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Suffering and prejudice: Do negative emotions predict immigration concerns?

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Abstract:

Despite being a regular suspect, a causal role of residents' *emotions* in predicting their opposition to international immigration has not been investigated. Using the individual-level panel data from Germany, we study the impact of the individual's experience of negative emotions (sadness, fear, and anger) on immigration concerns and bridge this gap in the literature. After controlling for person fixed effects and a battery of individual-level and macroeconomic controls, we find that negative emotions are statistically and significantly associated with the respondent's immigration concerns. The association holds for male as well as female respondents. To estimate the causal effects of negative emotions, we exploit the exogenous variation in negative emotions induced by the death of a parent or the change in averages of daily temperature and employ IV fixed effects regressions. Our findings suggest that, while within-person changes in the respondent's feelings of anger affect immigration concerns among all respondents, the feelings of sadness and fear affect immigration concerns only among females. The impact of sadness and fear is more forceful among females who are not always-working during the sample period, older in age, and rarely use online social media.

Keywords: Emotions, negative emotions, immigration concerns, public policy

JEL Classification: D91, F22, J18

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1 Introduction

Increasingly, economists highlight that an individual’s emotions form a pertinent predictor of her various behaviors and decisions. For example, Meier (2019) shows that within-person changes in the frequency of feeling the emotions of happiness, anger, and fear significantly affect the respondent’s economic preferences, measured in her risk attitudes and time preference. Others show that changes in emotions can predict election outcomes (Meier et al., 2019), increase the risk of domestic violence (Card & Dahl, 2011), and affect income later in life (De Neve & Oswald, 2012). Despite being a regular suspect, a causal role of the respondent’s emotions in predicting her immigration concerns has not been investigated. To bridge this gap in research, we use detailed German panel data and ask whether negative emotions play an independent causal role in determining the respondent’s immigration concerns.¹

In many Western democracies, concerns about international immigration are on the rise, and the *political equilibrium* has shifted towards the anti-immigration far-right politics (e.g., Trump’s electoral victory, Brexit referendum). Natives’ hostile attitudes towards immigration, not only affect immigrants’ wellbeing (Knabe et al., 2013), but can also increase labor market discrimination against immigrants, affecting their integration to host culture (Constant et al., 2009) and ultimately reducing further immigration to the country (Gorinas & Pytliková, 2017). In response, vast research has been devoted to understanding what explains the citizen’s immigration concerns. A huge portion of this research consists of correlation studies and lists numerous individual-level covariates of immigration concerns.² Accordingly, the respondent’s education (Hainmueller & Hiscox, 2007; Mayda, 2006; Scheve & Slaughter, 2001), her experience of the domestic labor market (Ortega & Polavieja, 2012), and inter-group contact (Enos, 2014; Janmaat, 2014; Laurence & Bentley, 2016) are shown to be crucial considerations. Beyond observable characteristics, new research shows that many subjective indicators, such as the individual’s nationalistic feelings (Jeong, 2013), personality traits (Gallego & Pardos-Prado, 2014), and the feeling of disappointment about their own achievements in life (Poutvaara & Steinhardt, 2018), are also associated with immigration concerns.

A less prominent, yet emerging strand of this research performs causal investigations. Authors find that the exogenous increases in the respondent’s education (Cavaille & Marshall, 2019; d’Hombres & Nunziata, 2016; Finseraas et al., 2018), and subjecting respondents to refugee inflows (Deole & Huang,

¹In baseline specifications, we only consider negative emotions as their impact on behaviors is straightforward compared to the more complicated effects that positive emotions have. See Loewenstein (2000, p. 426) for more discussion. In subsection 4.3, we also investigate the impact of positive emotions on the respondent’s immigration concerns.

²Numerous macro-level correlates are also shown to be crucial. The research finds that the country’s immigration share of the population (Davis & Deole, 2020), GDP per capita (Mayda, 2006), and unemployment rate (Wilkes et al., 2008) are correlated with citizens’ immigration concerns.

2020; Hangartner et al., 2019; Sola, 2018) impact their immigration concerns. Others show that the media coverage of migration topics (Benesch et al., 2019) and Islamist terror attacks (Finseraas et al., 2011; Schüller, 2015) also induce anti-immigration views. We contribute to this strand by introducing a novel determinant of the citizen’s immigration concerns, i.e., negative emotions.

