1 Empirical Approach

1.1 Data

My data are composed of a pooled cross section of the AmericasBarometer (AB) merged with daily CPC Global Unified temperature, based on interview date and cantons in Ecuador[1]. The AB is a public opinion survey conducted by the Latin American Public Opinion Project (LAPOP), which has conducted biennial survey waves of 1,500 - 3,000 in Ecuador and other countries from 2004 to 2023. I use the subscriber LAPOP datasets available through Universidad San Francisco de Quito's research affiliation with LAPOP, focusing on the eight survey waves carried out between 2008 to 2023[2]. The surveys are based on a multi-stage national probability design, representative at the national level, except for 2021, where the survey switched to a random-digit-dialing design due to the COVID-19 pandemic.

The explained variable of interest is presidential job approval, which the AmericasBarometer measures as in a 1-5 scale in the question: "Speaking in general of the current administration, how would you rate the job performance of President [NAME]"[3] (p.14), where 1 represents a very good performance and 5 terrible performance. This question is worded similarly to

[1] Cantons are the second level of the political-administrative division of the country, akin to municipalities or counties.

[2] The 2004 and 2006 waves did not record interview dates. The eight waves took place every two years between 2008 and 2016. The 2018/19 wave took place between late 2018 and 2019 across Latin America, and exclusively in early 2019 for Ecuador. The two most recent two survey waves were carried out in 2021 and 2023.

[3] LAPOP, "The AmericasBarometer by the Latin American Public Opinion Project (LAPOP) Ecuador 2004 - 2023 Merged File."

the classic Gallup presidential approval question, which the literature has used extensively[4] and has not been found to significantly deviate from other presidential popularity measures. I dichotomize the variable following LAPOP research reports[5] where responses lower than 3 are considered as approval for the incumbent president.

Table 1: Descriptive statistics for the matched AB data and weather variables

	N	Missing (%)	Mean	Std. dev.	Min	Median	Max
Presidential approval	14997	10	0.5	0.5	0.0	0.0	1.0
Daily minimum temperature (C)	15749	6	16.3	6.6	−2.2	18.3	27.8
Daily maximum temperature (C)	15749	6	24.4	4.9	8.4	25.3	34.3
Daily average temperature (C)	15749	6	20.4	5.5	4.6	22.0	29.3
Daily precipitation (mm)	15820	5	5.2	8.5	0.0	2.1	236.5
Female	15058	10	0.5	0.5	0.0	1.0	1.0
Age (years)	16649	0	37.9	15.7	16.0	35.0	96.0
Rural status	16562	1	0.6	0.5	0.0	1.0	1.0
Worse perception of personal econ.	16425	1	0.4	0.5	0.0	0.0	1.0
Worse perception of country econ.	13455	19	0.4	0.5	0.0	0.0	1.0
Religious	13336	20	0.9	0.3	0.0	1.0	1.0
Incumbent vote	11124	33	0.5	0.5	0.0	1.0	1.0
Ideology score (0-10)	9222	45	5.4	2.5	1.0	5.0	10.0
Support of democracy	16099	3	0.6	0.5	0.0	1.0	1.0
Perception of corruption	10897	35	0.6	0.5	0.0	1.0	1.0
Tolerance to bribes	13268	20	0.2	0.4	0.0	0.0	1.0
Political pride score	14899	11	4.1	1.8	1.0	4.0	7.0
Trust in police score (0-7)	13589	19	4.0	1.8	1.0	4.0	7.0
Trust in local government (0-7)	15055	10	3.9	1.8	1.0	4.0	7.0
External efficacy	13310	20	3.6	1.9	1.0	4.0	7.0
Internal efficacy	13244	21	4.0	1.6	1.0	4.0	7.0

Note: Descriptive statistics for variables used in the empirical analysis. For categorical variables, the percent of observations in the category out of the total sample is presented. For numerical (either ordinal or continuous) variables, the mean, standard deviation, minimum and maximum are presented. For both, the number of observations and the percentage of missing values.

Table 1 displays descriptive statistics for some of the variables used in the empirical analysis. I collect perceptions of personal and country economic situations, also measured on a 1-5 scale, where 1 represents a very good situation and 5 a terrible situation. Political ideol-

[4]Berlemann and Enkelmann, "The Economic Determinants of U.S. Presidential Approval."
[5]Layton et al., "Chapter 3. Citizen Security, Evaluations of the State, and Policy Preferences."

ogy is represented in a 0-10 scale, where 0 represents the "extreme left" and 10 the "extreme right". I include 1-7 scales for trust in police, local government, political pride, and support for democracy where 0 represents no trust or support and 7 complete the opposite. Corruption perceptions are collected by the AB as a 1-4 scale, where 1 represents "corruption not generalized" and 4 "very generalized" (p. 22).[6] I dichotomize this variable taking values greater than 1 as perceiving corruption. Corruption tolerance is measured as tolerance to paying a bribe, where 0 is not justified, and 1 is justified. The empirical analysis also includes gender, age, religiousness, ethnicity, civil status, education and labour market status. These last four variables are summarized in Table 2.

