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Policy Research Working Paper 11206

Temperature Anomalies as an Obstacle to Women's Rights and Economic Empowerment?

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WORLD BANK GROUP
Development Economics
Global Indicators Group
September 2025



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Abstract

Gender equality is associated with economic growth and resilience, yet various factors, including climate change, may stall progress toward equal rights for men and women. This paper analyzes historical temperature and precipitation fluctuations within countries to assess their effect on legal gender equality, using data from the World Bank's *Women, Business and the Law* dataset, which measures women's rights across 190 economies and five decades. The findings reveal that temperature anomalies correlate with slower progress in legal gender equality, particularly in low-income countries. Irregular temperature fluctuations significantly delay the development of legal frameworks for parental leave, marriage, and mobility. Countries, particularly those with limited resources, seem less inclined to provide tangible benefits to women. This study emphasizes the complex relationship between extreme temperatures and women's rights, highlighting the importance of addressing gender disparities to build more resilient societies, especially in the face of shifts in temperatures and weather patterns.

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Produced by the Research Support Team

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Authorized for distribution by Norman Loayza, Director, Global Indicators Group, World Bank Group

Keywords: Climate Change; Women's Rights; Legal Reform; Gender Equality; Women, Business and the Law

JEL Codes: Q54; Q56; J16; K38; D63

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We would like to thank Norman Loayza, Joshua Eastin, Caren Grown, Maria Floro, participants of the DECIG half-baked seminar, participations of the American University research seminar as well as the participants of the Jobs and Development Conference. IAFFE's Annual Conference and the Conference of the Royal Economic Society for their helpful comments and feedback on an earlier draft of this paper. The findings, interpretations, and conclusions expressed in this paper are entirely those of the authors. They do not necessarily represent the views of the International Bank for Reconstruction and Development/World Bank and its affiliated organizations, or those of the Executive Directors of the World Bank or the governments they represent.

We thank the members of the Development Economics Global Indicators Department of the World Bank Group for valuable inputs to an earlier draft of this paper, the Women, Business and the Law team and the Climate Change Knowledge Portal for making the data available. All remaining errors are our own.

1. Introduction

The increasing frequency of natural disasters and rapid climate change pose significant global challenges, with women disproportionately affected by climate-related shocks (e.g., Eastin 2018; Neumayer and Plümper 2007). The societal repercussions of rising temperatures and extreme weather events significantly disrupt socio-economic systems and exacerbate existing gender inequalities (Lau et al. 2021). Women often face heightened vulnerability due to their socio-economic status, limited access to resources, and entrenched gender norms. Climate change can either directly or indirectly exacerbate social, economic, and political issues, leading to economic hardship, political instability, migration pressures, and civil violence. These effects can systematically disadvantage women and girls (e.g. Wischnath and Buhaug 2014; Backhaus et al. 2015). On average, climate-related disasters result in higher mortality rates for women compared to men or cause women to die at an earlier age than men (Neumayer and Plümper 2007). Despite growing evidence on the gendered impacts of climate change, there remains a significant knowledge gap regarding its influence on women's legal rights. Little is known about how environmental stressors, such as rising temperatures and extreme weather, may shape the trajectory of legal protections and broader gender equality. As the climate crisis deepens, understanding this relationship becomes increasingly critical for designing inclusive and resilient legal and policy frameworks.

Our paper fills this knowledge gap and presents a global analysis over five decades and investigates the role of weather anomalies—specifically temperature and precipitation—on legal gender equality. Drawing on the World Bank's Women, Business and the Law (WBL) panel data,[1] we aim to quantify the relationship between climate variations and women's legal rights. The WBL panel data record gender reforms over five decades, from 1970-2023, covering 190 economies. The dataset includes detailed information on eight indicators structured around women's interactions with the law as they progress through their lives and careers: Mobility, Workplace, Pay, Marriage, Parenthood, Entrepreneurship, Assets, and Pension. The initial step in achieving gender equality involves legislative reform. For decades, women have faced legal restrictions and despite progress, about 2.4 billion working-age women live in economies where their rights are not on par with men's (World Bank 2024). Discriminatory laws continue to persist, embedded in

[1] https://wbl.worldbank.org/en/wbl-data

legal frameworks across all regions (Hyland et al. 2020). In essence, women still hold only three-quarters of the legal rights of men, undermining their ability to participate fully in the global economy (World Bank 2024). By optimizing the utilization of human resources and rectifying the misallocation of talent and skills, societies can achieve stronger and more inclusive growth (Badel and Goyal 2023; Ostry et al. 2018; Santos Silva and Klasen 2021; Stotsky 2006).

Our findings suggest that as climate change intensifies extreme weather patterns, such as rising temperatures and erratic precipitation, economies may exhibit a reduced willingness or capacity to dismantle legal barriers for women. Specifically, we find that temperature has a significantly negative correlation with legal gender equality, but only in low-income countries, while precipitation has a non-significant negative effect. These findings remain robust and consistent across alternate model specifications. Climate shocks appear to act as a deterrent to reform, particularly in contexts with limited fiscal and institutional capacity.

To better understand this pattern, we distinguish between two types of legal reforms: *enabling provisions*, which grant women new rights or benefits and require budgetary investments (e.g., paid leave, pension access), and *removal of legal restrictions*, which eliminate discriminatory rules but typically impose fewer fiscal demands. Our political economy framework posits that under climate-induced resource constraints, governments are more likely to deprioritize costlier reforms. Our results support this hypothesis: temperature anomalies significantly slow progress on enabling reforms, while the removal of legal restrictions remains largely unaffected. This effect is again concentrated in low-income countries and persists over time, suggesting that climate shocks may entrench gender-legal reform gaps where they are already most severe. This, in turn, reduces national resilience to future climate shocks, potentially trapping climate-exposed low-income countries in a cycle where both legal gender equality and climate adaptability are systematically undermined (Asongu et al., 2022).

Finally, while our empirical design does not establish a causal link between climate change and legal gender equality, the consistency and robustness of the relationship underscore its policy relevance. Our results highlight the need to integrate gender considerations into climate adaptation strategies and ensure that legal empowerment is not deprioritized during times of fiscal and environmental stress.

The remainder of the paper is structured as follows. Section 2 reviews the relevant literature and situates our analysis within existing research, highlighting the gap this study seeks to address. Section 3 introduces our theoretical framework, which outlines how climate-related pressures may lead policy makers to deprioritize legal reforms advancing women's rights, and presents the main hypotheses. Section 4 describes our empirical strategy and data sources. Section 5 presents the main results along with a series of robustness checks. Section 6 concludes with a discussion of the policy implications emerging from our findings.

2. Literature Review: Climate Change, Gender Inequality, and Legal Rights

The intersection of climate change and women's rights remains under-researched and undertheorized, yet it is increasingly gaining recognition as a critical area of study, highlighting the multifaceted impacts of environmental shifts on gender equality. The relationship between climate change and gender inequality is gaining attention as climate shocks have a disproportionate impact on women, particularly in lower-income countries, where preexisting social and economic disparities heighten vulnerability (Aggarwal and Steckel 2022; Eastin 2018; Lau et al. 2021; Neumayer and Plümper 2007). Studies show that women face higher morbidity and mortality following climate-related disasters, such as droughts, storms, and earthquakes, especially where socioeconomic status and institutional protections are weak; however, this disparity tends to diminish in countries with stronger women's rights (Awe 2023; Neumayer and Plümper 2007).

The literature highlights specific, localized effects, such as the higher mortality rates of girls during droughts in India and the Philippines due to son preference (Anttila-Hughes and Hsiang 2013; Chatterjee and Merfeld 2021), or the negative impact of climate shocks on girls' nutritional status in Indonesia (Thiede and Gray 2020). Other studies show that women face greater employment losses and reduced asset ownership after climate events in countries like India and Tanzania (Afridi et al. 2021; Lee et al. 2021). In addition to economic setbacks, climate change increases women's unpaid domestic work and diminishes their participation in income-generating activities (Lee et al. 2021; Maitra and Tagat 2024). Collectively, these findings indicate that climate change not only exacerbates existing gender inequalities but also undermines women's agency and contributes to a systemic "time poverty," which may significantly constrain their prospects for economic advancement and political participation.

To better understand these gendered outcomes, it is essential to situate them within broader climate-related economic impacts. In the context of climate and macroeconomic growth, the number of global and regional studies exploring welfare implications of climate change such as rising temperatures or erratic rainfall patterns is consistently growing (e.g., Azzarri and Signorelli 2020; Bretschger 2017; Burke et al. 2015; Burke and Tanutama 2019; Damania et al. 2020; Dang et al. 2023; Dell et al. 2012; Diffenbaugh and Burke 2019; Kahn et al. 2019; Linsenmeier 2023; Newell et al. 2021). Generally, these papers focus on changes in weather realization over time and their impact on outcomes such as agricultural output (Mendelsohn et al. 1994; Schlenker and Lobell 2010), labor productivity (Barreca 2012; Graff Zivin et al. 2018; Somanathan et al. 2021), or poverty (Azzarri and Signorelli 2020; Dang et al. 2023; Paglialunga et al. 2022) (for an overview, see Dell et al. 2014; Tol 2018). Making use of exogenous variation over time, these studies pinpoint the breadth of channels linking climate change and development outcomes, heterogeneous treatment effects across geographic areas, and nonlinear effects of weather variables (Dell et al. 2014).

