Assignment to Computer Terminals. Same procedure employed in the electoral model experiment.

Instructions. Same procedure employed in the electoral model experiment. Appendix B.1 contains an English translation of the instructions. This was the last opportunity that subjects had to pose any questions.

Quiz. Same procedure employed in the electoral model experiment. An English translation of the quiz questions can be found in Appendix B.2.

Rounds. Same procedure employed in the electoral model experiment.

Matching. In each round players were randomly divided into three groups of three players. Each group played a common-agency game (with one group playing treatment 1, one group treatment 2 and one group treatment 3). In each round and group, players were randomly chosen to play the role of agent, principal 1 and principal 2. After roles were assigned, each player was informed of his/her role.

Questionnaire. Same procedure employed in the electoral model experiment. Appendix B.3 contains an English translation of the questionnaire

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Payments. Same procedure employed in the electoral model experiment. Subjects earned, on average, US$ 8.07, which included a US$ 1.61 show-up fee, US$ 0.10 per correct answer on the quiz and US$ 0.10 for each point they received during the paid rounds of the experiment.

IV.4. Understanding of the Game and Randomization Balance

Table 8 shows that, on average, the subjects had a satisfactory understanding of the rules of the game. In fact, 81.11% of the subjects answered 4 or 5 questions correctly; while only 2.22% obtained a correct score on just 1 question or did not answer any of the questions correctly. In all, question 1 was answered correctly by 76% of the subjects, question 2 by 74%, question 3 by 94%, question 4 by 91% and question 5 by 91%.

Table 8 also shows the randomization balance across player roles (agent vs. principals). Note that all characteristics and the understanding of the rules of the game are very well balanced across roles, as the mean difference between agents and principals is not significantly different from zero either for subject characteristics or for their understanding of the game. The only exceptions are the variable that indicates if the subjects have studied game theory in the past and the understating of question 1, but both of them are significant only at the 10% level.

Tables 9 and 10, which compare the three treatments, show that all characteristics and levels of understanding of the game were perfectly balanced between T2 and T3. When we compare T1 and T3, the only variable that is not balanced is a dummy that indicates whether the subject lives in a town or in a rural area. The same thing happens when we compare T1 and T3 but, in this case, the income of the father is not balanced either. However, this does not affect the understanding of the game, for which there is no difference across the three treatments.

IV.5. Descriptive Analysis

Table 11 shows descriptive statistics for the main decisions taken by the subjects. For each treatment, Table 11 indicates the total number of observations, the sample mean and the standard deviation for the corresponding variable in each column. Column (1) reports the income tax rate, τ; column (2) gives the per capita level of public goods, g; column (3) shows the rents of the agent, $C_1 + C_2$; column (4) lists the payoff for the agent, v_A; and column (5) gives the payoff for the principals, $v_{P,\,1}$ and $v_{P,\,2}$.[10]

[10]We computed the utilities for the agents and found that 78.5% of them maximized their utility. Moreover, if we focus on the group that answered all the quiz questions correctly, we obtained that 86.4% of the agents maximized their utility.

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Table 8

Balance across Players' Roles

	All Subjects			Agent			Principals				
	N (1)	Mean (2)	SD (3)	N (4)	Mean (5)	SD (6)	N (7)	Mean (8)	SD (9)	Dif (10)	P Value (11)
Characteristics of Subjects											
Gender (male=1)	1440	0.43	0.50	480	0.44	0.50	960	0.43	0.50	0.00	0.91
Age (years)	1440	22.36	2.34	480	22.33	2.34	960	22.37	2.33	-0.04	0.66
Years at University	1440	3.94	1.64	480	3.90	1.60	960	3.96	1.67	-0.06	0.34
Major in Economics (=1)	1440	0.39	0.49	480	0.39	0.49	960	0.39	0.49	0.00	0.94
Studied Game Theory (=1)	1440	0.28	0.45	480	0.31	0.46	960	0.26	0.44	0.04	0.09*
Lives in City(=1) or Rural Area(=0)	1440	0.70	0.46	480	0.68	0.47	960	0.71	0.45	-0.03	0.45
Religion (=1)	1440	0.14	0.35	480	0.17	0.37	960	0.13	0.34	0.04	0.17
Income of Father	1440	11366.67	52159.70	480	13017.29	59603.02	960	10541.35	48019.97	2475.94	0.43
Income of Mother	1440	9998.89	52676.93	480	11154.17	59832.75	960	9421.25	48730.07	1732.92	0.58
Father Went to University (=1)	1440	0.41	0.49	480	0.39	0.49	960	0.42	0.49	-0.03	0.49
Mother Went to University (=1)	1440	0.34	0.48	480	0.32	0.47	960	0.36	0.48	-0.04	0.38
Understanding of the Experiment											
Answered correctly: Question 1	1440	0.76	0.43	480	0.74	0.44	960	0.77	0.42	-0.03	0.07*
Answered correctly: Question 2	1440	0.74	0.44	480	0.74	0.44	960	0.74	0.44	0.00	0.97
Answered correctly: Question 3	1440	0.94	0.23	480	0.94	0.23	960	0.94	0.23	0.00	0.87
Answered correctly: Question 4	1440	0.91	0.28	480	0.91	0.28	960	0.91	0.29	0.00	0.89
Answered correctly: Question 5	1440	0.91	0.28	480	0.92	0.27	960	0.91	0.29	0.01	0.16

