Heat, Intimate Partner Violence and Labour Market Schocks

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Work in progress - please do not circulate

One in four women globally has experienced violence from a current or former intimate partner. Despite IPV being a key issue on the political agenda, some contributing factors remain unclear. This paper quantifies the impact of extreme temperatures on the seasonality of IPV, particularly its increase during the summer months. Analyzing administrative data on all IPV reports in Spain from 2006 to 2022, we find that extreme temperatures lead to a 6% rise in IPV incidents and increase the severity of these offenses. Building on existing literature that links labor market shocks to IPV, we further demonstrate that the effect of extreme heat is more pronounced in areas experiencing significant negative labor market shocks. From a policy perspective, our projections suggest that climate change could lead to an additional 650-1300 IPV cases per quarter in the near future.

JEL codes: J12, K38, Q54

Keywords: Intimate partner violence, temperature, climate change, labour market shocks.

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1. Introduction

Intimate partner violence (IPV) is a pervasive issue, affecting one in four women globally at least once in their lifetime (WHO, 2022). Beyond the immediate and devastating effects on victims and their children, IPV imposes significant economic costs, including increased healthcare expenditures, demands on social services, and productivity losses (e.g., Aizer, 2010; Adams-Prassl et al., 2023). The broad impact of IPV has prompted a growing body of economic research aimed at understanding its determinants and consequences (e.g., Aizer, 2010; Adams-Prassl et al., 2023; Tur-Prats, 2019; Erten and Keskin, 2018; Bullinger et al., 2021; Leslie and Wilson, 2020).

This paper adds to this growing literature by examining the causal effect of extreme temperatures on IPV in Spain, focusing on whether high temperatures serve as a stressor that increases the incidence of IPV. Departing from the observed seasonal pattern of IPV — where cases peak during the summer months — we analyze rich administrative data on IPV-related outcomes across 431 judicial districts in Spain, spanning from 2009 to 2022. The detailed longitudinal nature of our data allows us to exploit both regional and temporal variations in temperature, enabling us to estimate a robust fixed effects model that controls for a comprehensive set of confounding factors. Furthermore, we investigate the mechanisms behind the relationship between temperature and IPV, particularly the role of labor market shocks and changes in time-use patterns.

Our analysis reveals consistent and robust effects of temperature on IPV in Spain. Specifically, we find that an increase of one degree Celsius in average maximum temperatures during the summer months (April-September) results in one additional IPV case reported to the police. When discretizing temperatures into two-degree bins, the increase in IPV reporting is most pronounced during periods with average maximum temperatures above 30 degrees Celsius. Our primary specification, which uses a binned indicator for days exceeding 30 degrees, shows that regions experiencing more than 40 such days report an increase of approximately seven IPV

cases per 100,000 women—representing a substantial 6% increase relative to the sample mean. We also observe an increase in the severity of violence, as indicated by the number of injury reports, as well as a higher likelihood of shared custody breaches. These effects remain stable across various extreme temperature metrics and model specifications.

Additionally, our findings highlight significant heterogeneity in the impact of extreme temperatures on IPV. For instance, we observe that foreign women in Spain are disproportionately affected by high temperatures, experiencing a 13% rise in IPV reporting above the sample mean, compared to a 4% increase among Spanish nationals. This disparity suggests that socioeconomic factors play a crucial role, as non-Spanish individuals are more likely to be part of low-income households, which are particularly vulnerable to the adverse effects of extreme heat (López-Bueno et al., 2020).

Several underlying mechanisms may explain these findings. First, heat exposure is known to induce physiological stress, lowering individuals' thresholds for aggressive behavior. Psychological research has long established a link between heat and aggression, suggesting that high temperatures increase discomfort and arousal, leading to a higher propensity for violence (Anderson, 2001; Anderson and DeLisi, 2011; Larrick et al., 2011; Baylis, 2020). Second, extreme heat can negatively affect mental health, exacerbating anxiety and depression, which can strain personal relationships and escalate conflicts, potentially leading to higher incidences of IPV (Hansen et al., 2008; Page and Howard, 2010). Third, the economic consequences of extreme heat, such as reduced labor productivity and financial stress, particularly in regions with high temporary employment, may also contribute to increased IPV incidents (Graff Zivin and Neidell, 2014; Heal and Park, 2013). Finally, sleep disruption caused by high nighttime temperatures may impair self-control and increase aggression, further elevating the risk of IPV (e.g., Killgore et al., 2005).

While our study cannot systematically explore all the potential channels linking extreme temperatures to IPV, we do provide evidence for some. First, using the last available time-

use survey in Spain (2010/11), we show [...]. Second, by analyzing the differential impact of the 2007/08 financial crisis across Spanish regions, we demonstrate that areas with larger unemployment shocks report significantly higher IPV effects during prolonged periods of extreme heat. This finding supports our hypothesis that economic vulnerabilities intensify the influence of temperature on IPV incidents.

We contribute to the literature in several ways. First, we add to our understanding of the determinants of IPV. A wealth of economic research has examined the determinants of IPV, focusing primarily on economic determinants. On the one hand, economic theories, such as resource theory and bargaining theory, have been pivotal in understanding these dynamics. Resource theory suggests that the availability of resources, or lack thereof, influences power dynamics in relationships, which can lead to IPV. Bargaining theory, as explored by Manser and Brown (1980), posits that household decision-making and conflicts can be analyzed through the lens of bargaining power, where economic independence or dependence plays a crucial role. On the other hand, empirical economic studies have helped to verify and quantify economic determinants of IPV. For instance, the work by Aizer (2010) indicates that economic downturns and financial stress can increase the incidence of IPV, as economic strain exacerbates tensions within households. Similarly, Adams-Prassl et al. (2023) discuss how fluctuations in economic stability, particularly employment status and income levels, can influence the frequency and severity of IPV. While economic empowerment can provide women with greater autonomy and resources to leave abusive relationships, it can also provoke backlash from partners feeling threatened by the shift in power dynamics, as noted by Peterman et al. (2017). More recent studies in the aftermath of the Covid 19 pandemic have shown that prolonged periods of cohabitation during lockdowns also increase IPV (e.g., Bhalotra et al., 2024). We add to this literature by exploring the role of extreme heat for IPV incidence and its seasonality, as well potential interactions with some of these established economic channels like unemployment and time spent at home.

Second, we add to our understanding on how the biophysical environment affects human

behaviour, specifically aggressive and criminal behavior. Studies suggest that environmental stressors, like heat waves, may increase the likelihood of criminal activity by causing physiological and psychological stress as well as changes in time use. Several empirical studies have found positive causal effects of heat on crime (e.g., Ranson, 2014; Blakeslee et al., 2021; Heilmann et al., 2021; Cohen and Gonzalez, 2024; Henke and Hsu, 2020). However, it is unclear to what extent this finding holds for IPV, which is more strongly related to (within-couple) power dynamics. This contrasts with many other crimes where the motivation may be driven by financial gain or other factors unrelated to a personal relationship. For instance, Cohen and Gonzalez (2024), analysing daily crime rates, temperature and time-use data in Mexico, show that people spend more time outside on hot days, contributing to higher crime rates. While it is clear how more time spent outside of the home might increase street crimes like thefts and injuries, one would assume the opposite for IPV, since more time at home can intensify domestic tensions and conflicts. Numerous studies support this notion, highlighting the heightened risk of IPV during extended periods of cohabitation like during the Covid 19 pandemic (e.g., Arenas-Arroyo et al., 2021; Leslie and Wilson, 2020). The literature on the relationship between heat and domestic violence is small, often focusing on multiple or other types of crime (Heilmann et al., 2021; Henke and Hsu, 2020; Cohen and Gonzalez, 2024). We contribute to this literature by offering a more focused analysis of the heat-IPV nexus and by shedding light on its underlying mechanisms and policy implications.

Our results hold significant importance not only within the academic literature but also from a broader social and global perspective. The intersectionality between economic vulnerabilities and environmental stressors highlighted in our study has critical policy implications, particularly in the context of climate change, where Southern Europe is increasingly experiencing extreme heat episodes. Our findings underscore the urgent need for preemptive measures to mitigate the elevated risk of IPV faced by women. This calls for a comprehensive strategy that addresses both economic inequalities and the challenges posed by climate-induced adversities.

The remainder of the paper is structured as follows. Chapter 2 describes the data and presents summary statistics, seasonal and regional patterns of IPV and weather characteristics, followed by a description of the research design in Chapter 3. Chapter 4 presents our results, sheds light on some of the underlying mechanisms and provides a back-of-the envelope calculation for future climate change implications on IPV. Chapter 5 concludes.

