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Does Financial Compensation Increase the Acceptance of Power Lines? Evidence from Germany

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Michael Simora, Manuel Frondel, and Colin Vance[1]

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Abstract

Although public support for renewable energy promotion in Germany is strong, the required power line construction has incited a groundswell of opposition from residents concerned about the impacts on their neighborhoods. This paper evaluates a large randomized one-shot binary-choice experiment to examine the effect of different compensation schemes on the acceptance of new power line construction. Results reveal that community compensations have no bearing on the acceptance level, whereas personal compensations have a negative effect. Two possible channels through which financial compensation reduces the willingness-to-accept are (1) crowding out of intrinsic motivation to support the construction project and (2) a signaling effect that alerts residents to potential negative impacts of the power lines. Both explanations call into question the efficacy of financial payments to decrease local opposition.

JEL Classification: M52, C93, Q40

Keywords: Not-in-my-backyard; willingness to accept; motivation crowding out; randomized discrete choice experiment

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1 Michael Simora, RWI and RGS Econ; Manuel Frondel, RWI, RGS Econ, and RUB; Colin Vance, RWI, RGS Econ, and Jacobs University Bremen. *– We are grateful to Mark Andor and Stephan Sommer for helpful comments and suggestions and to the Research Data Center Ruhr (FDZ Ruhr) for excellent research assistance. Moreover, we want to thank the participants of the 9th international workshop on empirical methods in energy economics in Oviedo, Spain, for valuable input. We gratefully acknowledge financial support by the Federal Ministry of Education and Research (BMBF) under grant 03SFK4B0 (Kopernikus Project ENavi) and grant 01 UN 1203C (Project AKZEPTANZ of the funding program "Environmentally and Socially Compatible Transformation of the Energy System"). We also gratefully acknowledge financial support by the Collaborative Research Center "Statistical Modeling of Nonlinear Dynamic Processes" (SFB 823) of the German Research Foundation (DFG), within Project A3, "Dynamic Technology Modeling". Finally, Michael Simora thanks the Ruhr Graduate School in Economics (RGS Econ) for granting a scholarship.* *– All correspondence to: Michael Simora RWI, Hohenzollernstr. 1-3, 45128 Essen, Germany, e-mail: michael.simora@rwi-essen.de*

1 Introduction

Germany's transition of its energy system towards renewable energy sources (´´Energiewende") is among the globe's most ambitious plans to reduce carbon dioxide emissions. Between 2000 and 2016, the share of renewable energies in Germany's gross electricity consumption increased from less than 7% to roughly 32% (BMWi, 2017), putting the country on track to meet its target of 35% by 2020. This progress owes to a strong promotion of renewable energy technologies, such as wind and solar power plants, granting them above-market feed-in tariffs. As a consequence, since the introduction of the feed-in tariffs in 2000 under the Renewable Energy Act, electricity prices for households have doubled.

Although opinion surveys indicate widespread support for the continued promotion of renewable energies (Andor et al., 2017a, 2017b), a vocal resistance has emerged on the question of where to construct the high-voltage transmission lines needed to transmit electricity from the wind turbines in Germany's north to the consumers in the rest of the country. While grid expansion is seen as indispensable to Germany's pivot from fossil fuel reliance, protest groups have sprung up along many of the planned pathways, motivated by concerns about negative impacts of the lines on human health and property values. This circumstance raises the question of how to counter the opposition of those adversely affected by the grid expansion.

The present paper takes up this question by presenting empirical results from a stated-preference analysis of the willingness to accept compensation for bearing the negative externalities caused by power lines. Previous studies on compensation mechanisms, both theoretical and empirical, yield no clear answers as to their effectiveness. While some studies suggest that compensation to the host community may help avoid opposition (Coursey, Kim, 1997; Cohen et al., 2016), others have argued that compensation payments might encourage people to see their situation through an economic lens, thereby undermining their intrinsic motivation to support the project (e.g. Krohn, Dambourg, 1999; Muradian et al., 2013; Tobiasson, Jamasb, 2016; Upham, Gar-

cia, 2015). Germany provides a particularly interesting case study of the effect of monetary compensation given the groundswell of opposition from local residents, juxtaposed with the steadfast support of renewable technologies even in the face of strongly increasing electricity prices.

Our approach employs a large randomized one-shot binary-choice experiment exposing participants to a hypothetical referendum on the siting of new overhead power lines in their neighborhood. The sample, consisting of about 7,000 households, was randomly split into three experimental groups. Subjects of the first treatment group received the information that their community will be compensated with either €100, €250, or €500 per residential household per year, with the concrete offer being randomly allocated. This treatment, henceforth called "community treatment", is based on German legislation according to which communities must be compensated for constructions derogating the natural scenery. The legislation requires communities to use the received money for nature conservation and landscape preservation measures (BMUB, 2013), information that is provided to all members of the community treatment group. While subjects of the control group received no compensation offer, those of the second group, henceforth called "household treatment group", were proposed a yearly compensation at the household level of either €100, €250, or €500, where the concrete amount again was randomly assigned.

Our results reveal that offering monetary compensation may be a counterproductive approach to increase the support of the siting of locally unwanted projects, often called the NIMBY (Not in My Backyard) problem. While we do not find any statistically significant effect of the treatment at the community level, there is a significantly negative impact at the household level: the share of pro-power-line votes is lowest among those participants who received an individual compensation offer.