The empirical analysis performed here uses the German Socio-Economic Panel (SOEP, 1984-2018, v35) data. While immigration concerns are included in most survey waves, an advantageous feature of the SOEP is that it records the respondent’s negative emotions annually since 2007. In particular, SOEP asks respondents to self-report their following three negative emotions: her self-reported frequency of experiencing sadness, fear, and anger in the last four weeks. Figure 1 shows the association between the respondent’s negative emotions and immigration concerns. In particular, the mean of respondents’ immigration concerns is shown for different frequencies of negative emotions felt in the last four weeks. We observe that the respondents who frequently (very rarely) felt negative emotions also reported being very (not at all) concerned about immigration. The formal empirical analysis performed in this paper finds supporting evidence for this observation. We find a positive and statistically significant association between the respondent’s negative emotions and her immigration concerns. The positive relationship holds for male and female respondents and is robust to the inclusion of numerous individual and regional characteristics and person fixed effects.

Due to the subjective nature of the variables of interest, we suspect that the relationship between negative emotions and immigration concerns is endogenous for the following reasons. First, the within-person variation in negative emotions may be correlated with unobservable factors that are also associated with changes in that person’s immigration concerns. Second, the respondent’s extreme anti-immigration views may reversely induce a high frequency of negative emotions. To address the problem of endogeneity and to identify the causal impact of respondent’s negative emotions on her immigration concerns, we exploit the exogenous source of variation in sadness and fear induced by the death of the respondent’s parent. Using the IV fixed effects strategy, we show that sadness and fear have a statistically significant and positive effect on immigration concerns, especially among female respondents. The effect heterogeneity analysis finds that the effect is stronger among females who are not always-working during the sample period, older in age, and rarely use online social media. For the endogenous negative emotion anger, we apply the *average temperature of the last two weeks* as the instrument variable (IV) and find that the respondent’s experience of anger affects all respondents’ immigration concerns. We test the robustness of our main findings and discuss their policy implications.

2 Data and variables

Our empirical investigation employs the high-quality SOEP data, which is a wide-ranging representative panel dataset of private households in Germany.³ While the respondent’s immigration concerns are regularly included, information on her negative emotions has been available annually since the year 2007 onward. Consequently, the sample period is restricted to the years between 2007 and 2018. The final sample consists of information on 242,582 individual-year observations, including 129,786 female and 112,796 male observations.

Negative emotions and immigration concerns

The outcome variable of interest records the respondents’ immigration concerns. The SOEP question asks “*How concerned are you about the immigration to Germany?*” The individual responses to this question vary as 1 (very concerned), 2 (somewhat concerned), and 3 (not concerned at all). We rescale these responses to generate our outcome variable, *immigration concerns*, which ranges from 1 - *not concerned at all* to 3 - *very concerned*, where higher values represent heightened concerns about immigration. Table 1 reports the summary statistics. Beyond overall sample means and standard deviations, columns (3)-(6) separately report information on female and male respondents in the sample. From the table, we observe that, on average, German respondents are concerned about immigration to Germany as indicated by the mean value of around 2 (*somewhat concerned*). The difference between females and males is minor in magnitude, but statistically significant.

The explanatory variables of interest are the respondents’ three distinct negative emotions: sadness, fear and anger. Individuals respond to the following survey question: “*I will now read off a number of feelings. For each one, please state how often you experienced this feeling in the last four weeks. How often have you felt angry/fearful/sad?*”. Their answers range from 1 (*very rarely*) to 5 (*very often*). The descriptive statistics presented in Table 1 show that German respondents, on average, report to negative emotions between 2 (*rarely*) and 3 (*occasionally*) as indicated by the mean value. Female respondents fair higher on all negative emotions than male respondents.

Other covariates

The choice of control variables needs careful attention. The first set of control variables includes the respondent’s demographic characteristics that form pertinent determinants of the individual’s immigration concerns and may also be correlated with her negative emotions. These variables include the respondent’s

³For more information on the SOEP data, see Goebel et al. (2019).

age (in years), gender (female/male), regional location (rural/urban), and marital status (married/not-married). After that, we refer to the existing research to justify the choice of the remainder of the control variables. Researchers demonstrate that the respondent’s education and occupational skills are important controls (*see* Hainmueller & Hiscox, 2007). They find that respondents with higher education levels and those working in higher occupational skills support all types of immigration. In response, we control for the respondent’s education level (years of schooling) and years of working experience. We also control for the respondent’s labor force status, as represented by 11 dummy variables, indicating whether the respondent is *working*, *working but not working past 7 days*, *unemployed*, *non-working*, or in seven other detailed categories of non-working respondents, e.g., the respondents *aged 65 and older*, on *maternity leave*, serving in the *military-community*. Table 1 reports the summary statistics of these variables. Accordingly, around 60% of the observations are working, whereas 4% are unemployed. Around 20% of the observations are non-working because they are 65 or older, which indicates that our sample also includes individuals retired from service.