Table 2: Descriptive statistics for socieconomic categories in the matched dataset

		N	Missing (%)	Percent
Ethnicity	Mestizo	13077	100	78.4
	Blanca	1321	100	7.9
	Indígena	771	100	4.6
	Negra	487	100	2.9
	Mulata	564	100	3.4
	Otra	197	100	1.2
Civil status	Single	3910	100	23.4
	Married/Common Law	6964	100	41.8
	Divorced/Separated/Widowed	764	100	4.6
Education	Primary or none	3931	100	23.6
	Secondary	7610	100	45.6
	Superior	3441	100	20.6
Labour market status	Employed	7887	100	47.3
	Not in Labour Force	5559	100	33.3
	Unemployed	1577	100	9.5

Education is a categorical variable for highest educational degree attained, including levels for primary (lumped with no education), secondary, and higher education (college, university

[6] LAPOP, "The AmericasBarometer by the Latin American Public Opinion Project (LAPOP) Ecuador 2004 - 2023 Merged File."

or higher are lumped together). Labour market status includes three categories: employed, not in the labour force, and unemployed. Not being in the labour force includes those retired, students, homemakers, and those not working.

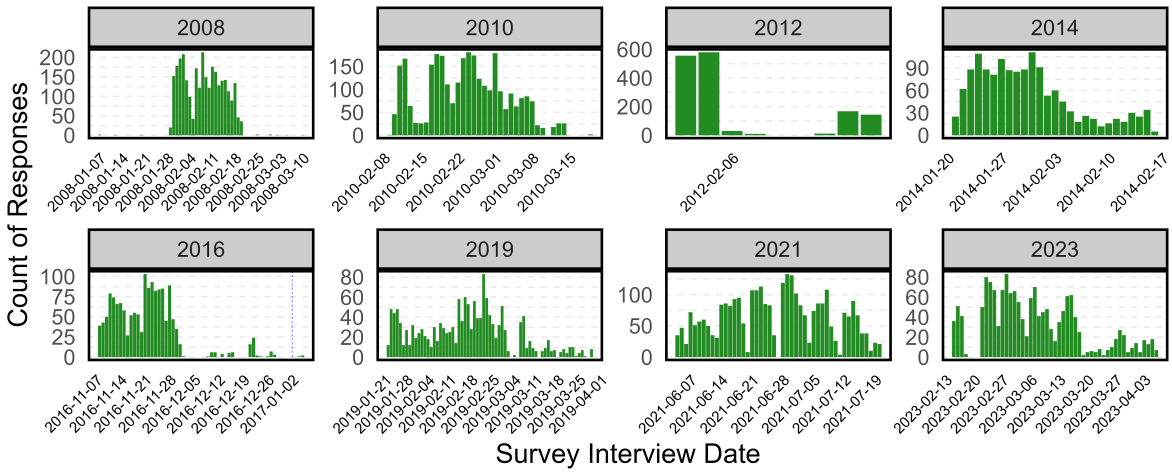
I extract daily minimum and maximum temperature and precipitation data from the CPC Global Unified Temperature datasets.[7] These data are prepared by the U.S. government National Oceanic and Atmospheric Administration (NOAA) and emerge from satellite imaging of the Earth surface. While daily weather data would typically be available from every country's meteorological authority[8], publicly available meteorological data from weather stations lacks the frequency and geospatial granularity required for this type of analysis.

I follow Quijano-Ruiz [-quijano-ruiz23] and compute weighted mean minimum and maximum temperatures for each canton and day, weighting by the surface area of each canton. Replication code for this process is available in a GitHub repository. The surface area of each canton is obtained the Ecuadorian statistics authority (INEC, for its initials in Spanish) geoportal, along with the map shapefiles and political administrative divisions to match the canton names and codes to the AB data.[9] I then merge this data with the AB data based on interview dates and canton codes.

Figure 1 shows the distribution of respondents by interview date in the AmericasBarometer survey waves. As it can be seen, most stay in a relatively small time frame. The 2018 wave

[7] National Oceanic and Atmospheric Administration (NOAA) Physical Sciences Laboratory (PSL), "CPC Global Unified Temperature."
[8] In Ecuador, the relevant institution is the Instituto Nacional de Meteorología e Hidrología.
[9] Instituto Nacional de Estadística y Censos, "Clasificador Geográfico Estadístico."