These results are in line with several empirical studies that document a negative effect of using price incentives (e.g. Frey, Oberholzer-Gee, 1997; Gneezy, Rustichini, 2000a, 2000b; Jack, 2009; Kerr et al., 2012; Mellström, Johannesson, 2008), suggesting that compensation payments may be the wrong approach to foster acceptance of un-

wanted projects (e. g. Muradian et al., 2013; Tobiasson, Jamasb, 2016). In fact, social psychology argues that there may be a crowding-out of intrinsic motivation by extrinsic incentives, such as monetary compensations, rendering the price mechanism ineffective. Further empirical evidence for a motivation crowding-out effect of financial incentives in various settings can be found in the reviews by Bowles and Polania-Reyes (2012), Frey and Jegen (2001), and Rode et al. (2015).

Conversely, empirical evidence on a positive influence of monetary incentives on pro-social behavior has also emerged. A recent study by Cohen et al. (2016), for example, finds a small positive effect of community compensation for most countries in the EU-27, with the notable exception of Germany, where a monetary compensation offer at the community level leads to a reduction in acceptance. To our knowledge, our study is the first to conduct a large randomized experiment to analyze the effect of both personal and community compensation offers on the acceptance of power line construction.

The subsequent section provides a conceptual framework of motivation crowding-out, while Section 3 describes the data. Empirical results are reported in Section 4, followed by a discussion of robustness checks in Section 5 and alternative explanations other than motivation crowding-out in Section 6. The final section summarizes and concludes.

2 Conceptual Framework

Following Frey and Oberholzer-Gee (1997), we now provide a conceptual framework of motivation crowding-out of monetary incentives applied to NIMBY projects, such as power line constructions. Without a doubt, the expansion of Germany's high-voltage grids improves the effectiveness and efficiency of the country's transition towards a more sustainable energy system and, thus, increases overall welfare. However, new transmission lines may have negative (perceived) impacts on, for instance, human health and property values of the immediate neighbors, thereby provoking

resistance. To solve such a NIMBY problem, economic theory suggests that the neighbors can be induced to accept the construction of the undesired power lines by compensating them in such a way that their net benefits become positive, while taxes have to be increased to raise the money required for compensation payments.

In formal terms, a representative individual residing in a prospective host community chooses the level of support s that maximizes this individual's utility $u(s)$:

$$\max_s \{u(s) := p(s)[b - e + r] + m(s, r) - c(s)\}, \tag{1}$$

where b stands for the individual benefit associated with power line construction, e denotes negative externalities, such as health risks or crop reductions, and r designates the monetary compensation that the individual will receive if the prospective host community allows the construction of the power line, henceforth termed *rewards*.

Assuming that in a referendum an individual votes in favor of power line construction if s is positive, $s > 0$, the level of support s influences the probability $p(s)$ of successful siting: the more a representative citizen increases the support level, the more likely is the construction of the power line: $p_s := \frac{dp}{ds}(s) > 0$, but there are decreasing returns: $p_{ss} := \frac{d^2p}{ds^2}(s) < 0$. Participating in a referendum and other forms of support represent costly activities, whose costs are captured here by cost function $c(s)$, which exhibits the standard properties: $c_s := \frac{dc}{ds}(s) > 0, c_{ss} := \frac{d^2c}{ds^2}(s) > 0$.

In addition to external motivation, such as monetary rewards, and other economic impacts, intrinsic motivation may also play a role, so that an individual's utility $u(s)$ consists of two parts (see maximization problem (1)): a first term with the standard features and a second describing intrinsic motivation, $m(s, r)$. Intrinsic motivation affects, for instance, the willingness to contribute to the solution of pressing national problems, such as the lack of transmission lines that hampers the progress of Germany's energy transition. The level of support is positively correlated with intrinsic motivation: $m_s := \frac{\partial m}{\partial s} > 0$, but with diminishing returns: $m_{ss} := \frac{\partial^2 m}{(\partial s)^2} < 0$.

Most importantly, if we assume that external compensation tends to crowd out in-

trinsic motivation, then $m_r := \frac{\partial m}{\partial r} < 0$. This assumption is in line with social psychologists, who argue that where individuals perceive an external intervention, such as monetary rewards, to be manipulative, their intrinsic motivation shrinks (for a survey, see e. g. Lane, 1991).

The starting point of many siting disputes is that no monetary compensations ($r = 0$) are offered for those who have to bear the negative external effects, yielding a negative net benefit for the individual in case of siting: $b - e < 0$, leading to resistance against siting, as individual benefits b can be expected to be much lower than the negative external effects e. To mobilize additional support, the regulator may contemplate offering a monetary compensation $r > 0$ so that $b - e + r > 0$, thereby reaching a level of support s^* sufficient for successful siting.

The overall effect of rewards, $\frac{ds^*}{dr}$, can be derived as in the following comparative static analysis. A rational citizen chooses the level of support s^* that maximizes expected net benefits $u(s)$, leading to the first-order condition $u_s := \frac{du}{ds} = 0$,

$$p_s[b - e + r] + m_s - c_s = 0. \tag{2}$$

In order to deduce $\frac{ds^*}{dr}$ we differentiate first-order condition (2) with respect to r, keeping in mind that the level of support s is a function of r. This yields

$$p_s + m_{sr} + p_{ss}[b - e + r]\frac{ds^*}{dr} + m_{ss}\frac{ds^*}{dr} - c_{ss}\frac{ds^*}{dr} = 0. \tag{3}$$

From equation (3) follows the overall effect of compensation:

$$\frac{ds^*}{dr} = \frac{p_s + m_{sr}}{-\{p_{ss}[b - e + r] + m_{ss} - c_{ss}\}}, \tag{4}$$

whose sign depends on the signs and magnitudes of p_s and m_{sr}, as the denominator is positive:

$$-\{\underbrace{p_{ss}}_{<0}\underbrace{[b - e + r]}_{>0} + \underbrace{m_{ss}}_{<0} - \underbrace{c_{ss}}_{>0}\} > 0.$$