Two early papers in the expanding literature on the climate economy testing the impact of climate change on economic development stand out (Burke et al. 2015; Dell et al. 2012). The authors empirically investigate the combined impacts of shifts in rainfall and temperature on overall economic outcomes, concluding that there is limited robust evidence that rainfall has a statistically significant relationship with GDP growth; in contrast, temperature is shown to have a consistent and nonlinear effect on GDP growth (Burke et al. 2015; Dell et al. 2012). Additionally, Dell et al. (2012) note that this impact is particularly significant in low-income countries.

Additional studies further underscore that pre-existing social and economic vulnerabilities exacerbate the immediate consequences of climate change. At the micro-level, households with lower income levels often lack the resources and preparedness to effectively respond or adapt to natural disasters (Masozera et al. 2007). At the macro-level, low-income countries face multiple challenges: they typically lack access to modern technology to be protected against climate change (Adger 2006; Yohe and Tol 2002), are more likely to be poorly governed, and have limited resources to direct toward responding to extreme weather events and rising sea levels (Mendelsohn et al. 2006). Furthermore, their economies are usually more dependent on the agricultural sector, which is particularly vulnerable to climate change (Tol 2018).

Although existing studies offer valuable insights into how climate change exacerbates gender disparities, particularly in relation to economic development, their focus on specific countries and local contexts often limits the generalizability of their policy recommendations. Some global studies, such as those by Grown et al. (2025), have demonstrated that transgressing planetary boundaries—like CO_2 emissions and material overuse—undermines sustainable well-being and disproportionately harms women, especially through inequalities in education and income. While their research emphasizes human development outcomes, our study shifts the focus to institutional responses, specifically examining how climate-induced stress affects the legal foundations of gender equality. In doing so, we address a notable gap in literature by calling for empirical research at the intersection of environmental change and gender rights frameworks. Similarly, Eastin (2018) highlights how climate change not only disproportionately affects women but also weakens institutional capacity, thereby eroding systemic support for gender equality and women's rights. Building on Eastin's work, our study goes a step further by disentangling which types of gender-related laws and rights are most difficult to enforce and promote in countries facing financial constraints and climate-related shocks.

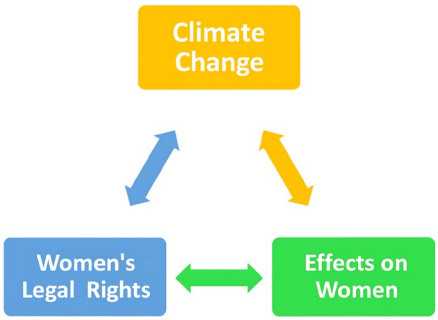
Our paper builds and expands on two strands of research: i) recent studies examining the macroeconomic effects of climate change and ii) studies exploring the complex dynamics between climate change and gender equality. While the literature on the macroeconomic effects of climate change is rapidly expanding, especially in terms of its exploration of economic growth, it often overlooks aspects of gender despite its interconnectedness with macroeconomic outcomes and financial stability (Stotsky 2006). There is hitherto insufficient exploration into the repercussions of climate on women's rights, particularly their legal rights. Our paper tries to fill this void, addressing the intersection of climate variability with gender dynamics. We highlight that there is a need for a more empirical exploration of this critical intersection to inform more inclusive and effective policy interventions.

3. Theoretical Framework: How Decision-Makers May Deprioritize Women's Legal Rights in the Wake of Climate Change

Climate change and gender equality are interconnected in a complex, cyclical relationship where environmental shocks disproportionately affect women, exacerbating existing inequalities and limiting their ability to secure and exercise legal rights (Figure 1). Climate-induced disasters

amplify preexisting vulnerabilities, including heightened exposure to gender-based violence, increased mortality rates, and an intensified burden of unpaid care work (Eastin 2018; Lau et al. 2021). These disparities stem from unequal access to resources, restricted decision-making power, and differing capacities to respond to climate-related crises (Aggarwal and Steckel 2022; Awe 2023). In turn, this erosion of rights weakens women's resilience to climate shocks, perpetuating the cycle.

Figure 1: Simplified Relationship of Climate Change on Women's Rights



To explain the institutional dynamics underlying these outcomes, we develop a political economy framework grounded in the literature on policy maker behavior under fiscal and electoral constraints (e.g., Acemoglu and Robinson 2012; Persson and Tabellini 2002). Our model is further informed by research on the persistent marginalization of gender reforms in national budgetary processes and institutional agendas (Agarwal 2018; Stotsky 2006).

While prior studies suggest that strong legal protections for women can mitigate the adverse effects of natural disasters (Neumayer and Plümper 2007), we theorize that in the wake of climate-induced shocks, policy makers may deprioritize legal gender reforms, as immediate climate recovery efforts dominate the policy agenda. This shift in political focus creates a feedback loop in which women's ability to advocate for reform declines at the very moment those reforms are most urgent. Because legal change typically requires sustained political mobilization and institutional support, these structural disruptions further delay or derail gender-equality legislation.

In addition to reshaping political priorities, climate shocks often deepen economic instability, reinforcing traditional gender norms that obstruct reform. Economic hardship may drive societies to reassert conservative roles, framing gender reform as politically costly or secondary (Jayachandran 2021). Climate change disproportionately affects women due to existing socio-

economic vulnerabilities such as limited asset ownership, restricted credit access, and reliance on climate-sensitive livelihoods (Erman et al. 2021; UNFCCC 2022). These inequalities may deepen resistance to gender reforms, especially in contexts where economic hardship reinforces patriarchal norms (Agarwal 2018). Legal reforms also require fiscal resources for implementation—ranging from awareness campaigns and enforcement mechanisms to administrative capacity-building. Climate shocks impose additional pressure on public budgets, often forcing governments to divert funds to disaster relief and climate recovery (UNEP 2024). In lower-income countries with limited fiscal space, this reallocation of resources further impedes the advancement of gender-related legal reforms (Bangalore et al. 2016).

Lawmakers operate under conditions of fiscal constraint and competing policy priorities, where decisions are shaped by public demand, electoral incentives, and available resources (Jordan et al. 2022; Kam 2009; Moore et al. 2024). Climate shocks intensify these pressures by reshaping political incentives: policy makers aim to maximize influence (policy-seeking), win votes (vote-seeking), and remain in office (office-seeking) (Jordan et al. 2022; Kam 2009; Moore et al. 2024). As preferences shift in response to crises, public demand tends to favor immediate relief—such as infrastructure repair, emergency aid, and food security—over long-term reforms. Consequently, gender equality initiatives are often deprioritized as politically costly or non-urgent (Jayachandran 2021; Pitkin 1967).

During climate-induced crises, the urgency of recovery efforts dramatically alters public expectations. The salience of immediate relief policies (e.g., food assistance, shelter, infrastructure repair) increases, while support for long-term structural reforms like those promoting gender equality diminishes. This reorientation in political and fiscal priorities reallocates resources and reshapes the legislative agenda.

Let R denote total fiscal resources available to the government. These are allocated between gender-equality-enhancing legal reforms (G) and climate-related recovery or adaptation policies (C). In the short run, we assume that R is fixed, constrained by limited borrowing capacity, rigid budget ceilings, or donor-imposed conditionalities, factors particularly binding in lower-income economies. This yields the resource constraint:

$$R=G+C \quad (1),$$

Governments facing fiscal scarcity must allocate a fixed pool of resources (R) in response to evolving societal needs and political pressures.

During climate shocks, the urgency of immediate recovery amplifies the perceived marginal utility of allocating resources to climate-related interventions (C) such as disaster relief, infrastructure repair, and food security. In contrast, the perceived marginal utility of investing in gender-equality-enhancing legal reforms (G) declines as these reforms appear less urgent or politically salient.

Policy makers, seeking to maximize aggregate utility under constrained budgets, rationally reallocate resources toward C during crises, leading to underinvestment in G, even when legal reforms could improve long-term resilience and reduce vulnerabilities. This reallocation is driven not only by public pressure but also by institutional incentives that favor visible, short-term responses over legal and institutional reforms with delayed or diffuse benefits.

The trade-off between C and G becomes especially stark in resource-constrained economies where fiscal space is limited, leaving governments with little to no room to expand the budget envelope through external financing or domestic revenue mobilization. In such contexts, every additional unit of expenditure directed toward climate response comes at the expense of advancing gender-equitable legal reform.

This leads to our central hypothesis:

H_1: Climate change has negative repercussions on legal gender equality, specifically in resource constrained economies.

Building on this reasoning, we further disaggregate G into components that differ in their fiscal and administrative demands:

Enabling provisions (G_e), such as paid leave or pension access, require substantial fiscal resources, administrative capacity, and service delivery infrastructure. These reforms impose recurring costs on government budgets and necessitate complex implementation systems to ensure effective reach and compliance. In addition, enabling provisions may require accompanying investments in awareness-raising, monitoring, and enforcement mechanisms, all of which further increase fiscal demands.

In contrast, the removal of legal restrictions (G_r) such as repealing laws that bar women from working in certain occupations or from owning property typically involves legal amendments with minimal budgetary cost. These reforms tend to be budget-neutral in the short run because they eliminate formal barriers without necessarily requiring state-provided services or transfer payments.