Note: "N" is the number of observations, "Mean" is the sample mean and "SD" is the standard deviation for the corresponding variable in each line. Columns (1)-(3) indicate the values for the complete sample, columns (4)-(6) for the subjects who played the role of agent and columns (7)-(9) for the subjects who played the role of principals. Entries in column (10) indicate the mean difference between subjects who played the role of agent and those who played the role of principals, while column (11) shows the p-value of the difference of means test. (Standard errors were clustered by session.) *indicates that the test is significant at 10%; **significant at 5%; ***significant at 1%.

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Table 9

Balance Across Treatments I

	All Subjects			T1		T2		T3	
	N (1)	Mean (2)	SD (3)	Mean (4)	SD (5)	Mean (6)	SD (7)	Mean (8)	SD (9)
Characteristics of Subjects									
Gender (male=1)	1440	0.43	0.50	0.41	0.49	0.46	0.50	0.43	0.50
Age (years)	1440	22.36	2.34	22.44	2.45	22.16	2.10	22.47	2.44
Years at University	1440	3.94	1.64	3.97	1.64	3.90	1.62	3.97	1.67
Major in Economics (=1)	1440	0.39	0.49	0.40	0.49	0.39	0.49	0.37	0.48
Studied Game Theory (=1)	1440	0.28	0.45	0.28	0.45	0.26	0.44	0.29	0.45
Lives in City(=1) or Rural Area(=0)	1440	0.70	0.46	0.76	0.43	0.66	0.47	0.68	0.47
Religion (=1)	1440	0.14	0.35	0.15	0.36	0.14	0.35	0.14	0.35
Income of Father	1440	11366.67	52159.70	11360.63	50533.32	12050.00	55377.89	10689.38	50517.40
Income of Mother	1440	9998.89	52676.93	9790.83	51050.55	10429.79	55773.11	9776.04	51176.98
Father Went to University (=1)	1440	0.41	0.49	0.42	0.49	0.41	0.49	0.40	0.49
Mother Went to University (=1)	1440	0.34	0.48	0.35	0.48	0.37	0.48	0.32	0.47
Understanding of the Experiment									
Answered correctly: Question 1	1440	0.76	0.43	0.75	0.43	0.74	0.44	0.78	0.42
Answered correctly: Question 2	1440	0.74	0.44	0.74	0.44	0.75	0.44	0.75	0.43
Answered correctly: Question 3	1440	0.94	0.23	0.94	0.24	0.96	0.19	0.93	0.25
Answered correctly: Question 4	1440	0.91	0.28	0.92	0.27	0.90	0.30	0.91	0.28
Answered correctly: Question 5	1440	0.91	0.28	0.91	0.28	0.89	0.31	0.93	0.26

Note: "N" is the total number of observations, "Mean" is the sample mean and "SD" is the standard deviation for the corresponding variable in each line. Columns (1)-(3) indicate the values for the complete sample, columns (4)-(5) for the subjects who played treatment 1, columns (6)-(7) for those who played treatment 2 and columns (8)-(9) for those who played treatment 3. Note that there were 480 observations of each of variable in each treatment.