If external compensations, such as monetary rewards r, do not affect intrinsic motivation, i. e. if $m_r = 0$ and, thus, $m_{sr} = 0$, the overall effect of compensation is perfectly in line with standard economic rules: $\frac{ds^*}{dr} > 0$, as $p_s > 0$. That is, an increase in monetary compensation r unequivocally raises support s^*. We hypothesize this standard outcome to be valid for the community treatment group, as we assume that monetary rewards at the community level do not affect the individual's intrinsic motivation. We believe that this assumption is all the more appropriate, as participants learned during the survey that German legislation requires communities to use monetary compensations for nature conservation and landscape preservation measures and, hence, compensations at the community level do not imply any income increases of individual households: $r = 0$.[1] Our assumption that monetary rewards at the community level do not affect intrinsic motivation leads us to

Hypothesis 1: $\frac{ds^*}{dr} > 0$ for subjects of the community treatment group, because $m_r = 0$ for $r = 0$. In other words, we do not expect a crowding-out effect of compensations at the community level.

If, on the other hand, there is a crowding-out of external compensations with respect to internal motivation, i. e. $m_r < 0$ and $m_{sr} < 0$, and if this motivation crowding-out dominates the standard relative price effect, it follows from expression (4) that the overall effect of compensation becomes negative: $\frac{ds^*}{dr} < 0$. We hypothesize this outcome to be valid for the household treatment group.

Hypothesis 2: $\frac{ds^*}{dr} < 0$ for subjects of the household treatment group, in other words, we expect a crowding-out effect of compensations at the household level: $m_r < 0$.

Finally, to incorporate non-linearities in the effect of monetary rewards, we assume that a crowding-out effect of compensations merely emerges when compensations are below a certain threshold $\underline{r}$: $0 \leq r < \underline{r}$. To this end, we slightly modify utility function

[1] Note that respondents generally had no a-priori knowledge of the law specifying community compensation. A Google search reveals that media coverage has been sparse, and terms associated with the law have received very little attention based on an analysis of Google trends.

$u(s)$ and assume that

$$u(s) := p(s)[b - e + r] + m(s, r)I(r < \underline{r}) - c(s),$$

where $I(r < \underline{r})$ is an indicator function that equals unity if monetary rewards r are "too low", that is, below a certain, but unknown threshold $\underline{r}$. In other words, Hypothesis 2 is assumed to be valid for minor rewards $r < \underline{r}$. Otherwise, if $r \geq \underline{r}$, that part that captures intrinsic motivation vanishes in utility function $u(s)$, as $I(r < \underline{r}) = 0$ so that only the standard pricing effect is at work. Specifically, if $r = \underline{r} = 0$, as in the case of our community treatment, we would expect no crowding-out effect and, hence, the validity of Hypothesis 1.

3 Data

To investigate the effect of various compensation levels on the willingness to accept compensations for tolerating the construction of new power lines, we employed a randomized one-shot binary-choice experiment, a framework that – under certain circumstances – Carson et al. (2014) found to be incentive-compatible, that is, to reveal respondents' true preferences. To this end, participants were confronted with a hypothetical referendum on the construction of new overhead power lines in their immediate vicinity, receiving the information that power grid expansion is needed for Germany's energy transition (for details, see Questions 1a - 1c in Appendix A).

This framing risks introducing social desirability bias that leads to an overestimation of the true share of pro-power-line voters. However, there are two reasons why we do not deem this a serious threat to the validity of our results. First, the framing is provided to all experimental groups alike. Under the assumption that whatever bias exists it is uniform across treatment and control groups, the difference between treatment and control groups should remain unbiased. Second, we believe that the framing is needed to maintain the realism of the experiment. It is likely that similar

information would be provided in a real referendum to allow residents to understand the full implications of the planned project.

The experiment was part of a household survey that was funded by the Federal Ministry of Education and Research (BMBF) within the project AKZEPTANZ, whose focus is on the social acceptance of Germany's energy transition.[2] Data was collected by the German survey institute *forsa* via a state-of-the-art tool that allows respondents to complete the questionnaire at home using either a television or the internet. A large set of socio-economic and demographic background information on all household members is available from *forsa*'s household selection procedure and updated regularly.

Households were randomly assigned to one of three groups: a control, a community treatment, and a household treatment, with the two treatment groups being randomly allocated compensation levels of either €100, €250, or €500 per residence. As no publicly available information on the offered amounts for compensation exists, we arrived at these figures based on the text of the legislation, which specifies that the compensation payment is a function of the size of the construction site and an approximate landscape value of the affected area, for which categories are published (BMUB, 2013). Using this information, along with assumptions about the size of the community and of the construction site, we undertook back-of-the-envelope calculations to obtain the range of likely compensations issued per household.

Two-sample t-tests on equal means indicate that randomization across control and treatments was successful: for the majority of control variables, the treatment groups do not differ significantly from the control group (Table 1). Note that the large share of males in our sample is due to the design of the underlying survey, where household heads were asked to fill in the questionnaire, who, by definition, typically make investment decisions for the household as a whole and often are male.

To capture the degree of urbanization, we distinguish between rural, intermedi-

[2]For more information on the project, the underlying questionnaires and a summary of the descriptive results, see www.rwi-essen.de/akzeptanz.

Table 1: Comparison of Means across Experimental Groups.