Let total legal reform investment be:

$G = G_e + G_r$

This disaggregation is important because the fiscal pressures imposed by climate shocks are likely to constrain these two types of reforms differently. When fiscal resources are strained and public budgets are reoriented toward urgent climate recovery efforts, governments face sharper trade-offs in allocating funds for reforms that demand ongoing expenditures and institutional capacity, such as those invoked by enabling reforms (G_e). By contrast, reforms that remove legal impediments (G_r) may require more political capital but less financial investment and may therefore be less vulnerable to fiscal reallocation pressures. Additionally, implementation of G_e reforms typically involves coordinated actions across multiple government agencies, the scaling up of service delivery, and consistent funding streams over time. These institutional conditions are more likely to be disrupted by the short-term demands of climate crisis management.

As a result, we theorize that while climate shocks exert a general negative effect on legal gender equality reforms, this effect is not uniform. The reforms most vulnerable to disruption are those with higher fiscal and administrative costs (G_e). In contrast, legal reforms that primarily require legislative change (G_e) without substantial fiscal commitment may still proceed even during fiscal tightening.

This distinction motivates our second hypothesis:

H2: The adverse effect of climate shocks on gender equality reforms is more pronounced for enabling provisions that require fiscal investment, while the removal of legal restrictions is less affected due to lower resource demands.

4. Identification Strategy and Data: Explaining Gendered Laws

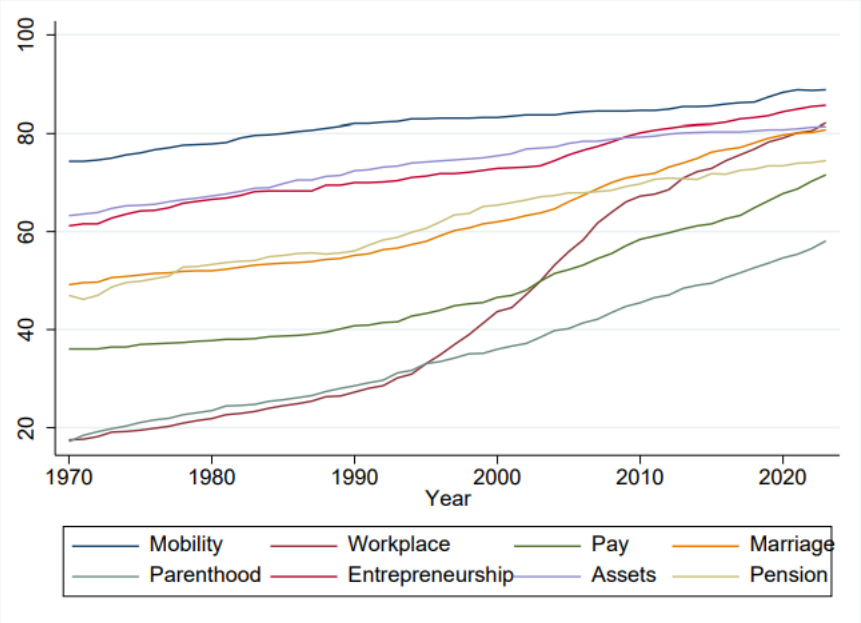
Our identification strategy builds on established approaches in the climate-economy literature (i.e., Burke et al. 2015; Dell et al. 2012), which exploit variation in temperature and precipitation over time using fixed effects panel regressions. We adapt this framework to examine how climate anomalies influence the evolution of women's legal rights globally. Our panel dataset spans 190 countries from 1970 to 2023, using country-year as the unit of analysis.

4.1 Dependent Variable

The main dependent variable is women's legal rights, which is measured by the Women, Business and the Law (WBL) index and its composite indicators (World Bank 2024). The WBL index analyzes laws and regulations identifying women's rights and legal barriers. The WBL panel dataset spans 54 years (1970-2023) and offers objective and measurable benchmarks for measuring progress toward gender equality in legislation across 190 countries. The index is composed of eight indicators and 35 binary questions structured around women's interactions with the law: Mobility, Workplace, Pay, Marriage, Parenthood, Entrepreneurship, Assets, and Pension (refer to Annex 1 for an overview). The WBL index is the average of the eight indicators, with 100 representing the highest possible score. A detailed discussion on the WBL database and the methodology of the WBL index can be found in Hyland et al. (2020).

Across the world, women's rights have expanded significantly over the past decades. Over the 54-year period covered in the data set, the global average of the WBL index increased from 45.7 to 77.9. Progress toward legal gender equality is observable across all eight areas measured and in all 190 countries, and countries have implemented over 2,000 legal reforms to improve legal gender equality; however, the pace of progress has varied significantly across areas of the law (Figure 2).

Figure 2: WBL index by indicator, 1970-2023



Source: *Women, Business and the Law* database

We differentiate the main dependent variable along two dimensions: i) legal provisions that provide for an enabling environment to support women (*enabling provisions*) and ii) legal provisions that uphold the equal rights of men and women and reforms that remove previously existing legal restrictions on women (*absence of restriction*).

We categorize the 35 binary questions into two groups: 16 questions are classified as enabling provisions while 19 are categorized as an absence of restrictions (refer to Annex 1 for the full classification). For each category, we compute a simple average of the binary indicators and scale the resulting score to range from 0 to 100. These two sub-indices serve as dependent variables in our disaggregated analyses of the relationship between climate anomalies and legal gender equality.

4.2 Independent Variable

Temperature and precipitation patterns and anomalies are crucial to monitor climate change, as they are key indicators of shifts in weather patterns and long-term climate trends (Dell et al. 2012; Eastin 2018). Assessing the impact of temperature and precipitation anomalies on legal gender equality, we draw on the ERA5 dataset by the European Centre for Medium-Range Weather

Forecasts (ECMWF), which offers a comprehensive analysis of global climate conditions. With a spatial resolution of 0.25°, ERA5 provides hourly estimates of several climate-related variables, such as temperature, precipitation, wind patterns, and humidity across the globe. ERA5 covers a wide temporal range, spanning from 1950 to 2023, allowing time-series analysis of climate trends and variability over several decades and matching the timeframe of our dependent variable. ERA5 data combines data from multiple sources, such as ground stations, satellites, and weather balloons, which increases data accuracy and reduces biases from individual weather stations (Dang et al. 2023). ERA5 data's public accessibility and its comprehensive coverage make it a valuable resource for studying climate impacts and informing decision-making processes related to climate adaptation and mitigation strategies.

We draw on country-year estimates for temperature and precipitation calculated by the World Bank Group's Climate Change Knowledge Portal to match our unit of analysis. Mean surface air temperature is calculated by assimilating data from various sources into a numerical weather model, and then computed by temporal averaging over hourly intervals and spatial averaging across different locations. The annual average mean surface air temperature is the average mean surface air temperature across the year. The aggregated accumulated precipitation is also calculated by incorporating observational data into a weather model, and then calculated by averaging hourly intervals and spatial grid points. The annual aggregated accumulated precipitation is the annual sum of the aggregated accumulated precipitation data. These country-year estimates for temperature and precipitation can be downloaded from the World Bank Group's Climate Change Knowledge Portal (CCKP).

4.3 Descriptive Statistics

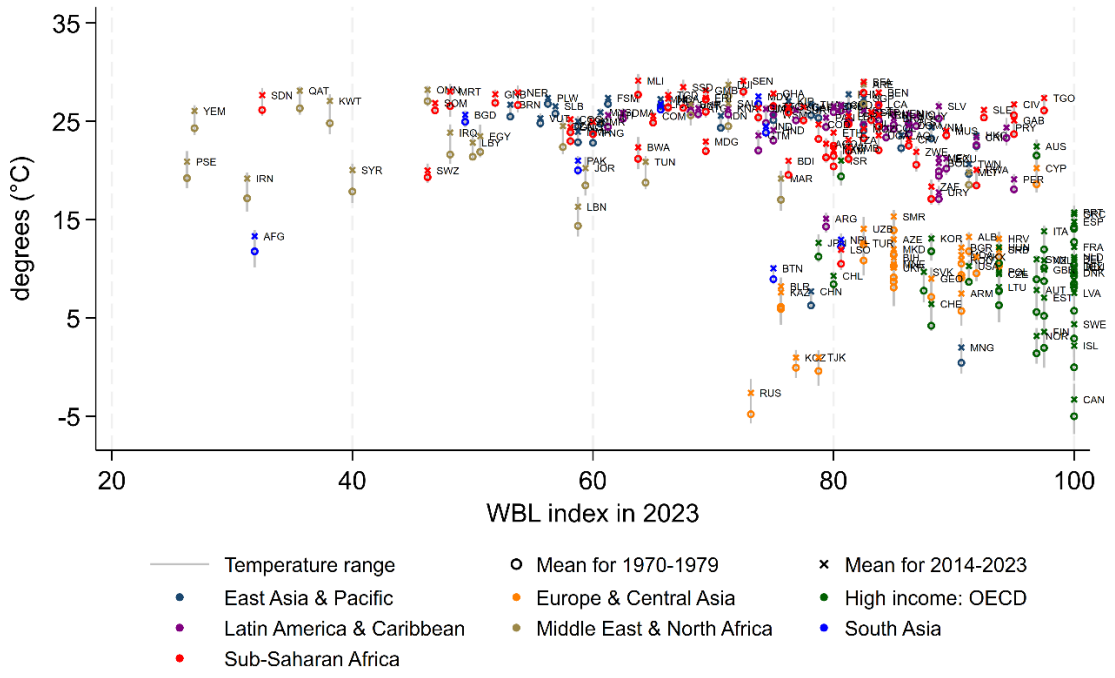
Before diving into the empirical model and analysis, we describe the climate and gender data in more detail. Figure 3 describes the variation of temperature and precipitation data, plotted against the WBL index measuring legal gender equality in 2023. The data are grouped by region to discern region-inherent patterns. Each gray vertical line presents the range of temperature or precipitation for a country in the year covered by the dataset (1970-2023). The circle indicates the average temperature or precipitation for 1970-1979, the first decade of the dataset; and the cross denotes the average temperature or precipitation for 2014-2023, the last decade of our dataset.

