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### Conference Paper Climate Policies and Green Party Performance in Local Elections

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### Climate Policies and Green Party Performance in Local Elections

#### Abstract

It seems plausible that influential green parties facilitate climate action. We test this hypothesis for local elections and the implementation of climate policies, here in terms of renewable energy capacity expansion. In an instrumental variable approach, we use fluctuations in national Green Party support for Germany to study the effects of an exogenous variation of Green Party votes in local elections on renewable energy expansion in the period 2009-2016. Surprisingly, our results suggest that more votes for the Green Party actually hinder the local energy transition. One extra percentage point for the green party reduces photovoltaic installations in a municipality by about 0.02-0.03 kW/person. These results are also helpful in disentangling the political effect of the Green Party from general demographic channels that correlate with local Green vote shares. They contribute to a better understanding of the reasons for and effectiveness of local governments' climate mitigation policies.

#### JEL codes: Q28, Q48, R50

Keywords: Green party, Urban climate action, Renewable Energy, Energy transition

#### 1. Introduction

Sub-national actors across the globe increasingly address climate change. Cities, for example, are pledging city-level greenhouse gas (GHG) emission reduction targets (Salvia et al., 2021; Rivas et al., 2021). The UN's Paris Agreement on Climate Change recognizes "the importance of the engagements of all levels of government [...] in addressing climate change" (Preamble). Cities appear to be well placed to address climate change. For instance, estimates show that up to 70% of global GHG emissions originate in cities (Shukla et al., 2022). Cities are particularly vulnerable to the impacts of climate change (Dodman et al., 2022). About 56% of the global population currently lives in cities, with a rising trend (Bank, 2023), and of these about 60% live in low-lying coastal areas (MacManus et al., 2021). From the economics perspective, however, GHG emission reductions are conventionally considered as contributions to a global public good. Thus, theory would let us expect that local governments would not provide such a good. So, it is puzzling that local governments pledge emission reductions, or one might suspect that pledges will not convert into actual reductions (Roggero et al., 2023).

However, first empirical studies indicate that many sub-national actors started to reduce emissions (e.g. Hsu et al., 2020; Kona et al., 2018). Local governments with more ambitious pledges tend to reduce more emissions, possibly more than the national average (Hsu et al., 2022). Yet, this research is hampered since GHG emissions are still difficult to measure locally. Major sources of emissions (e.g. from heating or transport), are usually accounted at the national level, and need to be down-scaled (Christen, 2014; Hsu et al., 2022; Arioli et al., 2020). Yet, there has been progress in data availability.

This raises the question of whether there are incentives or mechanisms for local governments to turn mitigation plans into action. One can conceive of several hypotheses. First, sub-national actors could be exposed to climate risk and thus find it in their interest to mitigate (e.g. Zahran et al., 2008; Kalafatis, 2018; Boussalis et al., 2018). Second, local climate action might be fostered by climate policy co-benefits like improved air quality, healthier physical activity, or savings in public energy costs (Karlsson et al., 2020; Dodman et al., 2022; Roggero et al., 2023). Third, lobby groups could shape climate action (e.g. Culhane et al., 2021), also at the local level. Fourth, sub-national actors could simply follow the climate mitigation path at the national level, making local mitigation complement instead of a substitute (e.g. Andonova et al., 2017; Woodruff and Stults, 2016; Domorenok, 2019; Roggero et al., 2023; Eisenack and Roggero, 2022). In this paper, we focus on a further under-researched channel, especially from a methodological perspective: Whether political parties drive climate action. Descriptive statistics seem to support this idea in some studies (e.g., Abel, 2021). It seems natural that the strength of parties that emphasizes environmental causes ("green" parties) at the local level does indeed lead to climate action. However, local election outcomes for green parties are quite likely endogenous to voters' green preferences. It is difficult to distinguish between the effect voters' green preferences in general, and the local political representation of a green party. Therefore, the hypothesis that voting success for green parties leads to climate action needs further causal testing.

To better understand the effect of green parties on climate action, we isolate green votes from general green preferences at the local level in Germany. We do this by using variations over time in Green Party support at a national level - measured by a weekly opinion poll - as an instrument for local election outcomes for the green party. We use local election data of 1,543 German municipalities which had local elections between 2009 and 2011. Our identification strategy relies on the assumption that national support for the Green Party only results in local-level climate policies if mediated by local green votes. Due to the data quality issues for local GHG accounting, we operationalize climate action as installation of renewable energy, in three ways: Either focusing on the local installation of wind power capacity, or photovoltaic (PV) capacity, or total renewable installation.