Variable	Description	Control Group	Community Treatment Group		Household Treatment Group	
Male	Dummy: 1 if respondent is male	0.686	0.665	(1.51)	0.670	(1.17)
Age	Age of respondent	55.58	54.91	(1.66)	55.02	(1.40)
Homeowner	Dummy: 1 if respondent is homeowner	0.623	0.630	(-0.52)	0.629	(-0.42)
Children	Dummy: 1 if respondent is living with children	0.146	0.149	(-0.33)	0.159	(-1.15)
Employed	Dummy: 1 if respondent is employed	0.571	0.574	(-0.17)	0.592	(-1.37)
College degree	Dummy: 1 if respondent has a college preparatory degree	0.394	0.398	(-0.32)	0.402	(-0.56)
East	Dummy: 1 if household resides in East Germany	0.211	0.198	(1.06)	0.200	(0.87)
Rural	Dummy: 1 if household resides in a rural area	0.204	0.183	(1.70)	0.208	(-0.33)
Intermediate	Dummy: 1 if respondent lives in intermediate area	0.446	0.448	(-0.11)	0.423	(1.53)
Urban	Dummy: 1 if respondent lives in urban area	0.350	0.369	(-1.28)	0.369	(-1.30)
Income	Household's net income per person (EUR)	1,536	1,526	(0.46)	1,519	(0.72)
PPI	Mean purchasing power index of a postal code area	1.90	1.91	(-0.49)	1.84	(1.90)
Green attitudes	Dummy: 1 if respondent generally votes for Green Party	0.101	0.120	(-2.02)	0.107	(-0.67)
Power pylons	Dummy: 1 if power pylons exist in a respondent's postal code area	0.799	0.787	(0.91)	0.782	(1.33)
Renewable facility	Dummy: 1 if renewable energy installations are located in a respondent's postal code area	0.580	0.549	(2.09)	0.554	(1.72)
Power plant	Dummy: 1 if there are conventional power plants in a respondent's postal code area	0.093	0.086	(0.90)	0.073	(2.49)
Number of observations:		2,151	2,241		2,176	

Note: for comparisons with the control group, t-statistics are reported in parentheses.

ate, and urban areas, following the regional typology established by the OECD (2011). We expect that respondents residing in a rural area vote less frequently in favor of construction, as they may be more inclined towards landscape preservation. Furthermore, we expect homeowners to vote less frequently in favor of construction, as they might fear a decrease in property value, regardless of whether there actually is an effect on housing prices (Baxter et al., 2013; Gregory, von Winterfeldt, 1996; Sims et al., 2008; Soini et al., 2011). Moreover, having invested in housing signals the willingness to stay in the current neighborhood and, hence, these households might be more inclined to covet an untouched landscape. This argument likewise may hold for households with children.

To control for the household's economic situation, we include monthly net income per person, as well as the mean purchasing power index (PPI) of the household's postal code area, as previous studies indicate that the economic situation of the whole community influences the acceptance of NIMBY projects (Jobert et al., 2007).[3] To con-

[3]PPI information is obtained from microm data on purchasing power (doi:10.7807/microm/kaufkraft: V4), with mean purchasing power in Germany normalized to 1.

trol for environmental attitudes, a dummy is included indicating whether the respondent tends to vote for Germany's Green Party. Alternatively, we have employed other proxies for environmental attitudes, such as a dummy indicating whether the household head is member of an environmental organization.[4] The effect of these proxies of environmental attitudes, though, is a priori unclear: While Baxter et al. (2013) conclude that green attitudes foster the support of necessary construction work, Soini et al. (2011) find the opposite result of less acceptance of power lines among respondents with stronger pro-environmental attitudes.

Finally, we include binary information about the existence of power pylons and power plants in a respondent's postal code area originating from OpenStreetMap.org (licensed under the Open Data Commons Open Database License (ODbL)).[5] To check for heterogeneity in the effect for different energy sources, we distinguish between renewable energy technologies and conventional power plants, including nuclear stations. According to Soini et al. (2011), respondents living in an area with a relatively high number of power lines are more likely to have a positive attitude towards them. Conversely, Cohen et al. (2016) conclude that if a respondent's neighborhood recently faced renewable infrastructure developments, the acceptance of new construction is reduced. Likewise, Upham and Garcia (2015) argue that in areas with an already high share of wind mills, the acceptance of new projects is lowered. However, these findings are either of descriptive nature or derived using rather rough measures. An advantage afforded by the present data is its use of highly resolved spatial data to analyze the effect of pre-existing power infrastructure on the acceptance of new power line construction.

Household income is measured in intervals of €500, ranging from €700 to €5,700. Assuming that household incomes lie in the middle of the interval, we divide this amount by the number of persons living in the household to get per-capita net income. Note that using the intervals instead does not change the empirical results.

[4]Estimation results in terms of signs, magnitudes, and significance levels are similar irrespective of which of these proxies is included in the regressions.

[5]Note that using the number of power pylons and plants that are located in the respondent's postal code area, rather than just binary information, does not change the results.

4 Empirical Results

Beginning our analysis with a comparison of group means, Table 2 reports the shares of pro-power-line votes across groups, as well as t-statistics to evaluate comparisons with the control group. While in statistical terms, there is no difference between the community treatments and the control group, household treatments with compensations of either €100 or €250 exhibit statistically significantly lower acceptance rates than the control group. For both these groups, offering compensation decreases the probability to vote in favor of power line construction by 4.8 and 5.4 percentage points, respectively. On the basis of these descriptive results, neither *Hypothesis 1* nor *Hypothesis 2* can be rejected: crowding-out is not an issue for the community treatment group, but cannot be ruled out for the household treatment group.