2. Institutional Background and Data

2.1. IPV in Spain

Historically, IPV in Spain was often hidden and treated as a private matter, influenced by deeply entrenched cultural norms and gender roles. During the Franco regime (1939-1975), the patriarchal structure of Spanish society was reinforced by laws and societal attitudes that placed women in a subordinate position, limiting their rights and access to resources. Domestic violence was rarely acknowledged or addressed by authorities, and victims had little recourse for protection or justice. The transition to democracy in the late 1970s brought significant social and legal reforms, including increased attention to women's rights and gender equality. The 2004 Organic Law on Integrated Protection Measures against Gender Violence marked a turning point, establishing comprehensive measures to prevent and prosecute IPV and support victims. Addressing gender equality and combating IPV have become key priorities for the Spanish government, as highlighted by the Spanish Government (2019). Since the mid-2000s, Spain has launched comprehensive programs targeting IPV. These include public awareness campaigns, the establishment of the Ministry for Equality, and the creation of specialized IPV courts (Garcia-Hombrados and Martínez-Matute, 2021).

According to the latest macro survey on Violence against Women, nearly 3 million women, or 14.2 % of women aged 16 and older, have experienced physical or sexual violence from a partner, (current or past) in Spain (Spanish Ministry for Equality, 2019). In 2019 alone, 55 women were

murdered by their current or former partners. Over the past 15 years, the number of intra-partner homicides has seen a slight increase, reflecting the growing concern of the Spanish population regarding IPV (Cento de Investigaciones Sociológicas, 2019; Garcia-Hombrados and Martínez-Matute, 2021). Similar to other developed countries and despite numerous campaigns and policies designed to raise awareness and encourage victims to report crimes, the reporting rates remain low, with only 21.7 % of IPV incidents reported to the police or brought directly to court (Spanish Ministry for Equality, 2019).

2.2. Data

We utilize two primary datasets that we link together for our analysis: one comprising reports of IPV incidents and the other containing detailed weather data.

First, we employ a comprehensive, publicly available administrative dataset that records all reported instances of IPV in Spain from 2008 to 2022. The unit of analysis is the 431 judicial districts (partidos judiciales) across Spain, hereafter interchangeably referred to as "regions," with data reported at the quarterly level.

Table 1 presents summary statistics for our main variables of interest, both in total counts and normalized per 100,000 women. Total offences include all IPV incidents reported to the police, whether by the victims, their families, or other authorities. This is the only outcome available since 2006, providing the most extensive data coverage with 29,300 observations. On average, a judicial district records 87.3 reports per quarter, equating to nearly 120 reports per 100,000 women. Total reports include all IPV reports made by victims and have been recorded since 2008. Given that the number of reports closely correlates with the number of offences, we do not focus on this outcome in our main analysis.

In 2016, authorities began documenting the number of IPV cases, which may differ from total reports as a single victim can file multiple reports. Since 2017, these cases have been further categorized by the victim's nationality (Spanish vs. non-Spanish). During this period, regions

reported an average of 128 IPV victims per 100,000 women per quarter, with the majority being Spanish nationals.

Additionally, we examine the number of injury reports, which are independently initiated by health authorities when a healthcare professional identifies physical evidence of IPV and files a report to the court. An increase in this variable likely reflects a rise in the severity of IPV, as the victim's injuries are severe enough to warrant formal documentation. The frequency of these injury reports is relatively low, with an average of 9.7 reports per 100,000 women recorded each quarter.

The second dataset comprises weather data collected by the Spanish Meteorological Agency's monitoring stations. We have access to daily readings from over 200 stations, capturing variables such as maximum, average, and minimum temperatures, as well as precipitation levels. We match weather stations to the 431 regional centroids based on proximity and aggregate daily readings using inverse distance weighting. Finally, we average these daily readings at the quarterly level to align with the frequency of the IPV dataset. Table 1 also includes an overview of temperature and precipitation variables in Spain during our sample period. Average maximum temperatures are slightly above 21 degrees Celsius, but reach a maximum of 37 degrees Celsius. It is important to keep in mind that these are quarterly averages, so that individual days will report higher values than the reported maximum values.

Table 1: Descriptive statistics

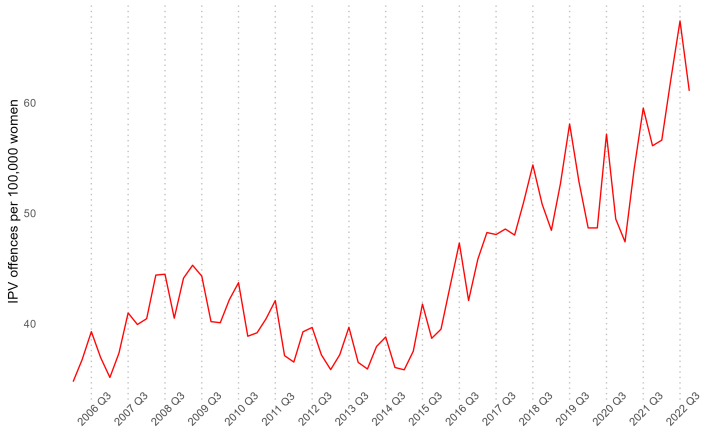
Statistic	N	Mean	St. Dev.	Min	Max
Total offences	29,300	87.3	213.5	0	4,207
Offences per 100k women	29,300	119.9	84.3	0.0	2,139.9
Total reports	24,136	85.1	200.2	0	4,005
Reports per 100k women	24,136	119.6	78.2	0.0	1,739.7
Total IPV cases	12,499	90.1	205.3	0	3,846
IPV cases per 100k women	12,499	128.3	79.0	0.0	906.5
Total IPV cases (Spanish nationals)	9,913	62.6	124.8	0	1,975
IPV cases (Spanish nationals) per 100k women	9,913	95.8	57.7	0.0	674.5
Total IPV cases (Foreign nationals)	9,913	30.4	92.1	0	1,871
IPV cases (Foreign nationals) per 100k women	9,913	37.7	41.6	0.0	419.5
Total injury reports	24,136	8.7	25.7	0	544
Injury reports per 100k women	24,136	9.7	17.6	0.0	223.0
Average max. temperature (Celsius)	29,308	21.3	6.4	1.8	37.3
Average mean temperature (Celsius)	29,308	15.9	5.8	−2.6	28.8
Average min. temperature (Celsius)	29,308	10.6	5.4	−6.7	23.8
Avg. precipitation (0.1 mm)	29,308	16.5	14.2	0.0	131.3

Notes: Own analysis based on administrative data on the universe of injury reports, offences and cases of IPV in Spain between 2006 and 2022 on the judicial district level.

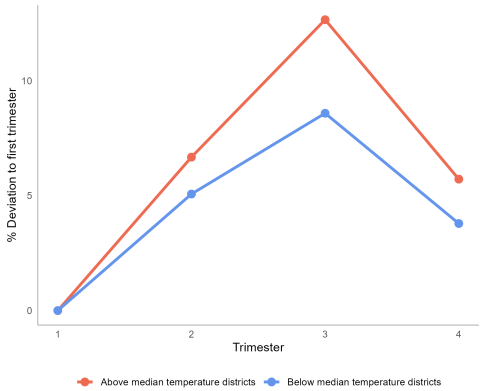
2.3. Descriptive overview

This section presents a descriptive overview on our main outcome of interest (IPV offences per 100.000 women) as well as on weather characteristics in Spain. Analogous descriptive information on other outcomes of interest can be found in Figure A.1 - Figure A.2 in the appendix section. Panel (a) of Figure 1 illustrates the evolution of IPV offences per 100,000 women over time during our sample period, highlighting two significant trends. Firstly, there is a notable surge in IPV incidence post-2015, likely influenced by increased reporting following the rise in public awareness from the Ni Una Menos campaign, launched in Argentina in June 2015 and soon gaining traction in Europe. Secondly, a clear seasonal pattern emerges, with IPV incidents peaking during the summer months, especially in the third quarter. This seasonality becomes more pronounced from 2017 to 2022. While multiple factors, such as extended exposure to intimate partners during the long summer break in August, likely contribute to this pattern, high summer temperatures might also be driving part of these effects. Notably, the seasonality

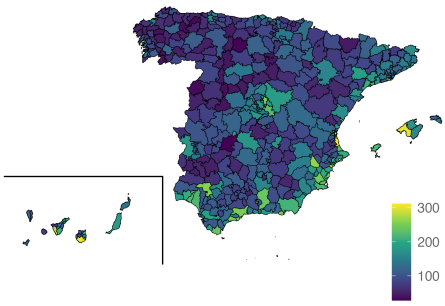
pattern is stronger in districts with above-median temperatures (Panel (b)). Additionally, Panel (c) reveals that IPV reports are particularly frequent in the central and southern regions of Spain. Figure 2 further shows that average maximum temperatures during our sample period can be over 10 degrees Celsius higher in the southern parts compared to the northern coastal regions and the Pyrenees, which are characterised by higher precipitation levels.