We thus contribute to the growing literature on public choice in environmental economics (e.g. Tavoni and Winkler, 2021; Eisenack and Hagen, 2023), here the role of political elections for sub-national climate policies. While environmental economics has done much research on policy impacts and evaluation, we think it is worthwhile to also study policy implementation, as it proceeds the former, and because policy implementation is presumably also driven by actors' expectation about policy impact. The effect of local or statelevel policy preferences (e.g. expressed by elections) for sub-national climate policy implementation have not been researched much from the theoretical perspective (see Eisenack, 2023). Empirically, it has been studied to some degree for the United States. Higher percentages of registered Democrats and Green party members are positively correlated with a city's likelihood to par-

ticipate in a climate action plan agreement Wang (2012); Hui et al. (2019) and to adopt ambitious renewable energy policies Armstrong (2019); Breetz et al. (2022). More liberal cities are associated with an increase in climate change programs (Matisoff, 2008) and, on the flip-side, a higher share of Republican votes negatively correlates with county-level votes for renewable portfolio standards (Pritchard and Mills, 2021). Interpreting climate action as reducing GHG emissions, Dietz et al. (2015) finds a lower increase in emissions over time for states with elected legislators that have a stronger environmental record. Few studies exist for the European context. Pablo-Romero et al. (2015) show that Spanish local governments have a higher probability of implementing environmental measures in the presence of more liberal political preferences. For a selected German municipality, Abel (2021) find that higher proportions of the Green party in local councils was associated with the early adoption of climate policies. Yet, this literature predominately analyzes a correlation between local political preferences and urban climate action. Instead, our paper contributes by isolating the causal effect of a political elections on local climate action.

Our results show that local elections indeed follow the trend of national opinion polls, but they can just explain part of the variation in election outcomes. Surprisingly, when it comes to local-level climate action, our results suggest that more votes for the Green Party actually hinder the local expansion of renewable generation capacity. One extra percentage point for the Green Party reduces photovoltaic installations by about 0.02-0.03 kW<sup>1</sup>/person. The

<sup>&</sup>lt;sup>1</sup>kW is the abbreviation for the unit of power kilowatt

effect is highly statistically significant across different specifications. The results for wind installations point in a similar direction. This aligns with the "Nixon-to-China paradox," where controversial policies are best implemented by a party not associated with those policies (Cowen and Sutter, 1998).

The paper is structured as follows: In sections 2 and 3, we present our data, some essential background on the German context, and the identification strategy. We then obtain our estimates in section 4, followed by a discussion of our results, and conclusions.

#### 2. Data and institutional background

We combine election data at the local level with voting intentions at the national level. These voting intentions are captured by the weekly opinion poll results of forsa, an independent private market and opinion research institute, which employs a representative sample of the German population eligible to vote (forsa, 2023). We use results to the poll question "If next Sunday were to be a federal election day for the German national parliament, which party would you vote for?".

Climate action can partly be operationalized by the capacity of installed renewable energy supply. We employ generation capacity data for photovoltaic (PV) and wind power plants in the Marktstammdatenregister (MaStR), a central registry of renewable power plants provided by the German Federal Network Agency (Bundesnetzagentur, 2023).<sup>2</sup> In the MaStR every owner of a power plant has to register data on the plant including its capacity, postal

 $<sup>^2\</sup>mathrm{Thanks}$  to Hülk et al. (2023) for compiling the data and making them available on Zenodo.

code, commissioning day. Even quite small rooftop PV power installations need to be registered. We match PV power plants to municipalities based on postal codes, and aggregate PV capacity at the municipality level for the years 2009 and 2016. Since renewables installation is often lagged due to complicated planning and public approval processes, we used data on this longer time period: The difference in installed renewable from 2009 to 2016. Table 2 shows descriptive statistics of the outcome variables. In order to avoid large upwards outliers as can be seen in table 2, we disregard the largest 5% municipalities in terms PV growth. For an easier interpretability we depict all renewable expansion in per person terms.