The data on temperature reveals an upward trend in temperatures across countries over the past five decades (this trend is well documented, see Brohan et al. 2006; Dell et al. 2021). More specifically, the global average temperature increased from 18.6 °C in the first decade to 19.9 °C in the last decade. While global temperatures have risen by more than 1 degree Celsius, on average, not all countries have experienced an equal level of temperature increase. For example, Mauritius experienced the smallest increase of 0.5 °C, from 23.6 °C to 24.0 °C; while Saudi Arabia faced the largest increase of 2.3 °C, from 24.5 °C to 26.8 °C. Regional differences are also large, with temperatures in South Asia increasing by 0.9 °C compared to an increase of 1.8 °C in the Middle East and North Africa.

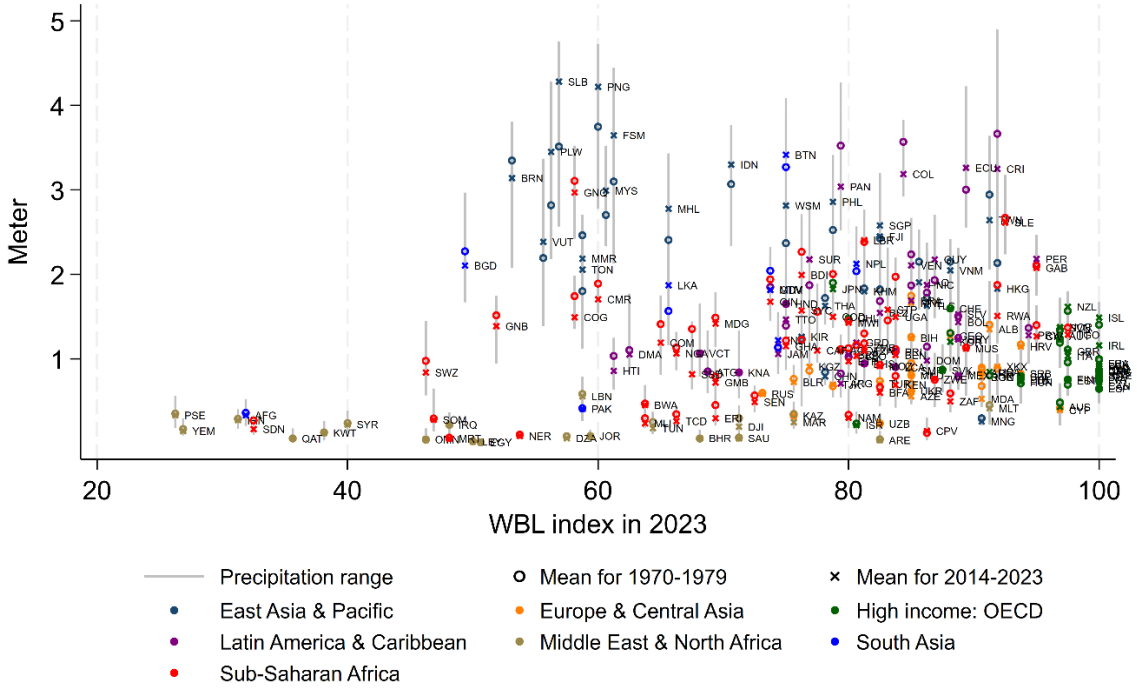
Figure 3(a) shows that colder countries tend to have higher legal gender equality measured by the WBL index compared to hotter countries. Figure 3(b) shows greater precipitation fluctuations over the years, and the fluctuations are, in general, larger for countries with already high precipitation level. No distinct upward or downward trend can be discerned between precipitation and gender equality across the observed period.

Figure 3: Variation of temperature and precipitation, by region

(a) Temperature (annual average mean surface air temperature)



(b) Precipitation (annual aggregated accumulated precipitation)



Note: The graphs present data on each country's temperature (figure 3(a)) and precipitation (figure 3(b)), plotted against the Women, Business and the Law index measuring legal gender equality in the year 2023. Countries are color-coded by region. For each country, the circle symbols represent the mean level of temperature/precipitation in the first decade of our sample (1970–1979), the cross symbols represent the mean level of temperature/precipitation in the last decade of our sample (2014–2023), and the gray lines indicate the observed range of annual temperature/precipitation levels during the sample period (1970–2023).

4.4 Empirical Model

To test our hypothesis that climate change has negative repercussions on legal gender equality, particularly in the form of reduced legal reforms during periods of environmental stress, we construct measures of temperature and precipitation anomalies based on standardized deviations from historical country means. Inspired by Eastin (2018), we calculate temperature anomalies using the formula:

$$A_{k,t}^{temp} = \frac{X_{k,t} - \overline{X_k}}{2 * \sigma_k} \quad (2),$$

where $A_{k,t}^{temp}$ is the standardized temperature anomaly for country k in year t, $X_{k,t}$ is the annual temperature or precipitation level, $\overline{X_k}$ is the country-specific long-run average (1970–2023), $2 * \sigma_k$ is the country-specific standard deviation of the climate variable.

Following standard practice in the climate literature where weather anomalies are defined as temperature or precipitation greater than two standard deviations from the long-term climatological mean (Breetzke and Corcoran 2024; Davy et al. 2016), we divide by $\mathbf{2} * \sigma_k$ to capture substantial deviations from the historical mean (approximately 95% of values under the normal distribution), allowing us to isolate unusually extreme climate years. For precipitation anomalies, we take the absolute value of the standardized deviation:

$$A_{k,t}^{precip} = \left| \frac{X_{k,t} - \overline{X_k}}{2 * \sigma_k} \right| \quad (3)$$

This construction treats both excessive rainfall and droughts symmetrically, recognizing that either extreme can disrupt institutional capacity and budgetary priorities in ways that affect legal reform.

We estimate the relationship between climate anomalies and women's legal rights using a two-way fixed effects panel model:

$$WR_{k,t} = \alpha + \beta_j * Climate_{k,t} + \varphi_k + \eta_t + \varepsilon_{k,t} \quad (4)$$

where WR denotes the dependent variable women's legal rights, either represented by the overall WBL index, one of its eight composite indicators, or the two reform typologies, enabling provisions, and absence of restrictions (as discussed in Section 4.1), for country *k* at year *t*. $Climate_{k,t}$ is a vector containing temperature and precipitation anomalies for country *k* at year *t*. β_j is the coefficient of interest denoting the relationship between climate change and women's legal rights. The terms φ_k and η_t represent country and year fixed effects to control for time invariant and country-specific factors, such as culture or geography, which may affect social preferences for legal gender equality and are a major source of omitted variable bias. $\varepsilon_{k,t}$ is the standard error that is clustered on the country level.

This specification follows the macro-climate panel regression literature (e.g., Dell et al. 2012; Burke et al. 2015), allowing us to isolate the within-country variation in climate shocks while controlling for all time-invariant national characteristics (e.g., geography, legal origin, cultural

norms) and common time trends (e.g., global climate or reform waves). To assess the robustness of our results and evaluate whether observable time-varying covariates enhance explanatory power, we estimate an alternative specification that omits country fixed effects and instead includes a vector of controls $Z_{k,t}$,

$$WR_{k,t} = \alpha + \beta_j * Climate_{k,t} + \eta_t + Z_{k,t} + \varepsilon_{k,t} \quad (5)$$

where $Z_{k,t}$ includes key covariates likely to influence both climate resilience and legal reform. We chose variables based on findings from earlier research identifying them as influencing both women's rights and climate shocks (i.e., Eastin 2018). Specifically, we control for the level of democracy, female mortality rate, urbanization rate, a country's reliance on agriculture, the number of disasters as well as net inflows of foreign direct investment (FDI). Data are retrieved from the World Development Indicators database, except for the disaster data, which are retrieved from EM-DAT, and democracy data, which are sourced from Varieties of Democracy (V-Dem) project. All summary statistics are provided in Annex 3.

5. Empirical Results

5.1 Main Specification: Climate Anomalies and Legal Gender Equality

The main estimation results assessing the relationship between climate anomalies and women's legal rights are presented in Table 1. Columns (1) and (2) estimate the effect of temperature anomalies, while Columns (3) and (4) focus on precipitation anomalies. Columns (5) and (6) include both temperature and precipitation anomalies simultaneously, following recommendations from previous literature to mitigate omitted variable bias arising from the correlation between these two climate indicators (Auffhammer et al. 2013; Dell et al. 2012). All specifications include interaction terms between climate anomalies and the low-income dummy. The total effect for low-income countries (shown at the bottom of the table) is obtained by forming the linear combination of each anomaly's main coefficient and its interaction coefficient with the low-income dummy.