(a) Seasonality in IPV offences over time



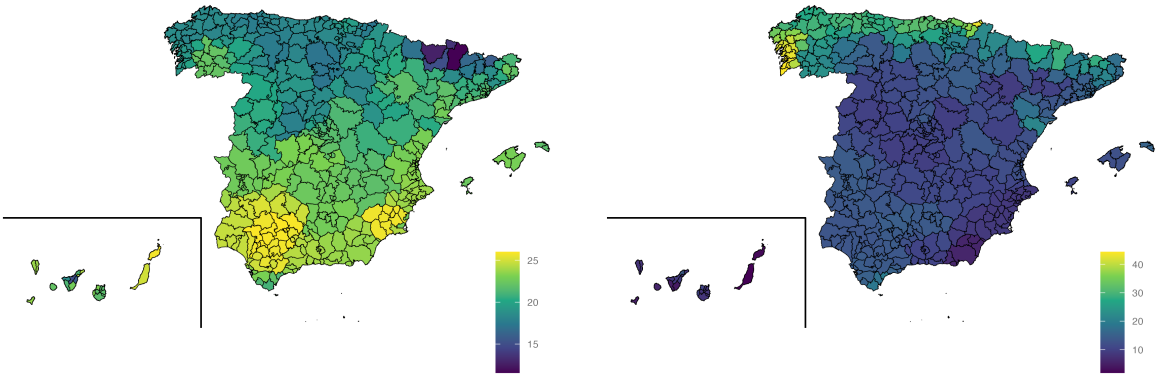
(b) Seasonality in IPV offences by median temperature



(c) Regional distribution of IPV offences

Figure 1: Descriptive overview of IPV offences per 100.000 women

Notes: Own analysis based on administrative data on the universe of injury reports, offences and cases of IPV in Spain between 2006 and 2022 on the judicial district level.



(a) Avg. quarterly avg. of daily max. temperature (Celsius)

(b) Avg. quarterly avg. of daily precipitation (0.1 mm)

Figure 2: Weather characteristics by region

Notes: Own analysis based on administrative data on the universe of injury reports, offences and cases of IPV in Spain between 2006 and 2022 on the judicial district level.

3. Research design

We use a similar model than the literature in the field. In order to uncover the effects of temperature exposure (e.g., Evans et al., 2023) on intimate partner violence, we employ a high-dimensional fixed effects model of the following structure:

$$Y_{iqy} = \sum_j \beta^j HD_{iqy} + \delta X_{iqy} + \mu_i + \alpha_q + \gamma_y + \sigma_{iy} + \varepsilon_{iqy}$$

where Y_{iqy} denotes the number of occurrences of an IPV outcome per 100.000 women in region i, quarter q and year y. HD_{iqy} is a measure of extreme temperatures as recorded in region i, quarter q and year y. As explained below, we employ a whole range of metrics to capture extreme temperature and make sure our results are robust to the specific metric chosen. The interpretation of our target parameter(s) β^j therefore depends on the specific extreme temperature metric used. Some specifications will include as control variable X_{iqy}, which denotes average daily precipitation in region i in quarter q and year y. This allows us to eliminate concerns

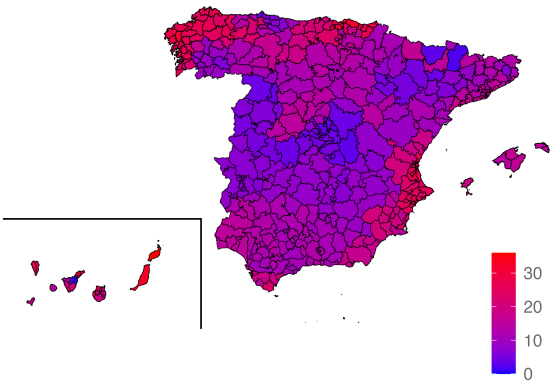
for a potential bias in our estimates due to interplay between precipitation and temperature conditions if precipitation itself affects our outcome of interest. Further, we include district (μ_i), quarter (α_q), and year (γ_y) fixed effects to account for cross-sectional variation, seasonality and general time trends over time. In some specifications, we include an additional province-year fixed (σ_{iy}) to account for changes in province-specific policy, societal and economic trends.

Our first naive model defines HD_{iqy} as a continuous variable capturing the effect of average maximum temperature in region i, quarter q and year y in a linear fashion. However, imposing a linear functional form might hide strong non-linearities in the causal relationship we analyze (Evans et al., 2023). In our main specification, we therefore define HD_{iqy} as a set of indicator variables that equal one if the number of hot days (defined as reaching temperatures above 30 degrees Celsius) experienced in region i in quarter q and year y falls into one of the following four categories: no hot days (base category), up to 10 days, 10-40 days, and more than 40 days. Alternative specifications will include indicators for different levels of the average maximum temperature or different total counts of degree-days by region i, quarter q and year y.[1]

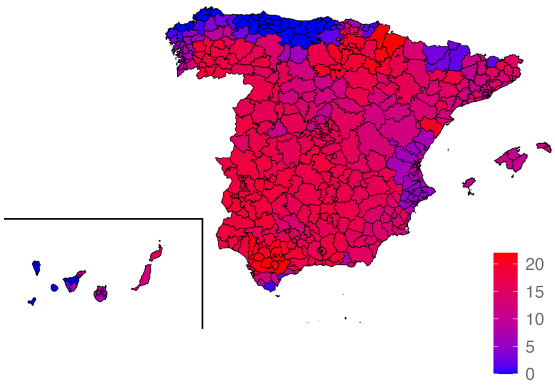
Figure 3 visualises the regions that identify the coefficients of our main specification. Panels (a), (b) and (c) show how many quarters fall into the specific extreme temperature category during our total sample period. As discussed above, coastal regions in the North of Spain and regions in the Pyrenees experience much lower temperatures than the rest of the country. It is therefore not surprising that the effect of having more than 40 days per quarter of maximum temperatures above 30C is not identified through variations from these regions. However, the map shows that variation is still coming from many different parts of the country, with a larger weight on the most Southern regions.

[1] We define degree-days on a daily level over a threshold of 30 degrees Celsius. The degrees-days on a particular day are calculated as the difference between the max. temperature on that day minus the threshold (in our case of 30 degrees). If the difference is negative, the day does not enter the sum. We aggregate by summing all daily degree-days at the quarter level.

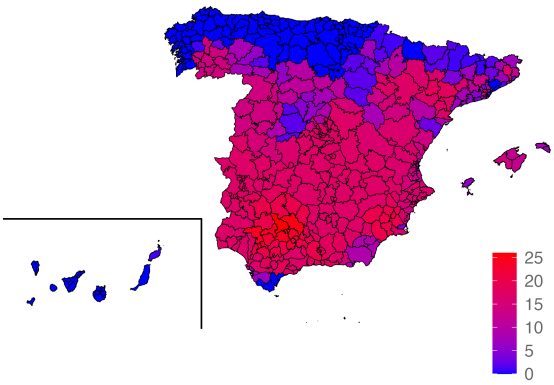
Figure 3: Treatment intensity by region



(a) < 10 days with max. temperature >30C



(b) 10-40 days with max. temperature >30C



(c) >40 days with max. temperature >30C

Notes: Own analysis based on administrative data on the universe of injury reports, offences and cases of IPV in Spain between 2006 and 2022 on the judicial district level.

4. Results

4.1. The effect of extreme heat on IPV incidence

We now move to the findings that we get when estimating the model above but using different measures of extreme temperature as our main explanatory variable of interest. In Table 2, we begin the presentation of our results by estimating Equation 3 imposing a linear relationship between average max. temperature and our main outcome of interest: total IPV offences per

100.000 women. As shown in Columns 1-4, the marginal effect of one additional degree Celsius (from here on referred to as C) in average max. temperatures has no significant effect on the outcome, irrespective of the set of fixed effects and controls that we include in the model. However, the linearity condition imposes that a marginal increase in average max. temperatures should have the same effect on IPV in both cold and hot periods. In order to relax this assumption, we split the sample and estimate the same model but including in the sample only the hot quarters of the year (April to September). As we can see in columns 5-8, one additional degree increases IPV by around one offence per 100.000 women. We interpret this as evidence that misspecifying a liner functional form in our setting might conceal causal effects that only occur after a certain temperature threshold is exceeded.