Table 1: Expansion of PV and wind between 2009-2016 in kW per person by municipalities

	mean	std	$\min$	25%	50%	75%	max
$\mathrm{PV}/\mathrm{pop}$	0.49	1.65	0.01	0.13	0.24	0.47	57.96
Wind/pop	0.34	2.10	0.00	0.00	0.00	0.00	38.52

Now turn to the background on the elections. Article 28 of the German constitution grants several rights to local governments in Germany, of which two are central for our study. First, local governments are eligible to autonomously decide on a broad set of local matters, some of which relate to climate action and the actual installation of renewable energy, in particular through the following channels: (1) Many utilities are (partly) owned by municipalities, so governments have a direct influence on installed capacity. (2) Energy consumption of public buildings, being a share of the total energy consumption, and can be directly influenced by local governments. (3) Municipalities need to approve, within some constraints, the construction of renewable energy projects. (4) Some cities directly regulate the installation of renewable energy, employ energy consultants or subsidize renewables (Schönberger, 2013). Second, municipalities have democratically elected governments, which is key to our identification strategy (see below).

German municipalities vote their local councils every five years with proportional representation. The local councils of each of the 16 German states are elected at the same day, but election dates differ between states. Five main parties dominate the party composition of local councils in our observed time period, namely the Social Democratic Party (SPD), the Chrisitian Democractic Union (CDU) and its Bavarian counterpart the Christian Social Union (CSU), the Green Party (B90/Grüne), the Free Democratic Party (FDP), and the Left (Die Linke). These parties also shape electoral outcomes of the national government.

We use municipal-level election results from 2009 and 2011, which are publicly available on municipal websites. We use election data from all municipalities in those 12 German states that held an election in either 2009 or 2011. The states with elections in 2009 are Baden-Württemberg, Mecklenburg-Vorpommern, North Rhine-Westphalia, Rhineland-Palatinate, Saarland, Saxony, and Saxony-Anhalt; for 2011, Hesse, Lower Saxony, Hamburg, Bremen, and Berlin. This allows us to cover a large part of Germany. The only missing municipalities are in Bavaria, Thuringia, Brandenburg and Schleswig-Holstein.

We opted to use only two election years in order to have a stable comparison without large time effects between the control group and the treated group. In this regard our approach is similar to difference-in-difference approaches (Roth et al., 2023). Nevertheless, we can employ a large variation of national green support (the opinion poll) during this time. The strong increase in green support between 2009 and 2011 is arguably due to the negative public perception of the national government at this time (CDU, CSU and FDP), and to a minor degree due to Fukushima nuclear disaster, which raised support to the anti-nuclear power Green party in Germany (Bukow, 2016; Rüdig, 2014). Figure 2 shows electoral outcomes at the local level. For the year 2009, losses/wins for the Green Party (represented by red/green), are almost equally distributed. However, for the year 2011, the positive national trend in 2011 indeed translates into positive election outcomes for the Green Party.

#### 3. Method

To test whether green parties lead to climate action at the municipality level, one could simply regress climate action on green vote shares using an ordinary least squares (OLS) approach including municipality and state-year fixed effects. The issue with this OLS regression is that green votes are endogenous to voters' preferences and a variety of local factors, like natural potential (Bierl et al., 2022) and economic growth (Gourley and Khamis, 2023). It would be difficult to distinguish between voters' green preferences and the Green Party itself leading to climate action. (Yet, see the results of an OLS estimator in table 4 in the appendix.)

We aim at overcoming this endogeneity problem by employing an instrumental variable approach (IV), which allows us to identify the causal effect of local green party support in elections on climate action. More precisely, we use variations over time in votes for the Green Party at the national level - meaFigure 1: Green Party outcome in local elections in 2009 (left) and 2011 (right), expresses as difference to the local outcome in the 2009 national election (grey: no local election in resp. year).







sured by a weekly opinion poll (see above) - as an instrument for municipality election outcomes for the Green Party (cf. Riedel et al., 2021). This strategy exploits that voting intentions for the Green Party at the national level may affect their support at municipality level elections to varying degrees. Changes in the voting intentions at the national level could e.g. result from alterations in the general perception of the party (or of its representatives) in terms of competence or popularity. Likewise, exogenous events such as the Fukushima nuclear accident may also change voting intentions at the national level. The media coverage of these signals may be more present to the voter than municipality level information of parties and their local representatives. Voters may employ this information at municipality elections, thereby allowing us to use party preferences at the national level as an instrument for municipality election outcomes.