Moreover, the existing research notes several macroeconomic indicators associated with respondents’ immigration concerns. In particular, the host country’s economic conditions are shown to be associated with citizens’ views of international immigration.⁴ For example, Mayda (2006) uses the host country’s GDP per capita as an indirect measure of the skill composition of natives relative to immigrants and finds that the richer the host country is, the more positive the effect of schooling on pro-immigration attitudes. Wilkes et al. (2008) find that the increases in the country’s unemployment rate induce citizens to want less immigration. Therefore, we include state-level information such as the logarithm of GDP per capita and unemployment rates as controls representing the state’s economic condition. Sola (2018) and Deole & Huang (2020) show that the 2015 refugee crisis, which brought a huge number of asylum seekers to Germany, increased all German residents’ immigration concerns. Therefore, we include the state-level growth rate of the foreign-born population to the model. The aforementioned state-level indicators are sourced from *Federal Statistical Office* of Germany.

⁴Davis & Deole (2020) show that the country’s macroeconomic characteristics, such as log GDP per capita and unemployment rate, mediate the salient association between the country’s population share of immigrants and citizens’ economic concerns over immigration.

3 Empirical strategy

3.1 Fixed effects model

To study the association between the respondent’s negative emotions and her immigration concerns, we first present the simple ordinary least square (OLS) estimates. After that, a significant portion of the empirical analysis is devoted to giving special attention to the subjective nature of the variables of interest, i.e., the respondent’s negative emotions and immigration concerns. It is possible that individuals, who frequently experience negative emotions, may also report heightened immigration concerns (across-individual correlation), underlining the relevance of person fixed effects for the analysis. Therefore, we estimate variants of the following fixed effects model:

$$Y_{ist} = \beta_0 + \beta_1 emotion_{ist} + \mathbf{X}_{ist}' \beta_2 + \mathbf{Z}_{st}' \beta_3 + \lambda_i + \lambda_s + \lambda_m + \lambda_t + \varepsilon_{ist}, \quad (1)$$

where Y_{ist} is immigration concerns individual i living in state s interviewed in year t . $emotion_{ist}$ represents the self-reported frequency of feeling negative emotions, i.e., sadness, fear, and anger of individual i in the last four weeks (before the interview day). \mathbf{X}_{ist} is a vector of individual-level characteristics. These include age and its quadratic and cubic terms, living in the urban region, being married, years of education and working experience with their quadratic terms, and dummy variables for different labor force status. \mathbf{Z}_{st} is a vector of annual state-level characteristics, including growth rates of foreigners, the logarithm of GDP per capita, and unemployment rates. λ_i indicates person fixed effects that control for level differences in immigration concerns between respondents due to individual-specific time-invariant factors. The term λ_s represents a set of dummy variables indicating state fixed effects, which control for state-level differences in time-invariant (un)observable factors influencing the outcome. The month fixed effects, λ_m , are a set of dummy variables for the twelve calendar months, controlling for the possibility that respondents recorded systematically different answers in immigration concerns and negative emotions in different months. For instance, individuals may report lower concerns as well as negative emotions during holidays. λ_t is a set of year dummy variables that control for the average change in immigration concerns and their influencing factors over time. ε_{ist} is the error term. We cluster standard errors at the individual level.

It is plausible that the relationship between negative emotions and immigration concerns is not uniform across pertinent individual characteristics. For example, Hatton (2017) demonstrates that men are slightly more likely to express immigration concerns than women. As Table 1 demonstrates, female respondents report higher levels of negative emotions than males. Consequently, we show baseline estimates separately

for male and female respondents.