Table 1 also compares the two different model specifications described in Section 4.4. Columns (1), (3), and (5) include country and year fixed effects, whereas Columns (2), (4), and (6) include year fixed effects plus controls. The estimates are broadly consistent across the two model comparisons.

Table 1: Main specification

Dependent variable: WBL index	(1)	(2)	(3)	(4)	(5)	(6)
Temperature anomalies	0.495	1.944*			0.496	1.953*
	(0.644)	(0.993)			(0.644)	(0.996)
Temperature anomalies interacted with low-income dummy	-1.981*	-5.387***			-1.987*	-5.389***
	(1.134)	(1.549)			(1.134)	(1.550)
Precipitation anomalies			0.069	0.532	0.062	0.529
			(0.356)	(0.662)	(0.358)	(0.673)
Precipitation anomalies interacted with low-income dummy			0.033	-0.709	0.136	-0.509
			(0.534)	(1.003)	(0.528)	(1.005)
Low-income country dummy	-0.912	-1.891	-0.972	-2.261	-0.967	-1.689
	(0.894)	(1.839)	(0.922)	(1.992)	(0.929)	(1.961)
Observations	9,240	6,448	9,240	6,448	9,240	6,448
R-squared	0.876	0.608	0.876	0.604	0.876	0.608
Country FE	Yes	No	Yes	No	Yes	No
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes	No	Yes
N of countries	189	170	189	170	189	170
Temperature impact on low-income countries	**-1.485****	**-3.443*****			**-1.491****	**-3.436*****
	(0.694)	(0.888)			(0.693)	(0.890)
Precipitation impact on low-income countries			**0.102**	**-0.177**	**0.197**	**0.0199**
			(0.401)	(0.673)	(0.390)	(0.661)

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

A central contribution of our analysis lies in the interaction between climate anomalies and a country's economic performance. Drawing on Dell et al. (2012), we interact temperature and precipitation anomalies with a binary indicator for "low-income countries," defined as countries with GDP per capita (current US$) below the cross-country median in every sample year. This approach enables us to test for heterogeneous effects of climate anomalies based on fiscal and institutional capacity, which is central to our theoretical framework.

Building on our model of resource-constrained policy making, we hypothesize that governments in low-income countries, which are more likely to be confronted with more binding budget constraints and narrower institutional capacity, face sharper trade-offs during climate-induced crises. When temperature shocks occur, governments in these settings are more likely to redirect scarce resources toward urgent climate response and recovery priorities (e.g., infrastructure repair, food security) at the expense of long-term, structural reforms such as legal gender equality. In the terms of our utility-maximizing framework, the marginal utility of climate adaptation (C) rises

under environmental stress, reducing the allocation to gender-equity-enhancing legal reforms (G). By contrast, governments in wealthier countries may have the necessary fiscal space and institutional resilience to maintain reform progress even amid climate shocks.

The results provide strong empirical support for the theoretical framework. The interaction terms at the bottom of Table 1 show that temperature anomalies have a significant negative effect on women's legal rights in low-income countries, while no such effect is observed in higher-income contexts. For instance, in Column (2), the coefficient for temperature anomalies is 1.944 (applying to non-low-income countries), while the interaction with the low-income dummy is −5.387 ($p < 0.01$). This yields a net marginal effect of −3.443 for low-income countries. This means that a one-unit increase in temperature anomaly—representing a year significantly hotter than historical norms—is associated with a 3.443-point decline in the WBL index for low-income countries, on average, holding other factors constant. This finding suggests that climate shocks hinder progress on legal gender equality precisely where institutional capacity and fiscal resources are most constrained.

By contrast, precipitation anomalies and their interactions with poverty are statistically insignificant across all model specifications. This finding is in line with existing macro-climate literature, which finds more consistent and economically meaningful effects for temperature variability than for rainfall anomalies (Dell et al. 2012; Tol 2018).

These findings are empirically consistent with the theoretical mechanisms outlined in Section 3. Climate shocks reshape the policy preferences of the public: during crises, demand shifts toward immediate, visible interventions (e.g., climate adaptation), reducing electoral support and political incentives for longer-term, redistributive reforms such as women's legal empowerment. Lawmakers in fiscally constrained settings, motivated by a combination of vote-seeking, office-seeking, and policy-seeking incentives, respond by deprioritizing gender reform when faced with environmental shocks.

Thus, the interaction term in our regression framework captures more than just vulnerability to climate anomalies; it reflects a deeper institutional inability to sustain inclusive reform agendas under climate pressure. The findings highlight the dual burden faced by low-income countries: greater exposure to climate risk and greater difficulty in pursuing equitable legal transformation when that risk materializes.

While columns (1)-(2) and (3)-(4) focus on the effects of temperature and precipitation, respectively, the subsequent analysis concentrates on the model with both temperature and precipitation, providing a full picture of climate's impact on legal gender equality.

5.2 Resource Constraints and Reform Selectivity

To further explore the mechanisms through which climate shocks influence legal gender equality, we disaggregate the WBL index into two conceptually distinct dimensions: (1) enabling provisions (Ge), which grant women new rights or benefits and typically require fiscal expenditures (e.g., paid maternity leave, pension access), and (2) removal of legal restrictions (Gr), which eliminate discriminatory laws (e.g., restrictions on freedom of movement or becoming head of household) but impose little to no budgetary cost on governments. This distinction allows us to empirically investigate whether in fiscally constrained environments (low-income countries) costlier reforms are more likely to be delayed or deprioritized when climate shocks occur.

The regression results presented in Table 2 confirm this theory. Column (1) shows that temperature anomalies significantly reduce enabling gender reforms in low-income countries. The marginal effect for low-income countries, -3.085 ($p < 0.01$), is large and statistically significant. By contrast, the impact of temperature anomalies on the removal of legal restrictions (Column 2) is statistically insignificant, both in the interaction term and the marginal effects.

These findings indicate that climate-induced resource constraints exert a selective halting effect on legal progress: governments under pressure do not abandon all reforms, but they scale back the ones that require financial commitments or institutional investment. Climate anomalies do not uniformly stall all forms of legal gender reforms, but rather exert targeted pressure on reforms with the highest fiscal footprint. This deepens our understanding of the reform bottleneck and underscores the importance of financial and institutional capacity in sustaining gender reform momentum in the face of environmental volatility.

Table 2. Climate Anomalies Stall Enabling Gender Reforms

	(1)	(2)
Dependent variables	Enabling legislation	Absence of restrictive legislation
Temperature anomalies	1.575*	-0.276
	(0.838)	(0.735)
Temperature anomalies interacted with low-income dummy	-4.659***	0.013
	(1.455)	(1.299)
Precipitation anomalies	0.463	-0.257
	(0.505)	(0.389)
Precipitation anomalies interacted with low-income dummy	-0.565	0.742
	(0.744)	(0.542)
Low-income country dummy	-1.927*	-0.208
	(1.134)	(1.110)
Observations	9,240	9,240
R-squared	0.852	0.870
Country FE	Yes	Yes
Year FE	Yes	Yes
N of countries	189	189
Temperature impact on low-income countries	**-3.085*** **	**-0.264**
	(0.912)	(0.866)
Precipitation impact on low-income countries	**-0.102**	**0.485**
	(0.527)	(0.401)

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

5.3 Regional Heterogeneity: Divergent Reform Responses to Climate Anomalies

To assess whether the effect of climate shocks on legal gender equality varies across regions, we disaggregate the sample into Sub-Saharan Africa (SSA) and non-SSA countries. This approach allows us to test whether the resource constraint mechanism and its implications for reform prioritization differ based on structural, institutional, and economic factors common within regions (Table 3).

In non-SSA countries, the interaction between temperature anomalies and the low-income country dummy is negative and statistically significant, indicating that temperature shocks are associated with a significant decline in the WBL index in low-income non-SSA economies. This supports the theoretical prediction that fiscal constraints intensify trade-offs, leading to de-prioritization of legal gender equality reforms during climate disruptions. In contrast, for SSA countries, the same interaction is negative but not statistically significant (–1.835, $p > 0.1$). This may be due to a greater resilience of legal institutions in SSA to climate-induced disruptions or alternatively reflect structural stagnation, where gender legal reform is already slow or stalled, irrespective of climate shocks.

The disaggregated analysis of reform types reveals more nuance: Enabling legislation (Columns 3–4), specifically in non-SSA countries, low-income-country interactions with temperature shocks are strongly negative and highly significant (–5.486, $p < 0.01$). This underscores that resource-intensive reforms like paid leave or pension benefits are most vulnerable to reprioritization in climate-affected, fiscally constrained settings. In SSA, the interaction is negative (–2.990) but not statistically significant. On the absence of restrictive legislation (Columns 5–6), across both SSA and non-SSA, the interaction between temperature anomalies and low-income countries is not statistically significant, implying that low-cost legal reforms (e.g., removing travel or employment restrictions) are less affected by climate shocks.

The regional results support our theoretical framework: in non-SSA countries, temperature anomalies significantly reduce progress on enabling legislation in low-income economies, consistent with the idea that resource-intensive reforms are most vulnerable during climate shocks. In SSA, effects are directionally similar but statistically insignificant, possibly due to lower baseline reform levels or greater donor buffering – mechanisms that require more in-depth additional research. In contrast, reforms that remove legal restrictions, being less fiscally

demanding, are largely unaffected, reinforcing our distinction between enabling (G_e) and cost-neutral (G_r) provisions.