The first stage of our model then reads

$$green\_local_{i,t} = \alpha_1 \ green\_national_t + \alpha_2 \ \zeta_i + \alpha_3 \ (\zeta_i \times \ green\_national_t) + \epsilon_{i,t},$$
(1)

where  $green\_local_{i,t}$  represents the share of green votes at the elections for the local council in municipality i at time t. To control for general support for the Green party in the respective municipality we took the difference between the vote share of the Green Party in the local election to outcome of the national election *Bundestagswahl* 2009 in the same municipality. So, for example a value of 2% indicates that a municipality has a 2% higher green share in the local election at time t compared to the green share in the Bundestagswahl 2009.

The variable green\_national<sub>i,t</sub> represents the share of green voting intentions at the national level at time t (according to the poll). Since East<sup>3</sup> and West Germany face different political cultures we control both for municipalities being in East Germany  $\zeta_i$ , and its' interaction with the national poll.

In the second stage of our model, we employ the residuals of the first stage and run

$$renewables\_installed_{i,t} = \beta_1 \ green\_local_{i,t} + \gamma \ X_i + \epsilon_{i,t}, \tag{2}$$

where renewables\_installed<sub>i,t</sub> represents the interpretation of installed renewable energy capacities in municipality i at time t. The installed capacity is measured in kW per inhabitant and refers to either PV, installed wind energy, or the total of both, depending on the model. The control variable  $X_i$ are mainly to represent if municipalities are classified as cities and if they are located in East Germany. We weight all observations by their population.

The core assumption of this approach is that voting intentions at the national level do not affect municipalities renewables installation other than via their effect on municipalities' voting outcomes. This could be challenged if the national support of the Green Party reflects a general shift in green sentiments which also change the position of other parties as well and the positioning is directly linked to the date of the election. This might be the case if after a municipal election a coalition agreement is formed between parties, which is influenced by the current time trend. However, we think that this is rather unlikely.

<sup>&</sup>lt;sup>3</sup>The area in which the centrally-planned GDR was located.

#### 4. Results

Table 2 shows the results of the first stage of our instrumental variables (IV) approach, which links the local election outcomes (or precisely its' difference to the outcome in the last national election) to the current national trend. A one percentage point increase in the Green Party share in the national survey translates into 0.23 percentage points more Green votes in local elections in West Germany. In East Germany, we actually see a much weaker relationship between the national survey and local Green election results. This is probably due to a weaker Green representation in this part of Germany and a different political culture. All of these effects are significant at the 1% level. We do not face a problem of a weak instrument with a Gragg-Donald Statistic of 166 and a positive Stock-Yogo-test at the 10% acceptance level (Cragg and Donald, 1993; Stock and Yogo, 2005).

For the second stage, we find that an increase in Green Party votes by about one percentage point reduces the installed photovoltaic capacity per person in a municipality by 0.018 to 0.032 in the period from 2009 to 2016. Note that the coefficients in 3 are larger by a factor of 100 because they reflect the effects of the share in decimals and not in percentage points, i.e. 1% is equal to 0.01. All of these effects are significant at the 1% level. For installed wind energy, the effects are still negative in most specifications, but become slightly positive when controlling for East Germany and for urban areas. However, we advise not to interpret the results for wind power capacity very strongly. First, wind power was installed in only 200 municipalities in our observation period, which makes these figures less reliable. Second, wind power plants tend to take much longer to plan and install, so is therefore more influenced by previous governments.

Looking at total installed renewable capacity, we find that about 0.03 to 0.1 less kW per person are installed for each Green Party election percentage point. However, these results are more volatile and a little bit less significant due to the noise introduced by wind power described above. Doing a back-of-the-envelope calculation the results can be interpreted that a 3 percentage point increase<sup>4</sup> in Green Party votes leads to a decrease of installed renewable capacity by about 0.1 kW/person. This is more than 10% of the average installed renewable capacity at this time. For a median municipality in our sample with 12.000 inhabitants this translates into 1.2 megawatt (MW)<sup>5</sup>. Therefore, this effect is economically significant.