Table 2: Linear marginal effect of average max. temperature on total offences per 100.000 women

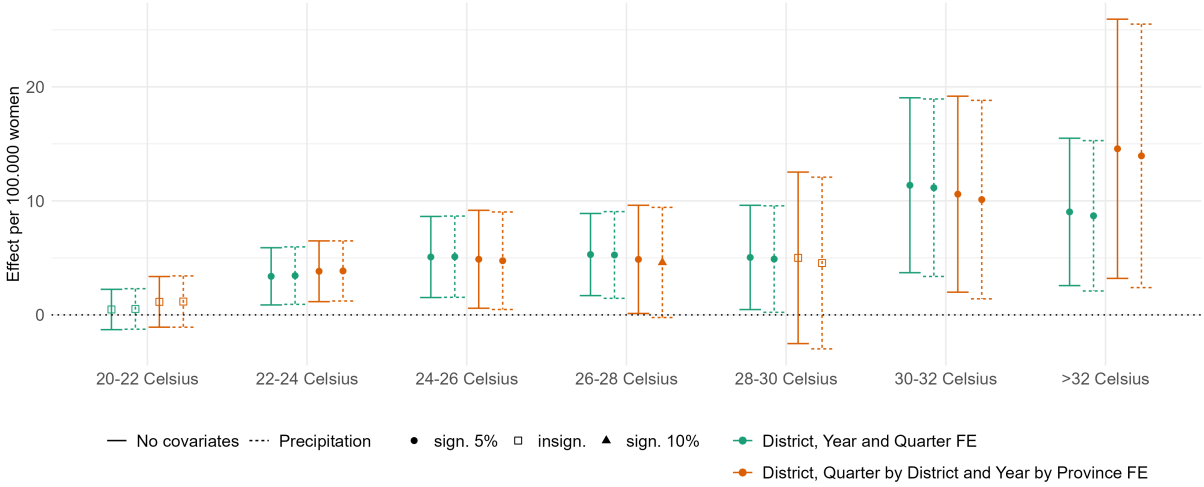
	All year				2nd and 3rd quarters			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	0.000	0.001	-0.030	-0.033	0.965**	1.268***	0.869**	1.100***
	(0.174)	(0.175)	(0.153)	(0.154)	(0.387)	(0.407)	(0.343)	(0.352)
Region FE	X	X	X	X	X	X	X	X
Year FE	X	X	X	X	X	X	X	X
Quarter FE	X	X	X	X	X	X	X	X
Year by Province FE			X	X			X	X
Precipitation control		X		X		X		X
N	24118	24110	24118	24110	12058	12054	12058	12054

Notes: Estimates based on administrative data on the universe of reports, offences and cases of IPV in Spain between 2009 and 2022 on the judicial district level.

To explore further these non-linear effects, as a second step, we expand on the previous specification and discretize average max. temperatures into two-degree bins starting from 20-22C until above 32C (below 20C being the reference category). Figure 4 presents the results on total offences per 100.000 women. The effect of temperature becomes visible at temperatures above 22C but it only becomes sizeable above the 30-degree threshold, beyond which it remains high

and relatively constant. In this Figure, we show the results for two specifications. The red lines include controls for district, year and quarter fixed effects while, in the orange bars, we estimate a more demanding specification in which we include controls for district, quarter by district and year by province fixed effects. As observed in the figure, adding additional fixed effects does not alter the point estimates of our results, although it does slightly increase the standard errors, as expected. In any case, the coefficients remain significant for the same temperature bins than in the less demanding green specification, except for the 28-30 degrees bin.

Figure 4: Non-linear marginal effect of average max. temperature on total offences per 100.000 women



Notes: Estimates based on administrative data on the universe of reports, offences and cases of IPV in Spain between 2009 and 2022 on the judicial district level.

In a final step, we build on the evidence in the previous paragraph to create a series of extreme temperature indicators based on the 30C cutoff. Our main specification includes indicators for having no days above 30C (base category), having up to 10 days, 10-40 days, and more than 40 days. The results are presented in Figure A.5 and Figure 6.

Figure A.5 presents our main results. In panel (a), we see that the number of offences per 100.000 women increases with the number of days above 30C in a quarter. Our most extreme definition of more than 40 days with average max. temperatures over 30C leads to an increase

of around 7 offences per 100.000 women. This implies a 6% increase over our sample mean of 119.6 reports per 100.000 women. Panel (b) presents the results on total IPV cases. Similar to panel (a), more than 40 days with average max. temperatures over 30C imply an increase of around 7 IPV cases per 100,000 women.

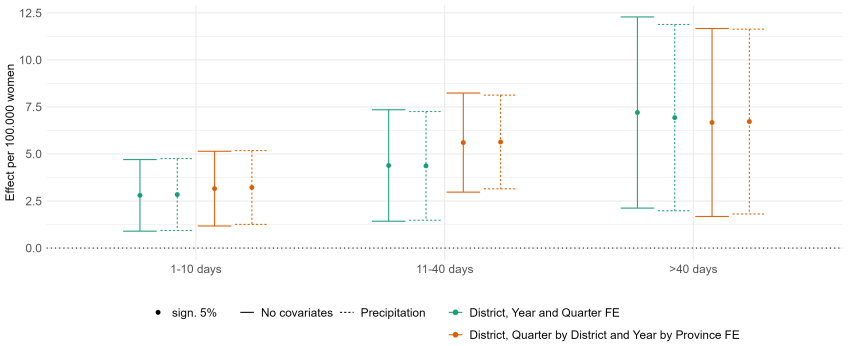
To gain further insights into the composition effects contributing to the observed increase in violence against women during periods of extreme heat, we analyze the number and source of the IPV report. Reports can be initiated by the victim herself (70% of reports in Spain), by the police if they are present at the time of the abuse (15%), by healthcare professionals—such as doctors, nurses, or emergency department workers—who are legally obliged to issue an injury report if they observe evidence of violence (12% of reports), or by family, friends, or third parties, including neighbors or bystanders (3% of reports). In cases where an IPV report is initiated through an injury report, the level of violence is likely to be more severe, as physical injuries inflicted by the perpetrator are present. We use injury reports as a proxy for the severity of IPV to explore any changes in the composition of reports when temperatures rise. In Panel (c), we present the point estimate from the same baseline model, focusing exclusively on IPV reports initiated by the healthcare sector. We estimate an increase of approximately one report (0.7-1.4 depending on the fixed-effect specification) in quarters with more than 40 days of maximum temperatures exceeding 30°C. This represents a substantial 11% increase over the sample mean of 8.7 injury reports per 100,000 women.

These findings suggest that the observed effects are not solely driven by increased reporting behavior; they also reflect a genuine rise in the underlying severity of violence. Since healthcare professionals are obligated to report IPV cases through injury reports, the likelihood of underreporting during extreme heat is very low.

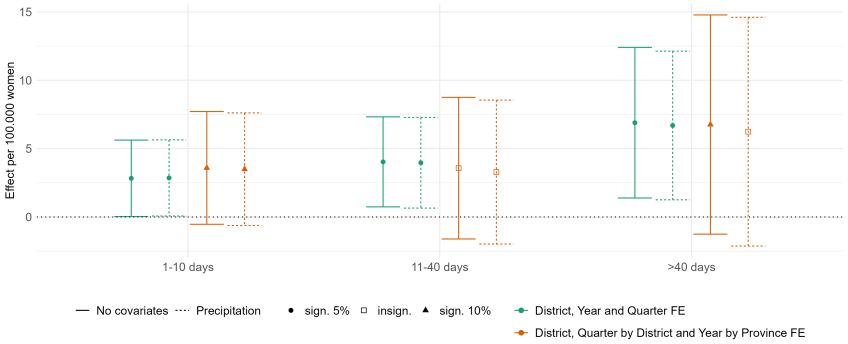
Finally, we check for heterogeneity along the nationality dimension. In Figure 6 we estimate the same baseline model according to the nationality status of the victim. Unfortunately, the judicial system only started reporting the number of IPV cases in 2016 and disaggregating the

number of cases by nationality in 2017, so that the underlying years for these results are restricted to this shorter time period. As discussed in Section 2, the number of IPV cases with a Spanish victim (95.8 per 100.000 women) is also considerably higher than for victims of other nationalities (37.7 per 100.000 women). However, the impact of heat seems to be stronger for cases involving a foreign victim (6 additional victims per 100.000 women on quarters with more than 40 days above 30C). This would represent a sizeable 20% increase over the sample mean, whereas the analogous effect for victims of Spanish nationality implies a 4% increase (not statistically significant). We argue that this is related to socio-economic differences between those two groups. Inhabitants without Spanish nationality might be more likely to belong to a low-income family, which has been proven to be associated with e.g. a higher health impact of heat waves (López-Bueno et al., 2020)