Overall, more than 50% of the respondents indicated voting in favor of construction, irrespective of the compensation level. This share, however, does not necessarily mimic the outcome of a real referendum due to potential biases, such as social desirability bias, the over-representation of males, and hypothetical bias, the latter of which is further explored in the subsequent section.

Table 2: Share of Pro-Power-Line Votes across Experimental Groups

	Shares	t-statistics	Number of observations
Control Group:	66.8 %	–	2,151
Community Treatment Groups:			
€100	64.7%	-1.07	776
€250	64.6%	-1.10	737
€500	67.7%	0.45	728
Total	65.5%	-0.57	2,241
Household Treatment Groups:			
€100	62.0%	-2.31	698
€250	61.4%	-2.66	725
€500	64.4%	-1.20	753
Total	62.6%	-2,04	2,176

Note: for comparisons related to the control group, t-statistics are reported.

Accounting for the control variables described in Section 3, we next estimate a probit model of voting in favor of construction. In addition to being of interest in their

own right, the inclusion of control variables serves to gauge the robustness of the descriptive results. Moreover, as argued by Angrist and Pischke (2008:23) and demonstrated empirically by Vance and Ritter (2012), the inclusion of controls in an experimental setting, where they are uncorrelated with the treatment, potentially increases the precision of the estimates by reducing the residual variance.

Table 3 presents both the coefficient estimates and the associated means of the marginal effects calculated for each observation. Following Greene (2007: E18-23, 2010: 292), who argues that in non-linear models, such as probit, tests on the statistical significance of an explanatory variable should be based on its coefficient, rather than the marginal effect, we find that the community treatment does not significantly bear on power line acceptance, irrespective of the offered amount. The household treatment, by contrast, significantly reduces the share of pro-power-line votes in those groups being proposed €100 or €250 compensation. The size of the reduction is on the order of 4.2 and 5.1 percentage points, which is roughly in line with estimates obtained from the comparison of shares in Table 2.

Also in line with the descriptive results, the €500 household treatment has no significant influence on the acceptance rate, with a magnitude that is lower than those of the other two treatments. This outcome may suggest a non-linear effect, whereby higher compensation offers at some point exhibit positive effects, as is found by Gneezy and Rustichini (2000b). While the maximum treatment amount of €500 in our data precludes us from pursuing this possibility, we later present evidence that inadequate compensation is an unlikely reason for votes against the project.

If we specify our model a bit differently and include dummies for the community and the household treatment irrespective of the compensation amount, and control for the latter as a separate explanatory variable, we arrive at similar conclusions (see Table B1 in Appendix B): While the community treatment has no significant effect on power line acceptance, the household treatment reduces the probability to vote in favor of construction by 5.5 percentage points.

Several other interesting effects emerge. First, with a marginal effect of 14.3 per-

Table 3: Probit Estimation Results on Pro-Power-Line Votes

	Coeff.s	Robust Std. Errors	Marginal Effects	Robust Std. Errors
Community Treatment:				
€100	-0.049	(0.055)	-0.017	(0.019)
€250	-0.050	(0.056)	-0.018	(0.020)
€500	0.018	(0.057)	0.006	(0.020)
Household Treatment:				
€100	-0.116*	(0.057)	-0.042	(0.021)
€250	-0.141**	(0.056)	-0.051	(0.020)
€500	-0.063	(0.056)	-0.023	(0.020)
Male	0.400**	(0.035)	0.143	(0.012)
Age	0.002	(0.002)	0.001	(0.001)
Homeowner	-0.271**	(0.037)	-0.097	(0.013)
Children	-0.116*	(0.051)	-0.042	(0.018)
Employed	-0.079	(0.042)	-0.028	(0.015)
College	0.036	(0.035)	0.013	(0.013)
East	0.031	(0.041)	0.011	(0.015)
Intermediate	-0.036	(0.048)	-0.013	(0.017)
Urban	0.052	(0.055)	0.019	(0.020)
Income	-0.003	(0.002)	-0.001	(0.001)
PPI	0.030	(0.017)	0.011	(0.006)
Green attitudes	0.251*	(0.054)	0.090	(0.019)
Power pylons	0.042	(0.044)	0.015	(0.016)
Renewable facility	-0.065	(0.036)	-0.023	(0.013)
Power plant	0.076	(0.060)	0.027	(0.021)
Number of observations	6,568		6,568	

Note: ** and * denote statistical significance at the 1 % and 5 % level, respectively.

centage points, male respondents have a substantially higher probability to vote in favor of construction. Moreover, as expected, being a homeowner decreases the probability to vote in favor of construction, as does living with children and – to a lesser extent – being employed. However, the latter two effects were not found to be robust (see Table B2 in Appendix B). Other socioeconomic indicators, like the household's per capita income and the average purchasing power of the community within which it is situated, are statistically insignificant. Location factors, including residence in an urban area as well as close proximity to power pylons and to power plants (whether conventional or renewable) are likewise insignificant. Finally, in line with Baxter et al. (2013), we find that green attitudes have a positive and statistically significant correlation with pro-power-line votes.

5 Robustness Checks

Our first robustness check recognizes that urban neighborhoods are unlikely to be affected by new power line constructions, with the consequence that urban residents might respond differently to compensation than their rural counterparts. To explore the implications of this potential heterogeneity for the estimates, the first model in Table 4 excludes urban residents. All treatments in this case are statistically insignificant. While we find no support for any crowding-out effect in this model, we maintain our conclusion that monetary compensation does not have the intended positive effect on the probability of supporting the project.