 $<sup>^4\</sup>mathrm{Mean}$  difference in Green election support between 2009 and 2011

<sup>&</sup>lt;sup>5</sup>Just to give an idea of the magnitude. This number roughly translates to 500 square meters of PV modules.

Table 2:	First	stage	of IV:	Effect	of national	Green	trend	on	local	green	election	outcome;
controlli	ng for	East	Germa	ny and	interaction	l						

Dependent Variable:	Local Green Vote Differences
Model:	(1)
Variables	
Constant	-0.0136***
	(0.0036)
National Election Survey	$0.2307^{***}$
	(0.0246)
East Germany	0.0080
	(0.0081)
National Election Survey $\times$ East Germany	-0.1483***
	(0.0545)
Fit statistics	
Observations	1,543
$\mathbb{R}^2$	0.07680
Adjusted $\mathbb{R}^2$	0.07500

IID standard-errors in parentheses Signif. Codes: \*\*\*: 0.01, \*\*: 0.05, \*: 0.1

	þ		4	,				4	
Dependent Variables:		PV Installati	on	Wind	power Insta	llation	Total Rei	newables Ins	stallation
Model:	(1)	(2)	(3)	(4)	(5)	(9)	(2)	(8)	(6)
Variables									
Constant	$0.3524^{***}$	$0.4567^{***}$	$0.4774^{***}$	$0.4041^{***}$	$0.6068^{***}$	$0.3648^{**}$	$0.7565^{***}$	$1.064^{***}$	$0.8422^{***}$
	(0.0141)	(0.0144)	(0.0219)	(0.0977)	(0.1079)	(0.1642)	(0.1015)	(0.1113)	(0.1694)
Green Votes	$-1.834^{***}$	$-2.539^{***}$	-3.243***	-6.359	-7.729*	0.5109	$-8.192^{*}$	$-10.27^{**}$	-2.733
	(0.6642)	(0.6107)	(0.8298)	(4.603)	(4.586)	(6.227)	(4.781)	(4.730)	(6.424)
City		$-0.2244^{***}$	$-0.2303^{***}$		$-0.4359^{***}$	$-0.3677^{***}$		$-0.6604^{***}$	$-0.5979^{***}$
		(0.0135)	(0.0143)		(0.1013)	(0.1070)		(0.1045)	(0.1104)
East Germany			-0.0297			$0.3474^{*}$			$0.3177^{*}$
			(0.0237)			(0.1778)			(0.1834)
Fit statistics									
Observations	1,465	1,465	1,465	1,465	1,465	1,465	1,465	1,465	1,465
$R^2$	0.00518	0.16364	0.16454	0.00130	0.01380	0.01637	0.00200	0.02856	0.03055
Adjusted $R^2$	0.00450	0.16249	0.16282	0.00062	0.01245	0.01435	0.00132	0.02723	0.02856
pvalue (Standard)	0.00584	$3.4  imes 10^{-5}$	$9.7  imes 10^{-5}$	0.16733	0.09216	0.93462	0.08684	0.03011	0.67063
pvalue (Kreis)	0.13156	0.01486	0.02509	0.37509	0.25640	0.90605	0.28072	0.13471	0.57918
IID standard-errors in	i parenthese	ŝ							

Table 3: Second stage of IV: Effect of predicted local Green votes on PV, wind, and total renewable expansion

Signif. Codes: \*\*\*: 0.01, \*\*: 0.05, \*: 0.1

#### 5. Discussion and Extensions

In order to support the robustness of our results we are going to operationalize climate action also in two other ways - climate mitigation plans and CO2 emissions.

First, climate action can be interpreted as the intention to mitigate climate change. This can be proxied by a dataset on the presence and type of local climate mitigation plan from Reckien et al. (2018), which is well-established in the literature (cf. Lee et al., 2020; Eisenack and Roggero, 2022). The dataset covers a sample of 885 cities representative for Europe and is constructed to be unbiased with regards to the selection of cities with or without a climate plan. The existence and type of cities' climate mitigation plans as of the year 2016 are coded as, e.g. "comprehensive and stand-alone" (type A), "mainstreamed and inclusive" (type B) and less elaborate plans (types C-F). According to this standardized coding, 66% of the cities in the sample have an type A mitigation plan. In our analysis, we interpret the existence of a type A plan as the municipality's intention to mitigate climate change. We restrict the dataset to Germany, which yields 106 municipalities.