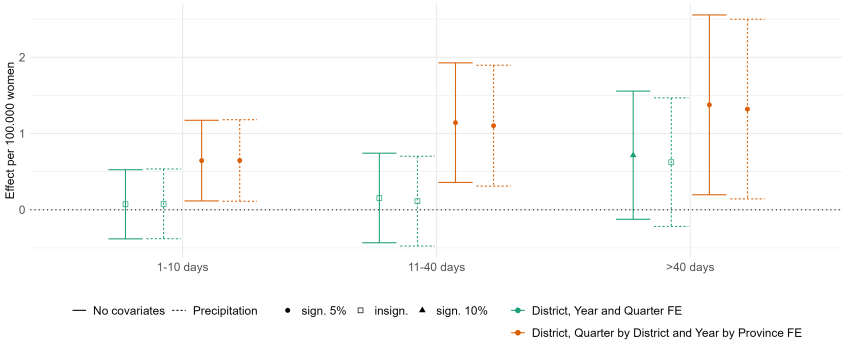
Figure 5: Main results



(a) Total offences



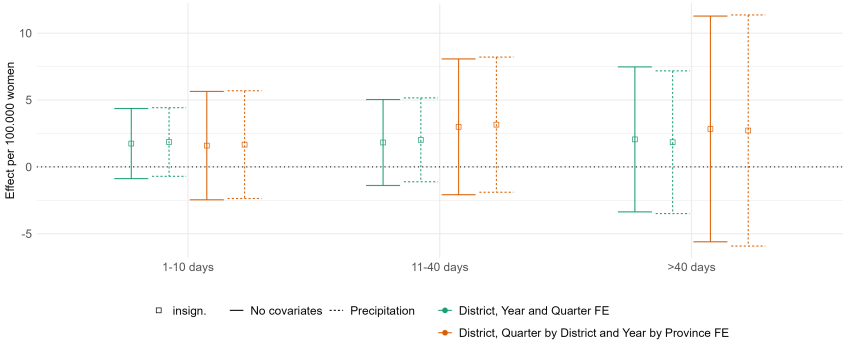
(b) Total cases



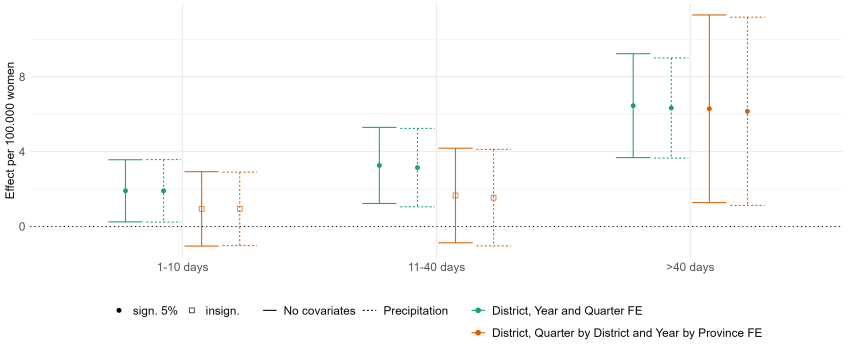
(c) Injury reports

Notes: Estimates based on administrative data on the universe of reports, offences and cases of IPV in Spain between 2009 and 2022 on the judicial district level.

Figure 6: IPV cases: heterogeneity by nationality



(a) Spanish nationals



(b) Foreign nationals

Notes: Estimates based on administrative data on the universe of reports, offences and cases of IPV in Spain between 2016 and 2022 on the judicial district level.

The results presented show a clear and consistent effect of extreme temperatures on a range of IPV outcomes. These effects remain stable across different fixed effects specifications, for different metrics that capture extreme temperatures and different time periods (excluding the years affected by the Covid-19 pandemic) (Tables A.3-A.7). However, we face the challenge that our current identification strategy does not allow us to separate the direct effect of heat on violent behaviour from the indirect effect that might arise if heat leads to an increase in the amount of time spent indoors, which in turn might increase the potential for conflict and a violent reaction by IPV perpetrators.

In order to understand whether our results are only driven by more time spent indoors, we estimate a model similar to Equation 3, where we aim to analyse the impact of another environmental factor, precipitation, that increases time spent indoors, on IPV. If our results are

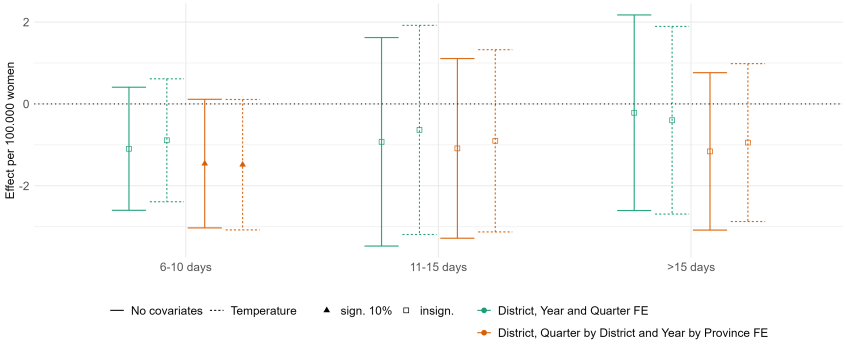
only explained by more time spent indoors when temperatures are high, then we should also observe a similar increase effect of temperatures on IPV. We create indicator bins capturing the number of rainy days[2] per region, quarter and year, based on the following classification: below 5 days (base category) 5-10 days, 10-15 days and above 15 days. Our hypothesis is that, if our main results for temperature are solely driven by changes in the relative importance of indoor vs outdoor time, we should expect to see similar effects for precipitation.

Figure 7 presents our results. The effect of precipitation on total reports (Panel (a)) and total IPV cases (Panel (b)) is always small in magnitude and never statistically significant.

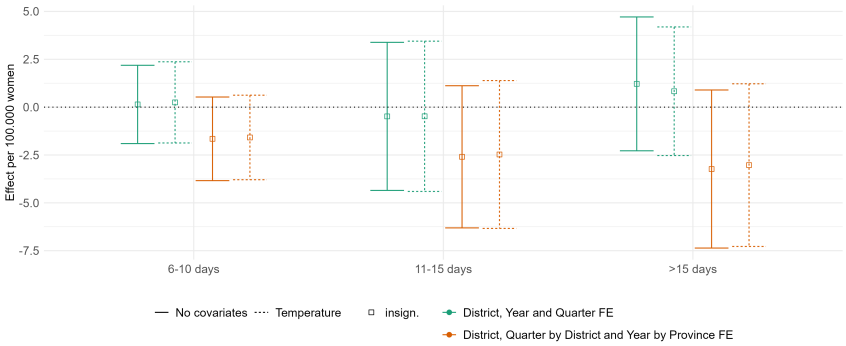
Thus, we interpret these results as providing evidence that the reported causal effects of extreme temperatures on IPV are not predominantly driven by changes in time allocation when temperatures raise.

[2]We define a day as a rainy day if the precipitation recorded is above the 90th percentile in the precipitation distribution. This corresponds to a daily precipitation of more than 4.65 mm.

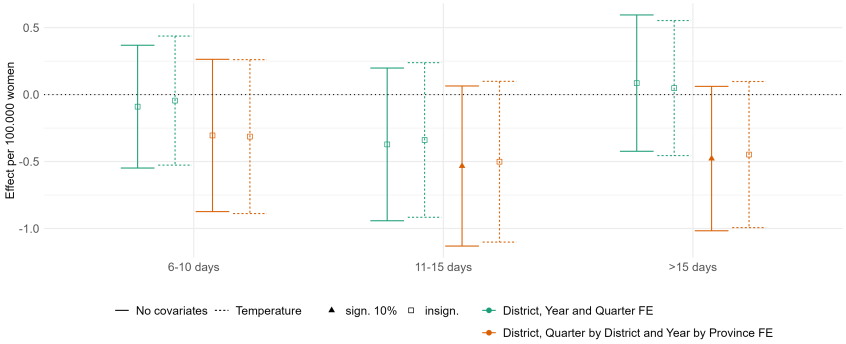
Figure 7: Effect of precipitation on IPV



(a) Total offences



(b) Total cases



(c) Total cases

Notes: Estimates based on administrative data on the universe of reports, offences and cases of IPV in Spain between 2009 and 2022 on the judicial district level.

We corroborate the robustness of our main results by varying (i) the fixed effects included in Equation 3 (Figure A.3), (ii) the treatment definition by calculating indicator bins grouping different numbers of degree-days above 30C (Figure A.6), and (iii) the observation period, eliminating potential biases arising from including the years of the Covid-19 pandemic (Figure ??). Our main results remain robust to all three of these robustness tests.

4.2. The role of labour market shocks

Economic downturns and labor market shocks have been shown to exacerbate stressors within households, which can, in turn, lead to increases in the incidence of IPV (Schneider et al., 2016; Aizer, 2010; Tur-Prats, 2019; Bhalotra et al., 2024). For instance, Schneider et al. (2016) find that job loss and economic instability are significant predictors of increased IPV, as financial strain often heightens household tension and reduces individuals' capacity to cope with external stressors. Moreover, Aizer (2010) provides evidence that IPV is more prevalent in contexts of higher unemployment, particularly among economically vulnerable populations.[3] In this framework, extreme heat may exacerbate the effects of unemployment on IPV by further straining households that are placed in a situation of financial pressure. The combined impact of economic insecurity and heat stress may thus create a compounding effect, leading to more pronounced increases in IPV during periods of high unemployment. Understanding these interactions is crucial for designing effective policy interventions that address both environmental and economic factors in reducing the likelihood of IPV. This backdrop sets the stage for analyzing the interaction effects between heat waves and unemployment shocks on IPV in the subsequent section of this study. We use the financial crisis of 2007/08 as an economic shock leading to surges in unemployment throughout the country. Using municipality-level data on male unemployment, we divide the municipalities into those that experiences a high (66th percentile or higher) increase in unemployment between 2006 and 2013[4] and those with a low (33rd percentile or lower) increase in male unemployment. Figure 8 displays the evolution of both unemployment rates and offences per 100,000 women in these two groups before and after the outbreak of the crisis.