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Table 10

Balance Across Treatments II

	T1/T2 (1)	T2/T3 (2)	T1/T3 (3)
Characteristics of Subjects			
Gender (male=1)	-0.05	0.03	-0.01
Age (years)	0.27	-0.30	-0.03
Years at University	0.07	-0.07	0.00
Major in Economics (=1)	0.01	0.02	0.03
Studied Game Theory (=1)	0.02	-0.03	0.00
Lives in city (=1) or Rural Area (=0)	0.09**	-0.01	0.08***
Religion (=1)	0.01	0.00	0.01
Income of Father	-689.38	1360.63	671.25***
Income of Mother	-638.96	653.75	14.79
Father Went to University (=1)	0.01	0.00	0.02
Mother Went to University (=1)	-0.02	0.05	0.03
Understanding of the Experiment			
Answered correctly: Question 1	0.01	-0.04	-0.03
Answered correctly: Question 2	-0.01	-0.01	-0.02
Answered correctly: Question 3	-0.02	0.03	0.01
Answered correctly: Question 4	0.02	-0.01	0.01
Answered correctly: Question 5	0.02	-0.03	-0.01

Note: Each entry indicates the mean difference between the two treatments in the column for the corresponding variable in each line. * indicates that the difference of means test is significant at 10%; **significant at 5%; *** significant at 1%. Standard errors were clustered by session.

Table 11

Decisions across Treatments (Descriptive Statistics)

	T (1)	g (2)	r (3)	*vA* (4)	*vP* (5)
T1					
N	480	480	160	160	320
Mean	0.48	0.97	0.56	3.53	3.70
SD	0.15	0.30	0.93	0.93	0.59
T2					
N	480	480	160	160	320
Mean	0.50	0.99	0.59	3.54	3.65
SD	0.21	0.43	0.85	0.85	0.72
T3					
N	480	480	160	160	320
Mean	0.48	0.96	0.78	3.72	3.55
SD	0.23	0.45	0.87	0.87	1.17

Note: Column (1): Income tax rate, τ. Column (2): per capita level of public goods, g. Column (3): Rents of the agent, r. Column (4): Payoff for the agent, vA. Column (5): Payoff for the principals, vp.

As predicted by the theory, the tax rate and the level of public goods are very similar in all the treatments. Indeed, the average tax rates are 0.48 in T1, 0.50 in T2 and 0.48 in T3, while the average levels of the public good are 0.97, 0.99 and

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0.96, respectively. Also, in line with theoretical predictions, the rents collected by the agent increase with inequality. On average, rents are 0.56 in T1, 0.59 in T2 and 0.78 in T3. The average payoff for the agent is also higher in T3 (3.72) than in T1 (3.53) and T2 (3.54).

IV.6. Results

We now formally test the theoretical predictions using regression analyses. In the context of perfect experimental data, the identification of the effects of interest does not require the inclusion of control variables. Moreover, the analysis is completely non-parametric, and we therefore need only to compare the mean outcome differences across treatment groups. Inferences could also be made non-parametric. Clustered standard errors are computed by session.

In order to formally test the hypothesis that more inequality leads to higher rents, we estimate the following regression models:

$$Rentag_{ips} = \alpha + \beta_1 DT + \beta_2 X_{ips} + \sum_{s=1}^{5} \beta_3 D\Theta_s + \varepsilon_{ips},$$

$$Payoffag_{ips} = \alpha + \beta_1 DT + \beta_2 X_{ips} + \sum_{s=1}^{5} \beta_3 D\Theta_s + \varepsilon_{ips},$$

where i indexes subjects, p = 1, 2, 3 … 16 indexes experimental rounds, and s = 1, 2 … 5 indexes experimental sessions. $Rentag_{ips}$ indicates the rents collected by the agent, while $Payoffag_{ips}$ is the payoff for the agent. The explanatory variable of interest is DT, a dummy variable indicating treatment status (Tj for j = 1, 2, 3). In some specifications, we also include control variables. We control for individual characteristics *Xips* (gender, age, number of years at university, whether his or her major is in economics, whether s/he has taken a course in game theory, whether s/he has a religion, the income of the father, the income of the mother, whether his or her father has gone to university, whether his or her mother has gone to university and the number of correct answers on the quiz) and for session fixed effects ($D\theta s$).

According to our theoretical predictions, we should expect a positive effect when comparing T1 with T2 and T2 with T3. Table 12 shows the estimations.[11]

In all cases we estimate a positive effect for inequality on rents and payoffs. When we compare T1 with T2, we obtain a positive but not statistically significant β_1. A move from no inequality to an income distribution with a Gini coefficient of ¼ (i.e., going from T1 to T2) induces an estimated increase in the rents collected by the agent of 0.034 points (0.0588 when we include controls). When we compare T2 with T3, we obtain a positive and statistically significant effect.