Second, we can interpret climate action as reducing  $CO_2$  emissions. This focuses on the outcome as opposed to the intention for climate action (as is the case for the existence of a type A mitigation plan). We employ a dataset by the World Bank that covers monthly mean values for  $CO_2$  emissions across the globe on a 25 km grid (World Bank Group, 2023) for the time span between 2014 and 2022. We match this data to German municipalities.

Furthermore, we aim to employ a larger time period in our IV approach

to capture effects for all federal states and longer time periods, and we also want to test the robustness of our results by using further specifications and different time horizons. We would be happy to present such extensions at the EAERE conference.

#### 6. Conclusion

Local climate action, and specifically the energy transition, is driven by a variety of factors. Here, we focus on the influence of local politics, namely voter support for a green party at local elections. While national-level politics has been studied much more, we extend the literature to the local level, where more observations can be made. Depending on the national context, also local governments have a relevant influence on climate-related sectors like energy, waste or transport (Hooghe et al., 2016). Our paper thus contributes to assessing local politics' environmental and economic relevance.

To avoid endogeneity problems, like in some earlier studies on local elections, we use an instrumental variables (IV) approach, which employs an exogenous national trend in green support at different election dates. We study local elections and renewables capacity expansion in German municipalities, which have considerable rights according to the country's constitution. The Green Party is broadly present across the country.

Our results indicate that a stronger Green Party actually lowers the installed renewables in municipalities. One additional percentage point in local elections decreases installed renewable by about 0.03 kW per person in the 7 years time period 2009 until 2016. For the average vote share differences between 2009 and 2011, being 3 percentage points, this means that about 10% of the expected renewables are "lost". This negative effect might be explained by the "Nixon-to-China" paradox, according to which parties not ideological associated with a policy can more easily implement this policy without facing a backlash.

Our results hold only for German municipalities and, even though we have no reason to believe that they would deviate for municipalities in other countries, we cannot establish external validity. So, a analysis of the influence of green parties in other countries might be an interesting avenue of future research. Moreover, our findings indicate that political preferences cannot simply explain the puzzle why local governments proactively engage in mitigation at all. On the other hand, our results help to disentangle the effect of general green preferences in municipalities from the effect of a green party. Our findings could be interpreted that green preferences are underestimated if it is not controlled for green party influence.

## Appendix

Dependent Variables:		oV Installati	on	Wind	power Insta	ullation	Total Re	enewable Ins	tallation
Model:	(1)	(2)	(3)	(4)	(5)	(9)	(2)	(8)	(6)
Variables									
Constant	$0.9136^{***}$	$0.9730^{***}$	$0.7018^{***}$	$0.7280^{***}$	$0.7971^{***}$	$0.6125^{***}$	$1.642^{***}$	$1.770^{***}$	$1.314^{***}$
	(0.0849)	(0.0857)	(0.1128)	(0.1090)	(0.1101)	(0.1454)	(0.1425)	(0.1433)	(0.1886)
Local Green Votes	$-4.095^{***}$	-3.341***	-1.786**	$-3.617^{***}$	$-2.740^{***}$	-1.681	$-7.712^{***}$	-6.080***	-3.467**
	(0.6978)	(0.7184)	(0.8311)	(0.8956)	(0.9229)	(1.071)	(1.171)	(1.201)	(1.389)
City		$-0.3588^{***}$	-0.3233***		$-0.4171^{***}$	$-0.3929^{***}$		-0.7760***	$-0.7162^{***}$
		(0.0877)	(0.0878)		(0.1126)	(0.1132)		(0.1466)	(0.1469)
East Germany			$0.4450^{***}$			$0.3029^{*}$			$0.7479^{***}$
			(0.1211)			(0.1560)			(0.2024)
Fit statistics									
Observations	1,543	1,543	1,543	1,543	1,543	1,543	1,543	1,543	1,543
${ m R}^2$	0.02186	0.03239	0.04081	0.01047	0.01921	0.02160	0.02739	0.04477	0.05318
Adjusted $\mathbb{R}^2$	0.02123	0.03113	0.03894	0.00983	0.01793	0.01970	0.02675	0.04353	0.05133
IID standard-errors in	parenthese	S.							

Signif. Codes: \*\*\*: 0.01, \*\*: 0.05, \*: 0.1

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