3.2 Fixed effects model with instrumental variables

Next, we estimate the causal effect of negative emotions on immigration concerns. We suspect many sources of endogeneity that can bias the estimates presented in equation (1). First, although the estimated model accounts for person fixed effects that control for time-invariant individual-specific factors, time-variant unobservable variables contained in ε_{ist} can influence both immigration concerns and negative emotions and bias our estimates. For example, the respondent's degree of experience with foreigners in her daily life may be correlated with her negative emotions and immigration concerns. Individuals' contact with immigrants, especially refugees, may induce negative emotions after hearing their plight and reduce their general concerns about immigration, depicting a negative bias to the estimates. In contrast, excessive media coverage of the crimes committed by immigrants may increase individuals' frequency of negative emotions, especially fear and anger, and also increase their immigration concerns, positively biasing the estimates in the fixed effects model.

Second, individuals intensely concerned about immigration may show increased levels of negative emotions, i.e., reverse causality. To overcome the issue of endogeneity, we implement the instrumental variables strategy. We exploit the exogenous variation in negative emotions induced by instrumental variables and estimate the following first stage regression:

$$emotion_{ist} = \alpha_0 + \alpha_1 IV_{ist} + \mathbf{X}'_{ist} \boldsymbol{\alpha}_2 + \mathbf{Z}'_{st} \boldsymbol{\alpha}_3 + \lambda_i + \lambda_s + \lambda_m + \lambda_t + \mu_{ist}, \quad (2)$$

where IV_{ist} is the instrumental variable. From the first stage, we obtain the predicted negative emotions (denoted as $\widehat{emotion}_{ist}$), which we substitute in equation (1) and estimate the second stage equation.

Now, we motivate the choice of our instrumental variables.

Death of a parent

The death of a relative is shown to instigate negative emotional responses in respondents (Liberini et al., 2017; Persson & Rossin-Slater, 2018; Meier, 2019). Using the detailed information recording the exact time of the death of the respondent's parents (calendar month and year) present in the SOEP, we exploit the exogenous variation induced by the event of death as an instrumental variable for the endogenous negative emotions.⁵ These SOEP variables record if any of the respondent's parents died in the year of the

⁵For supporting arguments for the exclusion restriction assumption, see Meier (2019, p.29)

interview or one year before. Using this information, we construct a dummy variable $death_{ist}$, indicating whether any one of the parents of individual i living in state s died in the year of the interview or one year before. The variation in $death_{ist}$ is across time and individual. Table 1 provides the summary statistics of the instrumental variable. It is worth noting that both male and female respondents report similar mean values of the newly created variable.

Next, we discuss the validity of the instrumental variable. First, based on first stage relationships shown in Table A-2 in the online appendix, we find that the death of a parent increases the frequency of feeling sad and fearful in the last four weeks. The frequency of feeling angry is, however, unaffected by the parent’s death, a finding similar to Meier (2019). Therefore, we restrict the use of the variable $death_{ist}$ as an IV only for the feelings of sadness and fear. In the next paragraph, we explore the usage of a distinct IV for the endogenous variable anger.

Second, as the parent’s death can affect immigration concerns through both the channels of sadness and fear, the exclusion restriction assumption is violated if we separately estimate the effect of sadness and fear on immigration concerns. To address this issue, following Meier (2019), we generate an aggregate measure of negative emotions, which we hereafter refer to as $sadness_fear$. This new variable is equal to $sadness \times 4 + fear$, where the multiplication factor 4 represents that the first stage coefficient (and t value) for $sadness$ is more than four times larger than for $fear$.⁶ With this innovation, we assume that the shock of the parent’s death affects respondents’ immigration concerns only through the channel of $sadness_fear$.

Another assumption in the IV analysis requires the exogeneity of the IV. The death of a parent is not precisely predictable, indicating that the timing of death can be exogenous. However, the parent’s health likely begins to worsen much before the event of death, questioning its unpredictability. We test the vulnerability of our results to this possibility in subsection 4.3. Finally, the first stage F statistics are well above 10, supporting the relevance assumption of the IV.