Table 3: Regional Heterogeneity Analysis

Dependent variables	(1) WBL index: Non-SSA	(2) WBL index: SSA	(3) Enabling legislation: Non-SSA	(4) Enabling legislation: SSA	(5) Absence of restrictive legislation: Non-SSA	(6) Absence of restrictive legislation: SSA
Temperature anomalies	0.969	0.335	1.262	2.402	0.818	-1.142
	(0.615)	(3.315)	(0.817)	(3.481)	(0.644)	(3.797)
Temperature anomalies interacted with low-income dummy	-3.249**	-1.835	-5.486***	-2.990	-1.526	-1.262
	(1.278)	(4.119)	(1.753)	(3.930)	(1.321)	(5.043)
Precipitation anomalies	0.054	0.725	0.447	1.195	-0.258	0.428
	(0.372)	(1.576)	(0.543)	(1.429)	(0.390)	(1.905)
Precipitation anomalies interacted with low-income dummy	0.735	-0.975	0.332	-2.238	1.120*	-0.017
	(0.646)	(1.584)	(0.913)	(1.583)	(0.649)	(1.882)
Low-income country dummy	-1.663*	1.697	-2.836**	1.442	-0.742	1.939
	(0.923)	(3.118)	(1.280)	(2.186)	(0.936)	(4.715)
Observations	6,801	2,439	6,801	2,439	6,801	2,439
R-squared	0.890	0.798	0.861	0.812	0.886	0.801
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N of countries	141	48	141	48	141	48
Temperature impact on low-income countries	**-2.281*** **	**-1.500**	**-4.224*** **	**-0.589**	**-0.708**	**-2.404**
	(0.857)	(1.497)	(1.234)	(1.501)	(0.908)	(2.201)
Precipitation impact on low-income countries	**0.789**	**-0.250**	**0.779**	**-1.044**	**0.862**	**0.411**
	(0.533)	(0.563)	(0.721)	(0.792)	(0.529)	(0.651)

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

5.4 Analysis by WBL Indicator

The analysis of the eight WBL indicators in Table 4 shows that temperature anomalies in low-income countries are most strongly associated with legal setbacks in the areas of marriage and parenthood, followed by mobility. While the association with parenthood aligns with theoretical expectations—given its reliance on enabling provisions such as paid maternity leave—the prominence of marriage and mobility is less intuitive, as these domains primarily involve the removal of legal restrictions rather than fiscally costly state provisions. One possible explanation

is that even deregulatory reforms can be challenging when they involve intra-household dynamics, which may face stronger social resistance than market-related reforms.

Mobility, in particular, stands out as one of the most difficult legal barriers to dismantle. Reforms in this domain involve granting women equal rights to leave the home, travel independently, or obtain a passport—rights that become even more critical in the context of climate shocks. That setbacks in mobility rights coincide with climate stress is striking, as restricted movement further increases women's vulnerability while limiting their ability to respond to or recover from environmental crises. Interestingly, no significant relationship is observed between climate anomalies and reforms related to pay and pensions, despite their high fiscal demands. This may suggest that such reforms are either more institutionally rigid and less subject to frequent legislative change, or are more likely to receive donor funding, insulating them from domestic fiscal constraints. These findings underscore the need for further research into the specific pathways through which environmental stress shapes progress across different dimensions of gender equality.

Table 4. Indicator level analysis

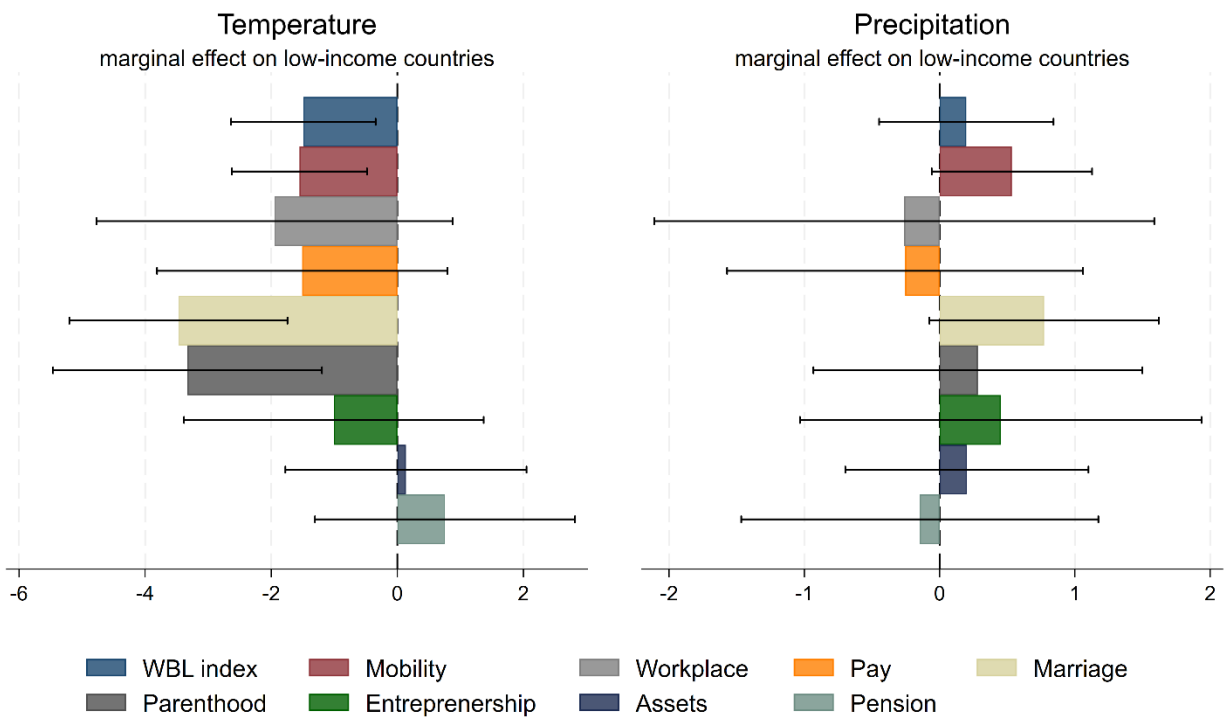
Dependent variables	(1) WBL index	(2) Mobility	(3) Work-place	(4) Pay	(5) Marriage	(6) Parent-hood	(7) Entrepre-nership	(8) Assets	(9) Pension
Temperature anomalies	0.496	0.822	-0.642	1.743	1.785*	3.495***	-0.554	-1.210	-1.470
	(0.644)	(0.602)	(1.571)	(1.190)	(0.934)	(1.068)	(1.024)	(0.907)	(1.293)
Temperature anomalies interacted with low-income dummy	-1.987*	-2.375**	-1.306	-3.251	-5.257***	-6.824***	-0.453	1.346	2.226
	(1.134)	(1.013)	(2.824)	(2.284)	(1.651)	(1.951)	(1.976)	(1.793)	(2.018)
Precipitation anomalies	0.062	-0.555	-0.146	0.021	0.299	0.164	0.134	0.088	0.487
	(0.358)	(0.358)	(0.953)	(0.700)	(0.518)	(0.661)	(0.637)	(0.400)	(0.832)
Precipitation anomalies interacted with low-income dummy	0.136	1.089**	-0.116	-0.277	0.473	0.119	0.318	0.114	-0.634
	(0.528)	(0.507)	(1.471)	(1.061)	(0.711)	(0.981)	(1.112)	(0.675)	(1.155)
Low-income country dummy	-0.967	0.664	-1.589	-0.687	-2.120*	-1.798	-0.263	0.080	-2.021
	(0.929)	(0.719)	(2.565)	(1.748)	(1.262)	(1.543)	(1.826)	(1.160)	(2.388)
Observations	9,240	9,240	9,240	9,240	9,240	9,240	9,240	9,240	9,240
R-squared	0.876	0.926	0.733	0.793	0.895	0.852	0.650	0.873	0.746
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N of countries	189	189	189	189	189	189	189	189	189
Temperature impact on low-income countries	**-1.491****	**-1.553****	**-1.948**	**-1.509**	**-3.472*****	**-3.329****	**-1.007**	**0.136**	**0.756**
	(0.693)	(0.648)	(1.708)	(1.393)	(1.046)	(1.290)	(1.438)	(1.157)	(1.248)
Precipitation impact on low-income countries	**0.197**	**0.534**	**-0.262**	**-0.256**	**0.772**	**0.283**	**0.452**	**0.202**	**-0.147**
	(0.390)	(0.359)	(1.118)	(0.796)	(0.513)	(0.735)	(0.898)	(0.544)	(0.799)

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Figure 4 visualizes the effects of temperature and precipitation anomalies on various dimensions of women's legal rights in low-income countries.

Figure 4: Coefficient plots for the WBL index and its eight indicators



Note: All models include interaction terms between climate anomalies and a low-income country dummy. The plotted marginal effect for low-income countries is calculated as the sum of each anomaly's main coefficient and its interaction coefficient with the low-income dummy.