Another possible threat to the validity of our study is hypothetical bias, which arises when individuals tend to overestimate both their WTP and WTA in hypothetical situations (Blumenschein et al., 2008; Little, Berrens, 2004; List, Gallet, 2001; Nape et al., 2003). This would imply that in a real referendum, more individuals would accept the offered payment and, hence, the share of pro-power-line votes would be higher than it is in our treatment groups.

To tackle hypothetical bias, further robustness checks are undertaken that incorporate the certainty corrective conceived by Johannesson et al. (1998). Following a similar procedure suggested by Blumenschein et al. (1998), upon indicating their referendum vote, respondents were asked whether they are very sure or not so sure about their response (see Question 2 in Appendix A). Those respondents who did not confirm to be sure about their actual voting behavior are then excluded from the analysis.[6]

Numerous studies, such as Blumenschein et al. (2008), Little and Berrens (2004), Ready et al. (2010), as well as Whitehead and Cherry (2007), argue that hypothetical bias can be reduced using this approach. In our case, this exercise does not fundamentally change the empirical results (Table 4, for the marginal effects, see Table B2 in Appendix B). In particular, the community treatment still does not have any significant bearing on voting behavior and the €100 and €250 household treatments continue to

[6] In total, 1,449 observations were dropped, out of which 579 respondents voted against and 870 in favor of construction.

Table 4: Probit Coefficient Estimates on Pro-Power-Line Votes: Robustness Checks

	Excluding urban respondents		Just sure respondents		Recoding unsure votes	
	Coeff.s	Robust Std. Errors	Coeff.s	Robust Std. Errors	Coeff.s	Robust Std. Errors
Community treatment:						
€100	0.019	(0.067)	-0.075	(0.062)	-0.049	(0.057)
€250	-0.113	(0.069)	-0.102	(0.064)	-0.032	(0.058)
€500	0.040	(0.071)	0.010	(0.065)	0.014	(0.060)
Household treatment:						
€100	-0.071	(0.072)	-0.135*	(0.065)	-0.110	(0.059)
€250	-0.107	(0.069)	-0.177**	(0.063)	-0.168**	(0.058)
€500	0.041	(0.068)	-0.109	(0.064)	-0.073	(0.058)
Male	0.383**	(0.043)	0.459**	(0.040)	0.301**	(0.036)
Age	0.005*	(0.002)	0.002	(0.002)	-0.000	(0.002)
Homeowner	-0.286**	(0.049)	-0.323**	(0.043)	-0.276**	(0.039)
Children	-0.056	(0.064)	-0.129*	(0.059)	-0.081	(0.053)
Employed	-0.045	(0.054)	-0.086	(0.048)	-0.113*	(0.044)
College	-0.030	(0.044)	0.019	(0.040)	0.029	(0.037)
East	0.035	(0.049)	0.021	(0.047)	0.005	(0.043)
Intermediate	-0.034	(0.050)	-0.006	(0.055)	0.029	(0.050)
Urban	–		0.094	(0.062)	0.108*	(0.057)
Income	-0.003	(0.003)	-0.002	(0.003)	-0.002	(0.002)
PPI	0.031	(0.020)	0.031	(0.020)	0.018	(0.018)
Green attitudes	0.181**	(0.070)	0.284**	(0.062)	0.226**	(0.057)
Power pylons	0.131	(0.068)	0.038	(0.051)	0.052	(0.047)
Renewable facility	-0.054	(0.044)	-0.059	(0.041)	-0.089*	(0.038)
Power plant	-0.038	(0.077)	0.075	(0.068)	0.050	(0.063)
Number of observations	4,186		5,119		6,568	

Note: ** and * denote statistical significance at the 1 % and 5 % level, respectively.

elicit negative effects.

A second strategy for dealing with hypothetical bias goes a step further. As some respondents refuse the hypothetical offer, but may accept it in a real referendum, we recoded all votes against construction to pro-power-line votes when respondents indicated that they were not sure about their response (Blumenschein et al., 1998; Champ et al., 1997; Morrison, Brown, 2009; Ready et al., 2010).[7] With this approach, the effect of the €100 household treatment loses statistical significance (p=0.062), whereas the other effects are similar to those of the baseline model (see Table 4). In particular, the community treatments still remain statistically insignificant and the €250 household

[7]The answers of 579 respondents were recoded. Whether the 870 pro-power-line voters who indicated to be not sure about their response are excluded from analysis does not lead to different results.

treatment has a significantly negative effect.

Our main results are thus robust against applying the certainty corrective, which is in line with some previous studies that come to the conclusion that hypothetical bias is not universal (Johnston, 2006; Smith, Mansfield, 1998; Taylor et al., 2001; Vossler, Kerkvliet, 2003). In general, hypothetical binary referendum outcomes were similar to follow-up real referendum outcomes in cases where the experimental setting was kept simple and the respondents were familiar with the object of choice, both being aspects that can reasonably be said to apply in the present setting.

Other robustness checks have been undertaken by including interaction terms to probe for heterogeneity in the treatment effects across socioeconomic groups. It is conceivable, for example, that wealthy households would show a more muted response to financial compensation than poorer households. We have consequently included an interaction of the treatments with household per capita income. Other specifications have also been estimated that interacted the treatments with indicators for children, home ownership, gender, Green party support, and urban residency. In no cases were statistically significant differential effects detected.