[11]In Appendix B.3.1 we replicate Table 12 only using observations for paid rounds. Results do not change.

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Table 12

Regression Analysis (Rents and Payoff for the Agent)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Treatment 1 (=0) vs Treatment 2 (=1)								
$\widehat{\beta}_1$	0.0341	0.0588	0.00939	0.0337	0.138	0.179	0.110	0.152
S.e. clustered by session	(0.0792)	(0.0799)	(0.0794)	(0.0800)	(0.0831)	(0.0844)	(0.0837)	(0.0860)
R-squared	0.000	0.036	0.000	0.035	0.007	0.109	0.004	0.105
N	320	320	320	320	185	185	185	185
Treatment 2 (=0) vs Treatment 3 (=1)								
$\widehat{\beta}_1$	0.185*	0.152*	0.178**	0.144*	0.297	0.260	0.289	0.251
S.e. clustered by session	(0.0669)	(0.0707)	(0.0631)	(0.0668)	(0.140)	(0.139)	(0.138)	(0.137)
R-squared	0.012	0.074	0.011	0.074	0.026	0.147	0.024	0.147
N	320	320	320	320	179	179	179	179
Treatment 1 (=0) vs Treatment 3 (=1)								
$\widehat{\beta}_1$	0.219*	0.235	0.188*	0.202	0.435**	0.458**	0.399**	0.420**
S.e. clustered by session	(0.0846)	(0.112)	(0.0825)	(0.110)	(0.109)	(0.136)	(0.107)	(0.135)
R-squared	0.015	0.048	0.011	0.047	0.057	0.149	0.048	0.144
N	320	320	320	320	180	180	180	180
Controls?	No	Yes	No	Yes	No	Yes	No	Yes

Note: *significant at 10%; **significant at 5%; ***significant at 1% (using standard errors clustered by session). Controls: Individual characteristics: gender, age, years at university, whether his/her major is economics, whether s/he has ever taken a course in game theory, whether s/he lives in a city, whether s/he has a religion, income of the father, income of the mother, whether his/her father has gone to university, whether his/her mother has gone to university (ii) Level of understanding of the game: number of corrected answers and (iii) Fixed effects by session. Columns (1), (2), (5) and (6) have as a dependent variable the rents of the agent and Columns (3), (4), (7) and (8) have as a dependent variable the payoff of the agent. Columns (1)-(4) include all the subjects while columns (5)-(8) include only subjects who answered correctly all the questions of the quiz.

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A move from an income distribution with a Gini coefficient of ¼ to another with ½ (i.e., going from T2 to T3) leads to an estimated increase in the rents of 0.185 points (0.152 if we include controls). Finally, when we compare T1 and T3, we obtain a positive effect which is statistically significant only for the specification without controls. A move from no inequality to an income distribution with a Gini coefficient of ½ (i.e., going from T1 to T3) induces an estimated increase in the rents of 0.219 points (0.235 if we include controls).

Quantitatively, these effects are smaller than the theoretical predictions. Indeed, as shown in Table 7, we should expect an increase in rents of 0.227 when we compare T1 with T2, $0.727 - 0.227 = 0.50$ points when we compare T2 with T3 and 0.727 points when we compare T1 with T3. Risk preferences do not seem to be the reason of these differences. First, note that the agent does not face a risky choice. Once the principals have decided on their contribution schedules, the agent selects one of three certain payoff options. Second, the principals are faced with strategic uncertainty because when they decide on their contributions, they do not know what contribution schedule has been selected by the other principal. It is not clear how this should affect the quantitative theoretical predictions for T2 and T3. Nevertheless, it should definitely not affect our prediction for T1. When there is no inequality, there is no conflict of interest and, hence, principals should not pay the agent to implement a policy that s/he will pick anyway. However, as Table 11 shows, in T1, on average, the agent collected 0.56 points.

One possible explanation for the gap between theoretical predictions and estimated effects is that some subjects found the common-agency game to be too complicated. And, in fact, if we focus on subjects who correctly answered all the quiz questions, the results are closer to the theoretical predictions. As shown in columns (5)-(8) of Table 12, the estimated effects are significantly bigger for all specifications. Specifically, estimated rents are 0.1318 points higher in T2 than in T1 (0.179 points when we include controls), 0.297 points higher in T3 than in T2 (0.26 points when we include controls) and 0.435 points higher in T3 than in T1 (0.458 points when we include controls). Thus, focusing on subjects with the highest level of understanding of the game significantly reduces the gap between the observed behavior and theoretical predictions.