5.5 Lagged Results

To assess whether the effects of climate anomalies unfold gradually or persist over time for the enabling provisions, we estimate a lag model for up to ten years. The results in Table 5 exhibit a consistently negative and statistically significant effect of temperature anomalies on enabling legal reforms in low-income countries across all lags. The magnitude of the impact ranges from −1.8 to −2.9 points on the WBL index, with all estimates statistically significant at least at the 5 percent level.

This sustained pattern suggests that the effects of climate shocks on gender reform are not short-lived or easily reversed. Instead, they appear to entrench reform inertia over the medium term, potentially by altering fiscal priorities, disrupting institutional continuity, or diminishing political will. In contrast, precipitation anomalies remain statistically insignificant across all lag periods,

reinforcing the earlier conclusion that heat stress—not rainfall variability—is the dominant climate risk for gender-legal progress in low-income contexts. The same specification was applied to legal restrictions, but the results were not statistically significant, as expected (see Annex 4).

Together, these findings underscore that climate shocks can have long-lasting consequences for structural reform, particularly when reforms require sustained public investment and institutional effort, as is typical for enabling provisions.

Table 5: Lagged effects

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependent variable: Enabling legislation	1 lag	2 lag	3 lag	4 lag	5 lag	6 lag	7 lag	8 lag	9 lag	10 lag
Temperature impact on low-income countries	**-2.906*** **	**-2.499*** **	**-2.056** **	**-1.833** **	**-2.432*** **	**-2.150** **	**-2.201** **	**-2.392** **	**-2.351** **	**-2.168** **
SE temp on low-income	(0.948)	(0.957)	(0.952)	(0.925)	(0.922)	(0.906)	(0.883)	(0.920)	(0.946)	(0.926)
Precipitation impact on low-income countries	-0.0912	-0.334	-0.438	-0.581	-0.934	-0.415	-0.284	0.0185	-0.319	-0.405
SE precip on low-income	(0.476)	(0.511)	(0.499)	(0.550)	(0.577)	(0.622)	(0.617)	(0.579)	(0.581)	(0.577)
Observations	9,049	8,860	8,671	8,482	8,293	8,104	7,915	7,726	7,539	7,352
R-squared	0.853	0.855	0.856	0.858	0.860	0.862	0.864	0.866	0.868	0.870
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N of countries	189	189	189	189	189	189	189	188	188	188

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

5.6 Robustness Tests

We conduct a series of robustness checks to ensure that our findings are not sensitive to model specification, error structure, or data source. Across all alternative specifications, our core result holds: temperature anomalies significantly reduce the likelihood of enabling legal reforms in low-income countries, while precipitation anomalies remain largely insignificant.

Following Dell et al. (2012), we cluster standard errors simultaneously by country and region-year to account for potential spatial and temporal correlation in climate shocks. The negative and statistically significant interaction between temperature anomalies and poverty status persists (-3.085, $p < 0.01$), confirming the robustness of our main result under a more conservative error structure (Annex 5). To avoid potential threshold sensitivity in the low-income-country definition,

we replace the poverty indicator with log GDP per capita and estimate the marginal effects at the 25th and 75th percentiles of the income distribution. Results largely remain the same with temperature anomalies significantly reducing enabling reforms in low-income, but have no significant effect at higher income levels. This reinforces the income-contingent nature of reform vulnerability and strengthens the interpretation of resource constraints (Annex 6). We re-calculate temperature anomalies using a less conservative one standard deviation (instead of two) as the scaling factor. The results remain consistent: the interaction term is negative and highly significant, and the marginal effect of temperature on low-income countries is still large and significant. This confirms that the observed relationship is not sensitive to the scaling of climate variability (Annex 7). ERA5 is a reanalysis dataset that blends models and observations, and to test whether our findings depend on the choice of climate data, we replicate the main model using the CRU TS (Climatic Research Unit Time-Series) dataset, which offers monthly averages derived directly from measurements from weather stations, and obtain overall robust results. The estimated marginal effect of temperature shocks on low-income countries is comparable in magnitude to that obtained using ERA5, providing additional confidence in the external validity of our findings (Annex 8).

Overall, across alternative specifications, including different clustering strategies, continuous income measures, alternative constructions of climate anomalies, and the use of a separate climate dataset, we consistently find that temperature anomalies significantly reduce the likelihood of enabling legal gender reforms, but only in low-income countries. The direction, magnitude, and statistical significance of the effect remain stable, underscoring the robustness of the relationship and lending further confidence to our central claim: climate-induced resource constraints selectively hinder progress on fiscally demanding gender equality reforms.

6. Conclusion

This paper provides a global, long-run analysis of how climate change influences legal gender equality, using panel data spanning five decades and 190 countries. Leveraging the World Bank's Women, Business and the Law (WBL) database, we examine how temperature and precipitation anomalies, key manifestations of climate change, affect legal rights for women. Our results reveal a robust, negative relationship between temperature shocks and legal gender equality, but only in low-income countries. These effects are concentrated in reforms that grant benefits to women,

such as those related to parental leave policies, rather than in removing restrictions. This asymmetry suggests that climate-induced resource constraints selectively stall resource-intensive reforms, while less fiscally demanding legal changes proceed, on average, unaffected.

Moreover, we show that the effects of climate shocks on legal reform are persistent, with setbacks lasting up to a decade. The domains most affected include areas like marriage, parenthood, and mobility, which often require infrastructure and institutional implementation.

These findings have important implications. As climate shocks divert attention and resources toward short-term adaptation, governments, especially in low-income settings, may deprioritize structural legal change. While we do not claim a direct causal pathway, the evidence highlights a consistent pattern: climate vulnerability is associated with delayed legal empowerment for women in precisely the countries where reform is most urgent.

Policy makers should integrate gender equality goals into climate adaptation strategies, ensuring that enabling legal reforms, those that grant access to resources, protections, and economic opportunity, are protected during times of fiscal and institutional stress. By acknowledging and addressing the specific vulnerabilities and contributions of women in the context of climate change, policy makers can develop more effective and equitable strategies that promote sustainable development and resilience for all.

The persistence of discriminatory laws, coupled with the adverse effects of climate shocks, underscores the urgent need for legislative reform and proactive policy measures that consider the specific needs of women and the planet. This is particularly important for countries where agriculture, fishing or forestry sectors are important for generating income, and where policies should focus on reinforcing communities' adaptive capacities amid shifting conditions. Legal gender equality is not an aspirational ideal to be pursued after crisis; it is a foundation for inclusive development and effective climate action. Given the evidence that climate shocks may impede gender-equitable legal reform, integrating legal gender equality into climate resilience planning represents an important avenue for promoting inclusive and sustainable development.

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Annex 1: Women, Business and the Law Index

Variable name	Definition	Enabling legislation	Absence of restrictive legislation
WBL index	Index capturing the legal inequalities between men and women in terms of mobility, workplace, pay, marriage, parenthood, entrepreneurship, assets, and pension. The index ranges from 0 to 100; the higher the index, the lower legal inequalities.		
Mobility	1. Can a woman choose where to live in the same way as a man?		✓
	2. Can a woman travel outside her home in the same way as a man?		✓
	3. Can a woman apply for a passport in the same way as a man?		✓
	4. Can a woman travel outside the country in the same way as a man?		✓
Workplace	1. Can a woman get a job in the same way as a man?		✓
	2. Does the law prohibit discrimination in employment based on gender?	✓	
	3. Is there legislation on sexual harassment in employment?	✓	
	4. Are there criminal penalties or civil remedies for sexual harassment in employment?	✓	
Pay	1. Does the law mandate equal remuneration for work of equal value?	✓	
	2. Can a woman work at night in the same way as a man?		✓
	3. Can a woman work in a job deemed dangerous in the same way as a man?		✓
	4. Can a woman work in an industrial job in the same way as a man?		✓
Marriage	1. Is the law free of legal provisions that require a married woman to obey her husband?		✓
	2. Can a woman be head of household in the same way as a man?		✓
	3. Is there legislation specifically addressing domestic violence?		✓
	4. Can a woman obtain a judgment of divorce in the same way as a man?		✓
	5. Does a woman have the same rights to remarry as a man?	✓	
Parenthood	1. Is paid leave of at least 14 weeks available to mothers?	✓	
	2. Does the government administer 100% of maternity leave benefits?	✓	
	3. Is paid leave available to fathers?	✓	
	4. Is there paid parental leave?	✓	
	5. Is dismissal of pregnant workers prohibited?	✓	
Entrepreneurship	1. Does the law prohibit discrimination in access to credit based on gender?	✓	
	2. Can a woman sign a contract in the same way as a man?		✓
	3. Can a woman register a business in the same way as a man?		✓
	4. Can a woman open a bank account in the same way as a man?		✓
Assets	1. Do men and women have equal ownership rights to immovable property?		✓
	2. Do sons and daughters have equal rights to inherit assets from their parents?		✓
	3. Do male and female surviving spouses have equal rights to inherit assets?		✓
	4. Does the law grant spouses equal administrative authority over assets during marriage?		✓
	5. Does the law provide for the valuation of nonmonetary contributions?	✓	
Pension	1. Is the age at which men and women can retire with full pension benefits the same?	✓	
	2. Is the age at which men and women can retire with partial pension benefits the same?	✓	
	3. Is the mandatory retirement age for men and women the same?	✓	
	4. Are periods of absence due to childcare accounted for in pension benefits?	✓	