In Figure 9, we show the result of an event study contrasting the differential effect of heat waves (defined as a minimum of 40 days above 30 degrees within a quarteryear, as the highest

[3] However, it is important to note that the literature presents mixed results on the question of how labor market shocks impact IPV. Anderberg et al. (2016) argue that male unemployment may actually decrease IPV. They posit that unemployment can lead to reduced household income and fewer opportunities for spending, which might limit the circumstances in which conflicts escalate into violence.

[4] We choose this time period, because national unemployment in the aftermath of the Financial Crisis reached a peak in 2013.

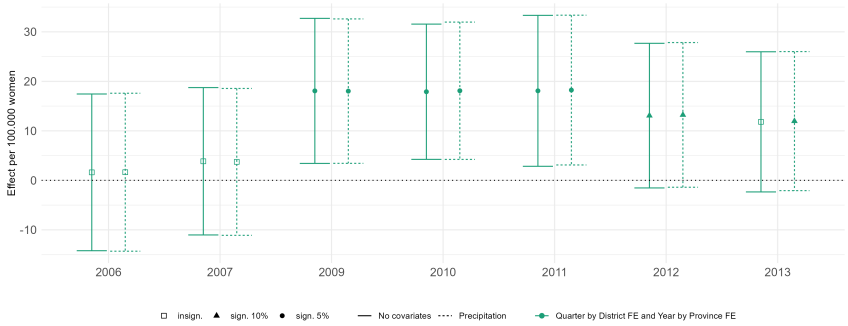
category in our main specification) on total offences per 100,00 women between the high and low unemployment municipalities over time. We observe that while the difference is close to and not statistically different from zero in the pre-crisis years, it is significantly higher (at the 5 percent level) at 18 offences per 10,000 women in high unemployment regions in the three post-crisis years 2009-2011, before it shrinks again to 13 in 2012 and 11 in 2013 (statistically significant at the 10 percent level). We read this finding as evidence that in particularly stressed economic contexts, heat has a particularly strong effect on IPV. This result is also evident from Table A.1, where we use a triple interaction (heat wave x high unemployment region x post-crisis years) to test the hypothesis of a compounding effect of heat and economic stress on IPV. The positive and highly significant coefficient for the triple interaction indicates that the combination of these stressors leads to a substantial increase in IPV.

Figure 8: Top vs. bottom unemployment terciles: Evolution in IPV offences and unemployment 2006-2013



Notes: Own analysis based on administrative data on the universe of injury reports, offences and cases of IPV in Spain between 2006 and 2022 on the judicial district level, and administrative data on male unemployment on the municipality level for the same years.

Figure 9: Top vs. bottom unemployment terciles: Event study



Notes: Own analysis based on administrative data on the universe of injury reports, offences and cases of IPV in Spain between 2006 and 2022 on the judicial district level., and administrative data on male unemployment on the municipality level for the same years.

4.3. Time-use changes

[following soon]

4.4. Climate change impacts: Back-of the envelope calculation

[following soon]

5. Conclusion

Intimate partner violence (IPV) is a widespread and growing issue globally, with rising trends observed in many regions despite the increasing implementation of policies aimed at preventing IPV and protecting victims. Focusing on Spain, the incidence of IPV exhibits seasonal variation, with higher reports during the summer months. While this pattern could be influenced by various factors that change during the summer, our focus in this paper is on one specific contributing factor: extreme temperatures. As climate change intensifies, extreme heat is expected to become more frequent and severe, particularly in Southern Europe. Therefore, understanding the impact of heat on IPV is crucial for anticipating future challenges.

In this study, we estimate the causal effect of high temperatures on IPV, examining its dynamics and exploring potential mechanisms driving this relationship. Utilizing detailed admin-

istrative data spanning from 2006 to 2022, covering over 400 geographical units in Spain, our analysis provides robust evidence of a significant and economically meaningful effect of extreme temperatures on reported IPV cases. Specifically, we find that experiencing more than 40 days with average maximum temperatures exceeding 30 degrees Celsius leads to a substantial 6% increase in IPV reports relative to the sample mean. Additionally, we observe an increase in the severity of violence, as indicated by a rise in injury reports, and a higher likelihood of shared custody breaches.

To ensure that our findings are not primarily driven by increased indoor time during the hottest days, we use detailed precipitation data as an alternative environmental factor that typically increases time spent indoors. Our analysis shows that precipitation has no significant effect on any of our IPV outcome measures, suggesting that the observed relationship between extreme heat and IPV is not simply a result of increased indoor activity.

Our study also uncovers important heterogeneity in the effects of extreme temperatures on IPV. First, the impact is notably stronger among victims of foreign nationality, indicating that vulnerable populations are more severely affected by heat-induced stressors. Second, consistent with existing literature that links employment conditions to IPV, we find that during economic crises, high temperatures have a more pronounced effect on IPV in regions that experience greater job losses and higher increases in unemployment.

These findings underscore the critical interplay between economic vulnerabilities and environmental stressors, highlighting the need for comprehensive policy approaches that address both economic inequalities and climate-related challenges to effectively combat IPV in the context of climate change.

Finally, from a policy perspective, we provide a preliminary estimate of the potential future impact of climate change on IPV. Using our results in conjunction with projections from the environmental literature, we estimate that climate change could lead to an increase of 650-1,300 IPV cases per quarter in Spain in the near future. If our findings are externally valid, this

suggests a substantial rise in violence against women in regions that are more vulnerable to the effects of climate change, emphasizing the urgency of integrating climate resilience into IPV prevention strategies.

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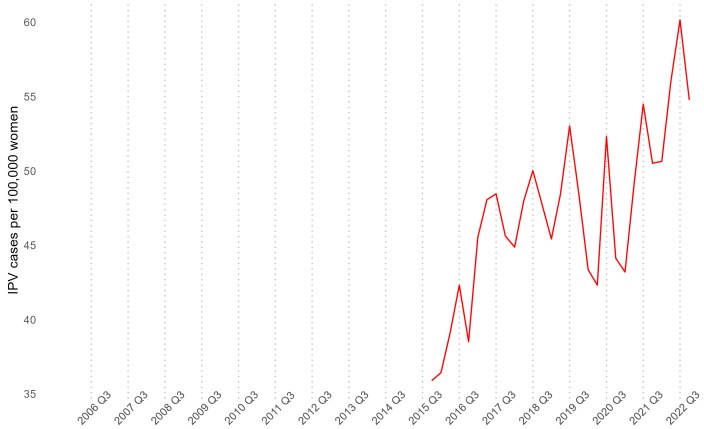
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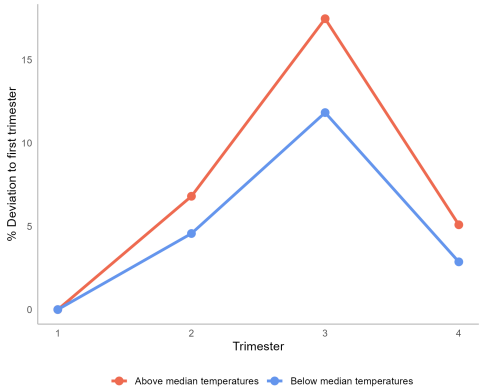
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A. Appendix

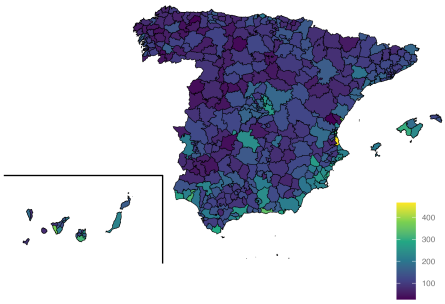
A.1. Descriptive overview of IPV outcomes