Summing up, we find evidence that supports the prediction of the common-agency model that higher inequality leads to higher contributions. Quantitatively, the effects are smaller than expected, but the gap narrows significantly when we focus on the subjects who had perfect scores on the quiz.

V. CONCLUSIONS

The relationship between horizontal conflicts of interest and vertical conflicts of interest is one of the fundamental questions in political economy. We have identified two sets of models that incorporate both types of conflicts (electoral models

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with endogenous rents and common-agency models), adapted them to a laboratory setting and used an experiment to test their main theoretical predictions. For both models we have found evidence that supports the prediction that higher inequality leads to higher political rents. We have also extensively discussed different possible explanations for the quantitative differences between the estimated effects and the models' predictions.

Formal theory, cross-country correlations and laboratory evidence all suggest that we should take the connections between horizontal and vertical conflicts seriously because they have several important implications. At the macro level, they could help to account for the persistence of corruption in some countries. Many developing countries are very unequal societies with intense horizontal conflicts (see, among others, Lichbach, 1989; Cederman et al., 2011; and Lupu and Pontusson, 2011). It should not be surprising that corruption and other forms of political rents are ubiquitous in these countries. Some economic structures are more likely to induce higher levels of heterogeneity in citizens' preferences over globalization and trade liberalization (see, for example, Galiani et al., 2014a; and Galiani and Torrens, 2014), and we can expect to observe more corruption and higher political rents in countries with those economic structures. The intensity of horizontal conflict tends to be higher in ethnolinguistically heterogeneous societies (see, for example, Cederman et al., 2011). We should also expect higher political rents in countries troubled by ethnic conflicts.

At the micro level, taking into account the relationship between horizontal and vertical conflicts may help to improve the design of anti-corruption policies. Our impression is that most of the recent literature on corruption has largely ignored this relationship (see, among others, Warren, 2004; Tavits, 2007; and Chang and Golden, 2010). The emphasis is on payment schemes, controls and audits, which are definitely good instruments for discouraging corruption, but, in some cases, mitigating horizontal conflicts could be an additional tool. Moreover, our findings indicate that we should assign scarce anti-corruption resources, such as inspectors and auditors, to areas in which there are intense horizontal conflicts.

We would like to close with a brief comment on the history of economic and political thought. One simple way of classifying social theories –and even, perhaps, political philosophies– is to gauge how much importance they place on horizontal and vertical conflict. At one extreme, we have theories that emphasize horizontal conflict. For example, in Marxist thought, the class struggle between workers and capitalists is the crucial social force, while the government is just an instrument that is used by one class to impose its will on the others. At the other extreme, we have theories that emphasize vertical conflict. For example, the liberal school of thought tends to stress the importance of a limited government, the separation of powers, and checks and balances. The weight that a social theory gives to horizontal versus vertical issues can also influence the evaluation of public policies. For example, a progressive social agenda that requires

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substantial political concentration to be successful will probably receive the support of those that place more importance on horizontal issues and be opposed by those who are more concerned with vertical problems. Moreover, the surrounding political discourse will probably reflect the tension between these perspectives. Groups that support the reform will argue that the opposition is trying to protect the interests of privileged groups with the specter of a terrible leviathan. The opposition will most certainly reply that the hidden agenda of the progressive reform is to create such a leviathan, which will end up devouring even the well-intentioned features of the reform. It would therefore seem that there is much to be gained from a better understanding of the relationship between horizontal and vertical conflicts and the associated trade-offs for society.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

Appendix A: Electoral Competition Game
Appendix B: The Common-agency Experiment

SUMMARY

We experimentally explore the connections between horizontal conflict of interests (citizens have heterogeneous preferences over collective decisions) and vertical conflict of interests (agents in charge of implementing collective decisions earn political rents). We identify two sets of models that incorporate both types of conflicts: electoral models with endogenous rents, and common-agency models. We adapt these models to a laboratory setting and test their main theoretical predictions. In both cases we find support for the proposition that more intense horizontal conflict leads to higher rents. Our findings have important implications. At the macro level, they help explaining the persistence of corruption in very unequal societies. At the micro level, our findings suggest that anti-corruption programs should allocate more resources (e.g., inspectors and auditors) to areas with intense horizontal conflicts.

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