To summarize, we find a significant and largely robust negative effect of the €100 and €250 household treatments, but no noteworthy effect of the community treatment. We conclude that offering individuals a financial compensation with the aim to reduce local opposition against necessary construction work is not expedient. While hypothetical bias is arguably a threat to our study, robustness checks indicate that the negative effect of the personal compensation offer maintains when the certainty corrective is employed. At the very least, there is no hint of a positive effect of such compensations, which undermines the case for using financial incentives to overcome NIMBY-type resistance.

6 Alternative Explanations

As explained by the theoretical background presented in Section 2, motivation crowding-out provides a potential explanation for the adverse response of subjects receiving financial compensations at the household level, but not for those of the community treatment group. Other explanations, however, also deserve consideration. To gain further insight, we asked respondents who voted against construction close-ended questions about the reasons for their decision. (For the exact wording of the questions and the available response options, see Questions 3a-3b in Appendix A.) A first rationale might be strategic behavior of the respondents: The offer is refused, hoping that a higher one will be made. However, the first column of Table 5 reveals that only 10% of those refusing the proposed compensation stated that the offer was too low. This would suggest that insufficient compensation offers may not explain the observed treatment effects. Interestingly, with the exception of differences by gender, there is little variation in indicating this reason over experimental groups and offered amounts.

Table 5: Shares and Potential Reasons of Respondents who Vote Against Construction

	Compensation too low	Compensation received as negative signal	No landscape derogation	Community Compensation not useful
Community treatment:				
€100	8.8%	38.7%	58.8%	21.5%
€250	10.7%	37.2%	55.2%	20.3%
€500	8.9%	34.5%	58.3%	21.3%
Household treatment:				
€100	12.8%	41.5%	49.1%	–
€250	8.6%	32.9%	50.0%	–
€500	10.5%	38.1%	51.9%	–
Males	12.4%	37.9%	51.5%	24.3%
Females	6.6%	36.0%	57.1%	16.6%
Rural	10.1%	37.1%	58.9%	14.0%
Intermediate	8.7%	34.5%	53.5%	20.3%
Urban	11.8%	40.8%	51.0%	26.6%
Total	10.0%	37.1%	53.8%	21.0%
Number of observations	1,583	1,583	1,583	770

Note: Respondents could indicate more than one reason for voting against the construction.

A second reason to vote against construction might be that participants interpret

the compensation as a signal of negative consequences and a higher risk (cf. Frey, Oberholzer-Gee, 1997). For example, if people perceive a risk for their health, they may strongly refuse construction, irrespective of whether there is any objective risk (Baxter et al., 2013; Cotton, Devine-Wright, 2013; Jay, 2007; Upham, Garcia, 2015). Similarly, some scholars argue that the compensation is refused if it is perceived as bribery (Aitken, 2010; Walker et al. 2014). In our case, respondents initially might not see a substantial risk, but get suspicious as soon as a compensation for the construction is offered. Seemingly, this negative signaling is a valid concern, as it is identified by approximately 37% of those refusing the financial compensation and voting against construction (see Table 5). Note that those accepting the compensation were not asked whether they perceive the project as a risk.

Third, respondents who voted against construction were asked whether they are not willing to impair the natural scenery and prioritize an untouched landscape over financial matters. As Column 3 in Table 5 reveals, this holds true for more than half of those respondents. Remarkably, participants in the community treatment tend to mention this reason more frequently than those in the household treatment, despite being informed that the community compensation would be reinvested in landscape preservation. The finding that residents in rural areas more frequently indicated the importance of an untouched landscape than respondents living elsewhere is less surprising. Visual aesthetic concerns hence seem to play a major role in the opposition towards construction, a result that has also been obtained in previous studies (Cotton, Devine-Wright, 2013; Eltham et al., 2008; Jobert et al., 2007; Upham, Garcia, 2015). This clear preference for an untouched natural scenery is relatively independent of financial compensation offers.

Finally, subjects of the community treatment group who voted against construction were asked whether they assess the community level compensation as not personally beneficial. This holds true for 21.0% of those respondents (see the last column of Table 5). While males indicated this point more frequently than females, there is also a high variation across the degree of urbanization. Whereas only 14.0% of respondents in

rural areas do not see a personal benefit in the community compensation, this motive applies to nearly 27% of the urban respondents. This discrepancy may relate to the fact that the community compensation was tied to measures of landscape preservation, which are more valuable to rural residents.

In short, there are several potential channels through which financial compensation reduces the willingness to accept power line projects. Most notably, in addition to the crowding-out of intrinsic motivation, compensation offers tend to imply a negative signaling. In any case, our results suggest that financial compensation offers are not an effective policy instrument for reducing local opposition against new electric power lines.

7 Summary and Policy Implications

This paper has analyzed the impact of hypothetical compensation offers on the individual acceptance of new overhead power line construction in the direct neighborhood. While this construction is indispensable to the success of Germany's energy transition, it has been met with strong opposition from local residents. To probe the strength of this opposition in the face of financial incentives, we implemented a large randomized one-shot binary-choice experiment in which respondents were confronted with a hypothetical referendum. Different experimental groups were offered either no compensation, a yearly payment at the household level or a yearly payment at the community level. The latter is based on German legislation, according to which communities have to be compensated for construction work that derogates the natural scenery.

We find that, if anything, financial incentives lower the support for the expansion of power lines. The proposed financial compensation at the household level significantly diminished the willingness to accept the construction project, whereas the community level compensation had no statistically significant effect on the acceptance rate.