(a) Seasonality over time

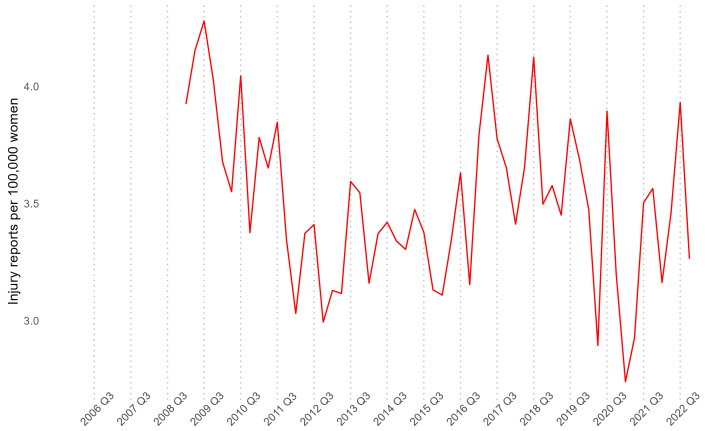


(b) Seasonality by median temperature

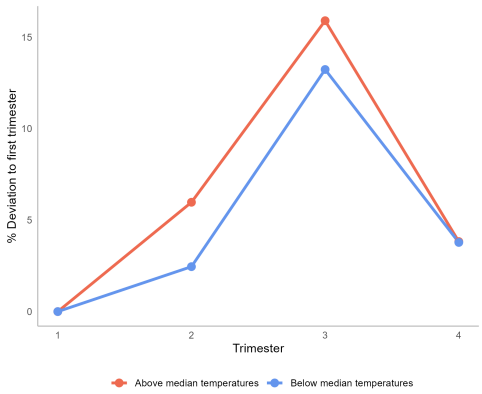


(c) Regional distribution

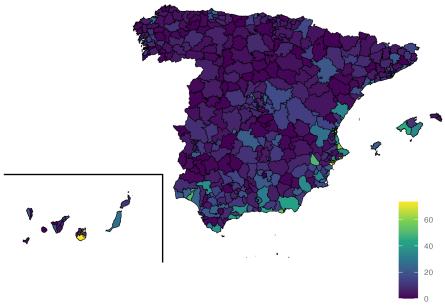
Figure A.1: Descriptive overview of IPV cases per 100.000 women



(a) Seasonality over time



(b) Seasonality by median temperature



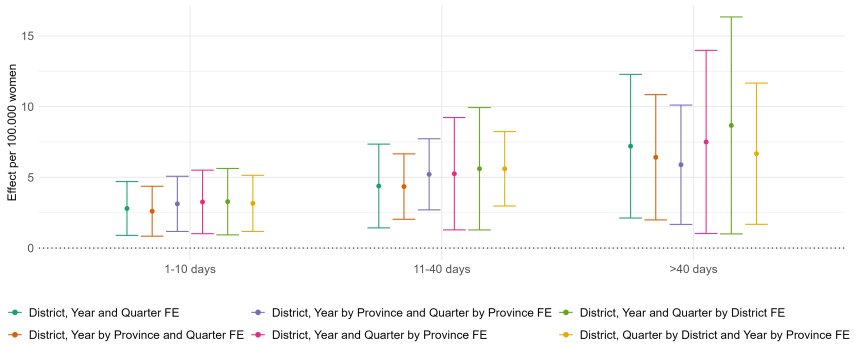
(c) Regional distribution

Figure A.2: Descriptive overview of IPV cases per 100.000 women

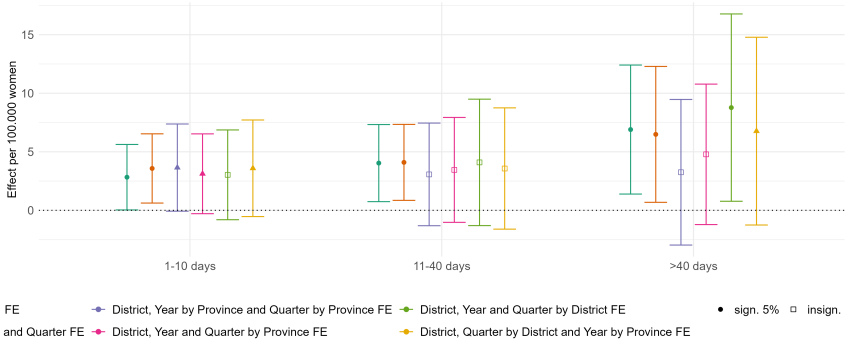
A.2. Results - robustness checks

A.2.1. Alternative fixed effects specifications

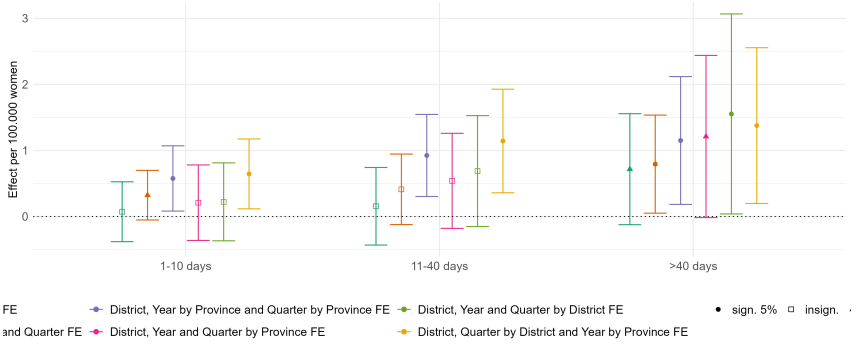
Figure A.3: Main results



(a) Total offences



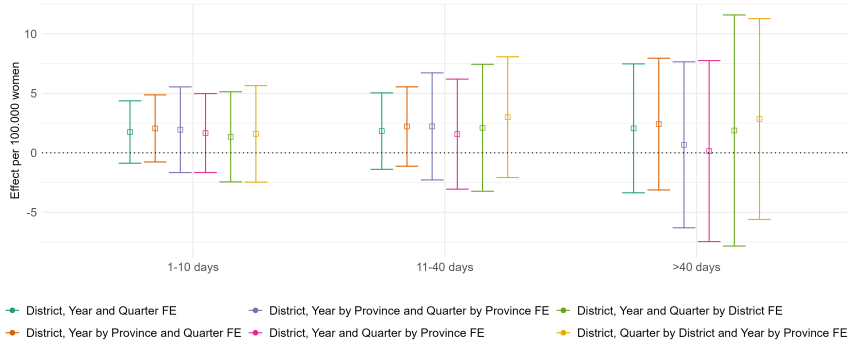
(b) Total cases



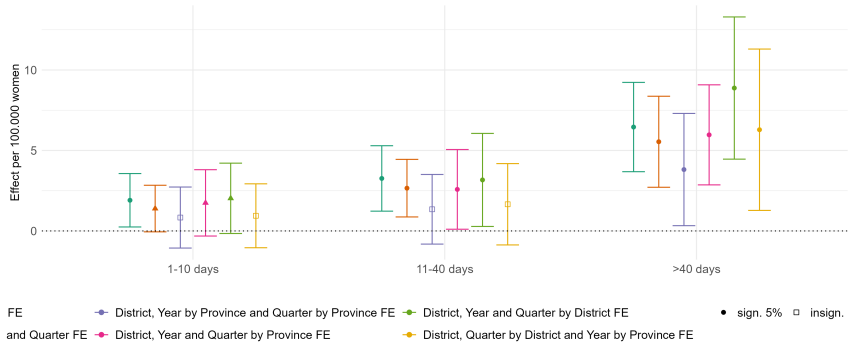
(c) Injury reports

Notes: Own analysis based on administrative data on the universe of injury reports, offences and cases of IPV in Spain between 2006 and 2022 on the judicial district level.

Figure A.4: Heterogeneity by nationality



(a) Spanish nationals

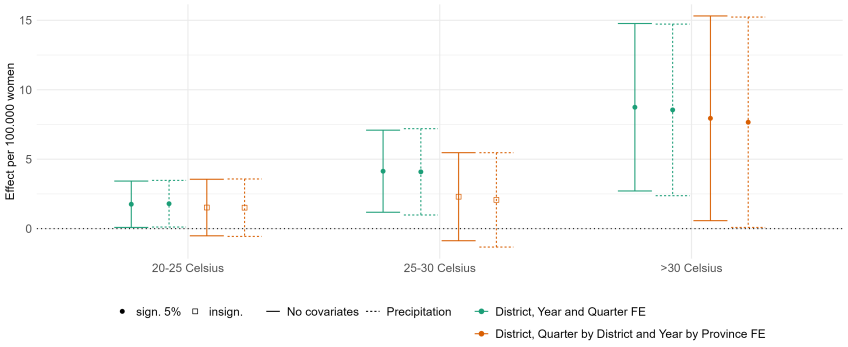


(b) Foreign nationals

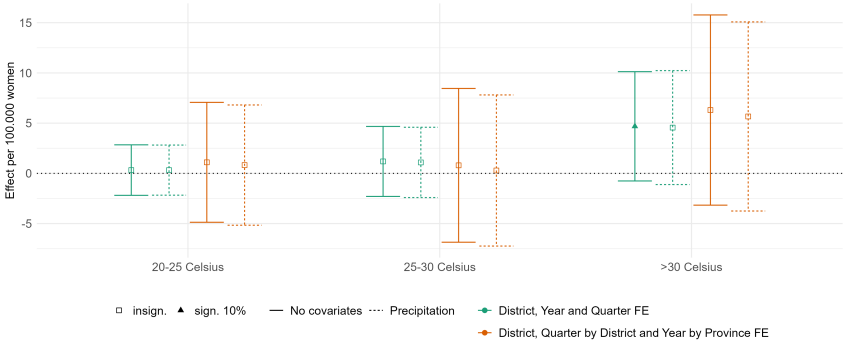
Notes: Own analysis based on administrative data on the universe of injury reports, offences and cases of IPV in Spain between 2006 and 2022 on the judicial district level.