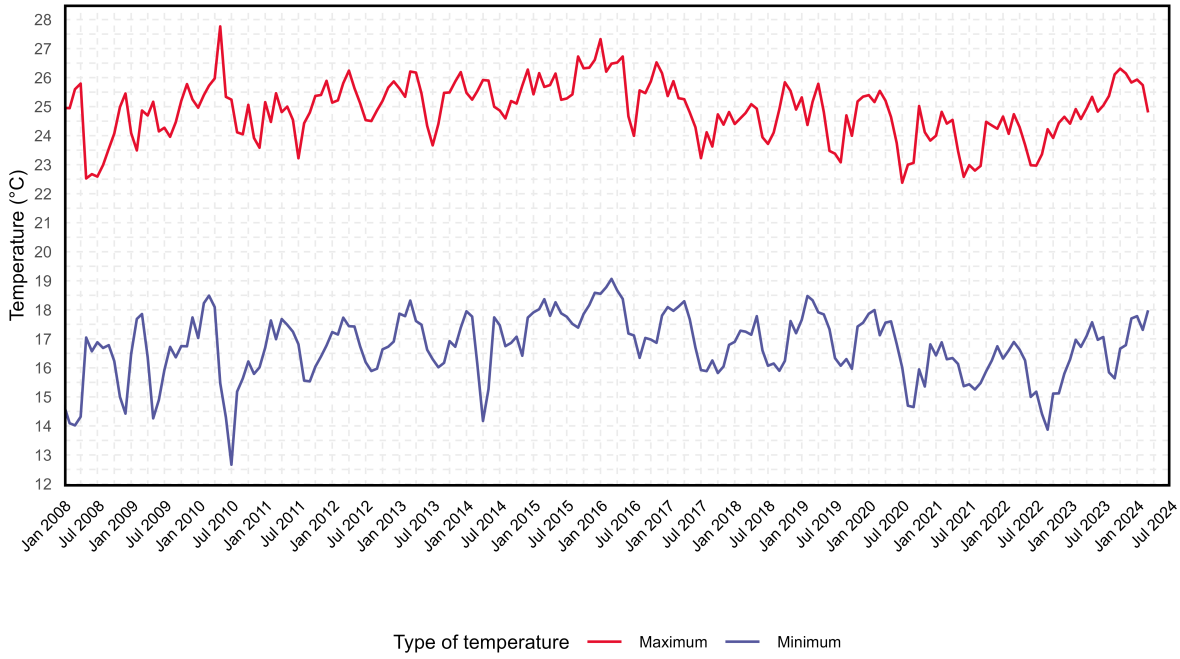
Figure 1: Survey dates of the Americas Barometer in Ecuador, 2008-2023



(sometimes referred as the 2018/19 wave) is the most spread out due to the survey being carried out between late 2018 and early 2019. Most waves are carried out January to April. These periods contain rich variation of temperature across cantons.

In Figure 2 I show mean monthly minimum and maximum temperatures from 2008 to 2023. The smallest average minimum temperature was 12.7, compared to the largest maximum temperature of 27.8. There are no notable upward or downward trends through time, with some periods showing higher temperatures. An important feature is that the spread between minimum and maximum temperatures is relatively stable, which will be important for the identification strategy, which I describe below.

Figure 2: Mean monthly temperatures, 2008-2023



1.2 Identification strategy

I exploit variation produced by a natural experiment: the transitory nature of daily temperature changes. I assume these changes are random and exogenous to variables related to political mechanisms or other variables that can affect the performance of political leaders. By making this assumption, I can define a presidential popularity function as follows:

$$\text{approval}_{it} = \alpha + \tau_d + \theta_j + \beta\ \text{temp}_{jd} + \mathbb{X}'_{it}\gamma + u_{it} \tag{1}$$

where approval_{id} is presidential approval, τ_d and θ_j are vectors of interview date and canton

fixed effects, temp_{jd} is daily temperature for canton j on day d, $\mathbb{X}'_{it}$ a vector of survey-wave and individual varying controls, γ the vector of associated control coefficients and u_{it} an error term. The parameter β is the coefficient of interest, which measures the effect of temperature on presidential approval. The assumption of randomness in daily temperature changes implies that

$$\text{E}[\text{temp}_{jt} \times u_{it}] = 0 \tag{2}$$

which allows me to estimate β consistently.

A potential worry is that temperature, as measured by the CPC Global Unified Temperature data, suffers from measurement error, $\hat{\beta}$ can suffer from attenuation bias, which leads to underestimation of the true effect of temperature on presidential approval. Attenuation bias will exist if measurement error is more likely to be present in days with higher or lower temperatures, or for certain cantons. There is no reason to assume this is the case, but I address this possibility in the conclusion. If measurement error is present but not correlated with the error term, then $\hat{\beta}$ will still be consistently estimated, but with less precision.

Further, given that I only observe presidential approval in an ordinal or binary scale, I cannot directly estimate Equation 1. While it is possible to use a linear probability model, I choose to follow the literature and use logistic regression as the link function to estimate the probability of observing approval of the incumbent president. I cluster all standard errors at the canton

level, to allow for spatially clustered correlation in the error term.