Our results suggest that policy makers should exercise caution when implementing

financial compensations as an instrument for reducing local opposition against power line constructions. Instead, several scholars stress that construction plans should be made transparent ab initio and locals should be included in an early planning stage to avoid a feeling of governmental enforcement and being passed over (Aitken, 2010; Ciupuliga, Cuppen, 2013; Cotton, Devine-Wright, 2013; Eltham et al., 2008; Krohn, Dambourg, 1999; Upham, Garcia, 2015). Devine-Wright (2012) and Tobiasson et al. (2016) further underline the importance of trust in the network operator, as well as in the local government. When informing residents, officials should emphasize community benefits and environmental usefulness (Cohen et al., 2016; Walker et al., 2014). By contrast, financial compensation for residents is likely to be insufficient or even counterproductive in the German context, as this uses economic incentives to encourage support for an endeavor – the energy transition – that is already highly popular, largely owing to its environmental benefits.

Appendix A: Survey Questions

A crucial part of Germany's energy transition is grid expansion. Please assume that – following the advice of expert net planners – it is intended to build a new overhead power line through your immediate vicinity.

Question 1a for control group:

In a referendum, residents are asked to vote on this construction. How would you personally vote in this referendum?

(i) I would vote in favor of constructing the new power line

(ii) I would vote against constructing the new power line

(iii) I would abstain from voting

(iv) I do not know

Question 1b for community treatment group:

Your community will be compensated with a yearly payment of €[100, 250, or 500] per residential household, which your community has to use for nature conservation and landscape preservation measures. In a referendum, residents are asked to vote on this construction. How would you personally vote in this referendum?

(i) I would vote in favor of constructing the new power line

(ii) I would vote against constructing the new power line

(iii) I would abstain from voting

(iv) I do not know

Question 1c for household treatment group:

Every residential household will be compensated with a yearly payment of €[100, 250, or 500]. In a referendum, residents are asked to vote on this construction. How would you personally vote in this referendum?

(i) I would vote in favor of constructing the new power line

(ii) I would vote against constructing the new power line

(iii) I would abstain from voting

(iv) I do not know

Question 2 (all groups):

How sure are you that you would really vote [in favor of or against] construction in the referendum?

(i) Very sure

(ii) Not so sure

(iii) I do not know

Question 3a for respondents who indicated to vote against construction in community treatment group:

Why would you vote against the construction of the new power line? Which of the following reasons apply for you?

(i) I personally do not benefit from the compensation

(ii) The offered compensation is too low

(iii) The offered compensation points on negative consequences of the construction

(iv) I do not want the landscape to be derogated

(v) A different reason

(vi) I do not know

Question 3b for respondents who indicated to vote against construction in household treatment group:

Why would you vote against the construction of the new power line? Which of the following reasons apply for you?

(i) The offered compensation is too low

(ii) The offered compensation points on negative consequences of the construction

(iii) I do not want the landscape to be derogated

(iv) A different reason

(v) I do not know

Appendix B: Robustness Checks

Table B1: Probit Estimation Results on Pro-Power-Line Votes: Alternative Specification

	Coeff.s	Robust Std. Errors	Marginal Effects	Robust Std. Errors
Community treatment	-0.073	(0.051)	-0.026	(0.018)
Household treatment	-0.154**	(0.052)	-0.055	(0.019)
Offered amount (in €100)	0.016	(0.012)	0.006	(0.004)
Further controls	Yes		Yes	
Number of observations	6,568		6,568	

Note: ** and * denote statistical significance at the 1 % and 5 % level, respectively.

Table B2: Marginal effects of Pro-Power-Line Votes resulting from Probit Estimations: Robustness Checks

	Excluding urban respondents		Just sure respondents		Recoding unsure votes	
	Coeff.s	Robust Std. Errors	Coeff.s	Robust Std. Errors	Coeff.s	Robust Std. Errors
Community Treatment:						
€100	0.007	(0.024)	-0.026	(0.022)	-0.015	(0.018)
€250	-0.042	(0.026)	-0.035	(0.023)	-0.010	(0.018)
€500	0.014	(0.026)	0.003	(0.022)	0.004	(0.018)
Household Treatment:						
€100	-0.026	(0.027)	-0.047	(0.023)	-0.035	(0.019)
€250	-0.040	(0.026)	-0.062	(0.022)	-0.054	(0.019)
€500	0.015	(0.025)	-0.038	(0.022)	-0.023	(0.018)
Male	0.141	(0.016)	0.160	(0.013)	0.095	(0.011)
Age	0.002	(0.001)	0.001	(0.001)	-0.000	(0.001)
Homeowner	-0.105	(0.018)	-0.113	(0.015)	-0.087	(0.012)
Children	-0.020	(0.023)	-0.045	(0.021)	-0.026	(0.017)
Employed	-0.017	(0.020)	-0.030	(0.017)	-0.036	(0.014)
College	-0.011	(0.016)	0.007	(0.014)	0.009	(0.012)
East	0.013	(0.018)	0.007	(0.016)	0.002	(0.014)
Intermediate	-0.012	(0.018)	-0.002	(0.019)	0.009	(0.016)
Urban	–		0.033	(0.022)	0.034	(0.018)
Income	-0.001	(0.001)	-0.001	(0.001)	-0.001	(0.001)
PPI	0.011	(0.007)	0.011	(0.007)	0.006	(0.006)
Green attitude	0.067	(0.026)	0.099**	(0.022)	0.071	(0.018)
Power pylons	0.048	(0.025)	0.013	(0.018)	0.017	(0.015)
Renewable facility	-0.020	(0.016)	-0.020	(0.014)	-0.028	(0.012)
Power plant	-0.014	(0.028)	0.026	(0.024)	0.016	(0.020)
Number of observations	4,186		5,119		6,568	

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