Source: World Bank 2024

Annex 2: Variable definition and source

Variable name	Definition	Source
	Dependent variables	
WBL index	WBL index (1970-2023)	*Women, Business and the Law* database
Mobility	Mobility indicator (1970-2023)	*Women, Business and the Law* database
Workplace	Workplace indicator (1970-2023)	*Women, Business and the Law* database
Pay	Pay indicator (1970-2023)	*Women, Business and the Law* database
Marriage	Marriage indicator (1970-2023)	*Women, Business and the Law* database
Parenthood	Parenthood indicator (1970-2023)	*Women, Business and the Law* database
Entrepreneurship	Entrepreneurship indicator (1970-2023)	*Women, Business and the Law* database
Assets	Assets indicator (1970-2023)	*Women, Business and the Law* database
Pension	Pension indicator (1970-2023)	*Women, Business and the Law* database
	Independent variables	
Average Mean Surface Air Temperature (°C)	The variable is the annual average of surface air temperatures. It is derived by assimilating observational data from various sources into a numerical weather model, calculating hourly temperature estimates, and then averaging these values temporally and spatially over the course of a year. (1950-2023)	ERA5 reanalysis data, as processed and calculated by the World Bank Group's Climate Change Knowledge Portal
Aggregated accumulated precipitation (mm)	The variable refers to total precipitation over a year. Observational data is assimilated into a weather model to estimate precipitation on an hourly basis, which is then averaged over spatial grid points. Finally, these hourly values are summed across all hours in the year to yield the annual total precipitation. (1950-2023)	ERA5 reanalysis data, as processed and calculated by the World Bank Group's Climate Change Knowledge Portal
	Control variables	
Number of disasters	The variable is constructed by including only natural disasters that are classified as climatological, hydrological, and meteorological, given their relevance to climate change. (1970-2025)	EM-DAT
Agriculture, forestry, and fishing, value added (% of GDP)	This variable is defined as the percentage share of the gross domestic product (GDP) that is contributed by the net output (or value added) of the agriculture, forestry, and fishing sectors. (1960-2023)	World Development Indicators
Foreign direct investment, net inflows (% of GDP)	This variable is defined as the net inflows of investment funds received from foreign sources, as a percentage of GDP. (1960-2023)	World Development Indicators
GDP per capita (current US$)	This variable is defined as the gross domestic product measured in current U.S. dollars divided by the country's mid-year population. (1960-2023)	World Development Indicators
Urban population (% of total population)	This variable is defined as the percentage share of a country's total population that resides in urban areas. (1960-2023)	World Development Indicators
Mortality rate, adult, female (per 1,000 female adults)	This variable is defined as the probability of a 15-year-old female dying before reaching age 60, if subject to age-specific mortality rates of the specified year between those ages. (1960-2023)	World Development Indicators
Electoral democracy index	This variable comes from the V-Dem question: "To what extent is the ideal of electoral democracy in its fullest sense achieved?" The electoral principle of democracy seeks to embody the core value of making rulers responsive to	V-Dem

citizens, achieved through electoral competition for the electorate's approval under circumstances when suffrage is extensive; political and civil society organizations can operate freely; elections are clean and not marred by fraud or systematic irregularities; and elections affect the composition of the chief executive of the country. In between elections, there is freedom of expression and an independent media capable of presenting alternative views on matters of political relevance. In the V-Dem conceptual scheme, electoral democracy is understood as an essential element of any other conception of representative democracy --- liberal, participatory, deliberative, egalitarian, or some other.
Scale: Interval, from low to high (0-1). (1789-2023)

Annex 3: Summary statistics

Variables	Obs	Mean	Std.Dev	Min	Max
WBL index	10,260	59.96	18.75	17.50	100
Mobility	10,260	82.11	25.63	0	100
Workplace	10,260	43.64	33.86	0	100
Pay	10,260	48.07	31.31	0	100
Marriage	10,260	62.13	29.95	0	100
Parenthood	10,260	35.21	30.83	0	100
Entrepreneurship	10,260	72.99	21.22	0	100
Assets	10,260	73.80	29.19	0	100
Pension	10,260	61.71	29.00	0	100
Average Mean Surface Air Temperature (°C)	10,260	19.19	7.996	-6.830	29.82
Aggregated accumulated precipitation (mm)	10,260	1,217	860.2	5.850	4,897
Number of disasters	10,260	1.180	2.699	0	43
Agriculture, forestry, and fishing, value added (% of GDP)	7,763	14.79	13.22	0	79.04
Foreign direct investment, net inflows (% of GDP)	8,319	3.779	15.85	-360.4	452.2
GDP per capita (current US$)	9,240	8,230	14,467	20.72	133,712
Urban population (% of total population)	10,152	51.38	24.06	2.845	100
Mortality rate, adult, female (per 1,000 female adults)	9,788	179.8	113.7	21.66	997.6
Electoral democracy index	8,875	0.446	0.285	0.0100	0.922

Annex 4: Lagged effects for absence of restrictive legislation

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependent variable: Absence of restrictive legislation	1 lag	2 lag	3 lag	4 lag	5 lag	6 lag	7 lag	8 lag	9 lag	10 lag
Temperature impact on poor countries	-0.0938	0.168	0.331	0.0978	-0.204	-0.169	-0.0448	-0.175	-0.0934	0.265
SE temp on poor	(0.857)	(0.829)	(0.789)	(0.751)	(0.743)	(0.727)	(0.730)	(0.733)	(0.742)	(0.715)
Precipitation impact on poor countries	0.483	0.401	0.225	0.280	0.305	0.355	0.220	0.323	0.0908	-0.0311
SE precip on poor	(0.419)	(0.415)	(0.408)	(0.460)	(0.420)	(0.438)	(0.390)	(0.345)	(0.354)	(0.322)
Observations	9,049	8,860	8,671	8,482	8,293	8,104	7,915	7,726	7,539	7,352
R-squared	0.873	0.876	0.879	0.883	0.886	0.889	0.893	0.896	0.899	0.902
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N of countries	189	189	189	189	189	189	189	188	188	188

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Annex 5: Cluster standard error by country and region-year

Dependent variable: Enabling legislation	(1)
Temperature anomalies	1.575
	(1.052)
Temperature anomalies interacted with low-income dummy	-4.659***
	(1.635)
Precipitation anomalies	0.463
	(0.621)
Precipitation anomalies interacted with low-income dummy	-0.565
	(0.823)
Low-income country dummy	-1.927
	(1.178)
Observations	9,240
R-squared	0.852
Country FE	Yes
Year FE	Yes
N of countries	189
Temperature impact on low-income countries	**-3.085*** **
	(1.170)
Precipitation impact on low-income countries	**-0.102**
	(0.612)

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Annex 6: Alternate specification of low-income countries

	(1)	(2)	(3)
Dependent variables	WBL index	Enabling legislation	Absence of restrictive legislation
Temperature anomalies	-3.578	-12.646***	3.612
	(2.920)	(3.856)	(3.217)
Temperature anomalies interacted with log GDP per capita	0.395	1.516***	-0.490
	(0.364)	(0.481)	(0.393)
Precipitation anomalies	-0.099	-1.770	1.355
	(1.244)	(1.566)	(1.314)
Precipitation anomalies interacted with log GDP per capita	0.020	0.233	-0.162
	(0.150)	(0.198)	(0.152)
log GDP per capita	1.610**	3.466***	0.128
	(0.680)	(0.899)	(0.687)
Observations	9,240	9,240	9,240
R-squared	0.877	0.855	0.870
Country FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
N of countries	189	189	189
Temperature marginal effect at 25th percent	**-0.989**	**-2.720*** **	**0.406**
	(0.619)	(0.836)	(0.769)
Precipitation marginal effect at 25th percent	**0.0345**	**-0.242**	**0.293**
	(0.349)	(0.419)	(0.398)
Temperature marginal effect at 75th percent	**-0.0125**	**1.024**	**-0.803**
	(0.519)	(0.705)	(0.588)
Precipitation marginal effect at 75th percent	**0.0849**	**0.335**	**-0.107**
	(0.297)	(0.439)	(0.290)

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Annex 7: Alternate calculation of temperature anomalies

Dependent variable: enabling legislation	Alternative temperature anomaly
Temperature anomalies	0.787*
	(0.419)
Temperature anomalies interacted with low-income dummy	-2.330***
	(0.727)
Precipitation anomalies	0.463
	(0.505)
Precipitation anomalies interacted with low-income dummy	-0.565
	(0.744)
Low-income country dummy	-1.927*
	(1.134)
Observations	9,240
R-squared	0.852
Country FE	Yes
Year FE	Yes
N of countries	189
Temperature impact on low-income countries	**-1.542*** **
	(0.456)
Precipitation impact on low-income countries	**-0.102**
	(0.527)

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Annex 8: Alternative data source: CRU TS

Dependent variable: enabling legislation	CRU
Temperature anomalies	2.510***
	(0.912)
Temperature anomalies interacted with low-income dummy	-4.999***
	(1.347)
Precipitation anomalies	-0.345
	(0.548)
Precipitation anomalies interacted with low-income dummy	1.335
	(0.919)
Low-income country dummy	-2.748**
	(1.157)
Observations	9,240
R-squared	0.852
Country FE	Yes
Year FE	Yes
N of countries	189
Temperature impact on low-income countries	**-2.489****
	(1.009)
Precipitation impact on low-income countries	**0.990**
	(0.720)

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1