A.2.2. Alternative treatment specifications

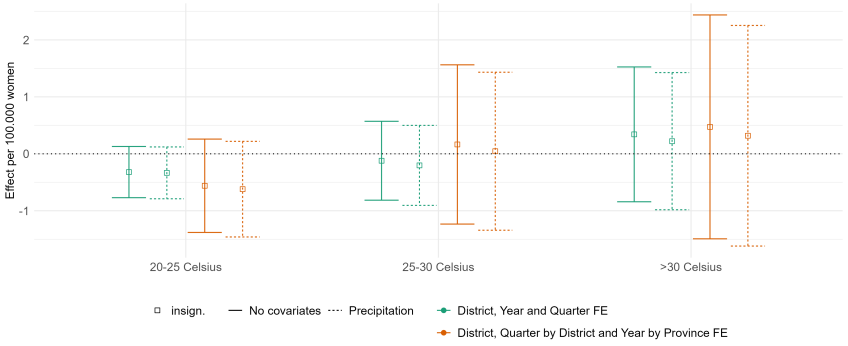
Figure A.5: Main results - average maximum temperature bins



(a) Total offences



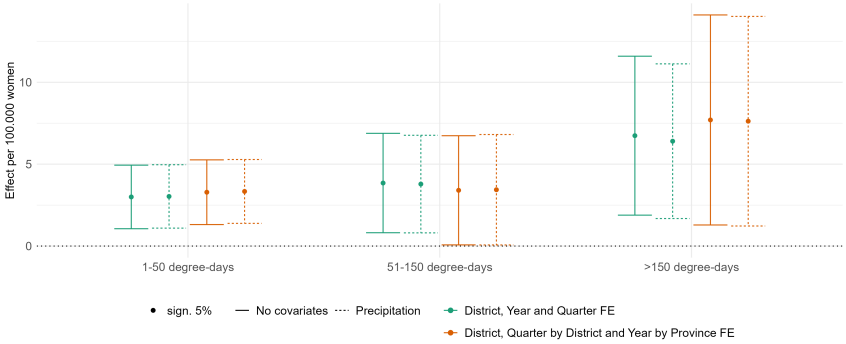
(b) Total cases



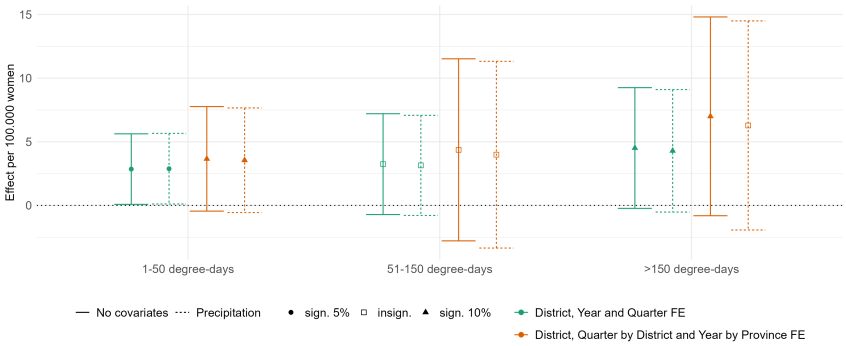
(c) Injury reports

Notes: Estimates based on administrative data on the universe of reports, offences and cases of IPV in Spain between 2009 and 2022 on the judicial district level.

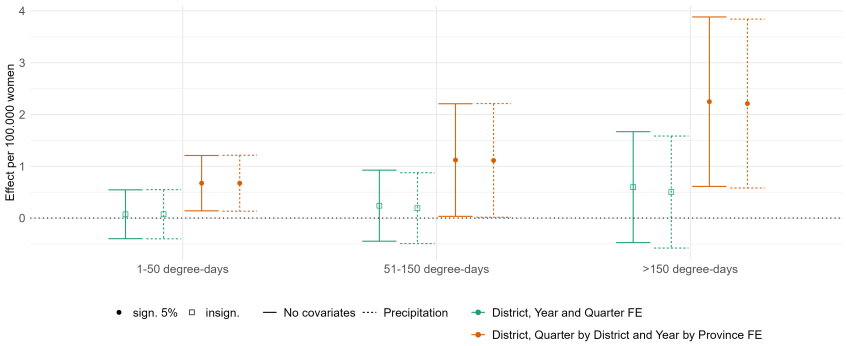
Figure A.6: Main results - degree-days above 30C bins



(a) Total offences



(b) Total cases

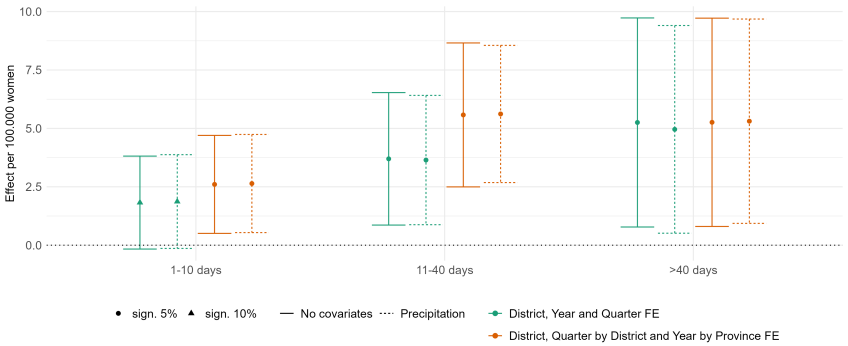


(c) Injury reports

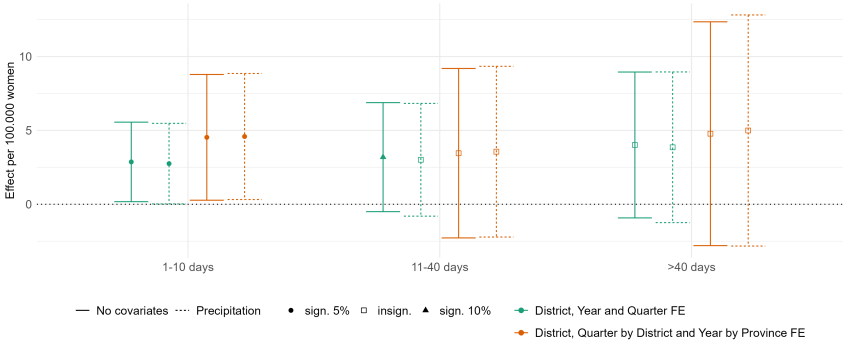
Notes: Own analysis based on administrative data on the universe of injury reports, offences and cases of IPV in Spain between 2006 and 2022 on the judicial district level.

A.2.3. Excluding Covid-19 years

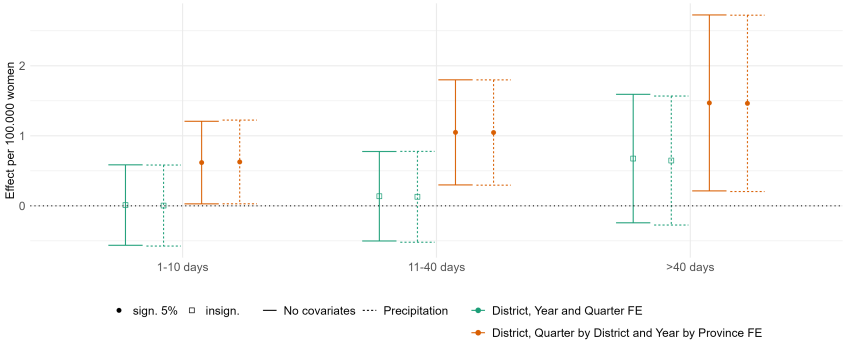
Figure A.7: Main results - excluding Covid years



(a) Total offences



(b) Total cases



(c) Injury reports

Notes: Own analysis based on administrative data on the universe of injury reports, offences and cases of IPV in Spain between 2006 and 2022 on the judicial district level.

	(1)	(2)
1-10 days above 30C	4.131	4.058
	(2.596)	(2.636)
>10 days above 30C	14.203***	14.164***
	(3.718)	(3.724)
1-10 days above 30C X crisis	-1.161	-0.924
	(2.485)	(2.506)
>10 days above 30C X crisis	-6.858**	-6.594**
	(2.789)	(2.886)
1-10 days above 30C X high UR increase	6.147	6.156
	(4.957)	(4.928)
>10 days above 30C X high UR increase	-12.944*	-12.998*
	(6.958)	(6.933)
High UR increase X crisis	-5.978	-6.035
	(6.402)	(6.404)
1-10 days above 30C X high UR increase X crisis	-5.446	-5.370
	(4.658)	(4.647)
>10 days above 30C X high UR increase X crisis	14.434***	14.556***
	(4.975)	(4.956)
District FE	X	X
Province by Year FE	X	X
Quarter by District FE	X	X
Weather controls		X
N	13353	13353

Table A.1: Interaction effects of heat and unemployment shocks on IPV

A.3. Labour market shocks