Weather indexes

For the endogenous regressor $anger$, we employ a new IV. We exploit the fact that the SOEP interviews are randomly completed throughout the year. We use weather information associated with the interview day as the exogenous source of variation for the endogenous regressor. By assuming that the effect of weather on individuals’ immigration concerns works only through the respondents frequently feeling angry,

⁶Our results are robust to the usage of $sadness \times n + fear$ (with $n = 5, 6, 7, 8$). The results are available upon request.

we propose the average temperature as the new IV.⁷ The information on the daily average temperature originates from the German Meteorological Service (*Deutscher Wetterdienst*). The dataset records weather information in more than 1,000 weather stations located all across Germany. We aggregate these averages on the 96 German spatial planning regions (*Raumordnungsregion*, or ROR) and construct a continuous variable $temperature_{rt}$ for the planning region r in which the respondent lived in year t .⁸ Table 1 presents descriptive statistics of the newly generated continuous variables. Based on the first stage F statistics, the baseline specification considers the average temperature in the ROR in the last two weeks as the IV.⁹ The F statistics are above 10 for the overall sample, slightly above 10 for the male sample and below 10 for the female sample. A reason for inconsistent support of the relevance assumption could be that controlling for month fixed effects, year fixed effects, and state fixed effects leads to a small variation in weather indexes, which also suggests that a large sample of observations may be necessary when weather indexes are used as IVs.

4 Results and discussion

4.1 Baseline results

Table 2 begins the empirical analysis by establishing the association between an individual’s negative emotions and immigration concerns. The organization of the table is as follows. While columns (1)-(3) report the estimates of the OLS regressions, columns (4)-(6) report the estimates of the fixed effects model. Columns (1) and (4) show the results for the overall sample, whereas columns (2)-(3) and (5)-(6) present separate estimates for male and female respondents. A broad reading of the results suggests that the respondents’ negative emotions are positively associated with their immigration concerns in all specifications. Panels A and B present this association for the respondent’s frequency of feeling sadness and fear and find supporting evidence of the positive association with immigration concerns. Panel C reports that the positive association also holds for the aggregate measure of negative emotions *sadness_fear*, as noted in section 3. Panel D shows that a positive and statistically significant association is also present for the respondent’s frequency of feeling angry. From a simple comparison of coefficients of OLS and fixed

⁷The baseline specification also controls for the average humidity in the last two weeks as a further covariate in both first and second stage. Schinasi & Hamra (2017) show that crime rates are correlated with the mean daily heat index, a metric that combines temperature and dew point. Their findings suggest that both temperature and humidity are important influencing factors for aggression. Following their strategy, we identify the impact of the average temperature on the frequency of anger by controlling for the average humidity.

⁸For more information on the generation of weather variables, see online appendix B.

⁹For robustness, we implement several measures of average temperatures, i.e. average temperature in the last week, last three weeks, and last four weeks. The results are presented in columns (10)-(12) of Table A-2 in the online appendix.

effects estimates, we conclude that person fixed effects explain much of the positive association between negative emotions and immigration concerns, and form necessary controls. Also, the positive association does not differ too much across male and female respondents.¹⁰

Table 3 presents the results of the IV fixed effects estimation. With reference to the discussion in subsection 3.2, columns (1)-(3) show the estimates for the endogenous regressor, *sadness_fear*. In columns (4)-(6), we consider the respondent’s frequency of feeling angry. The first stage holds for the overall sample and female/male subgroup analysis for the *sadness_fear* measure. Also, we note that the first stage association is more pronounced for females than for males. For females, experiencing the death of a parent leads to more negative emotions by 1.622 points. The F -statistics for the first stage are also comfortably above 10, supporting the instrumental variable’s validity. The second stage results find that an increase in the frequency of negative emotions does not induce a statistically significant increase in immigration concerns for the entire sample. The results of the subgroup analysis show that negative emotions statistically and significantly increase immigration concerns among females, but not for males. In terms of magnitude, the increase in female respondent’s immigration concerns is equivalent to an increase of 0.021 ($= 1.622 \times 0.013$) points, which is about 1% of the sample mean. It is noteworthy that the magnitude of the estimates presented here is larger than the one in Table 2, which suggests a negative bias of the estimates in the fixed effects model. The story of refugees’ plight, discussed in Section 3.2, provides one argument for the larger magnitude of coefficients in the IV fixed effects model.

Next, we discuss the results for the endogenous regressor anger. In the first stage, we find a statistically significant and positive effect of the average temperature on the frequency of anger for the overall sample and male/female subsamples. In terms of magnitudes, an increase in the average temperature by 10° Celcius degrees leads to a higher frequency of anger by 0.03 points. The second stage results in column (4) suggest that the feeling of anger raises individuals’ immigration concerns by 0.012 ($= 0.03 \times 0.407$) points, about 0.6% of the mean value. The second stage results for subsample analyses indicate no statistically significant effects.

¹⁰Instead of using a linear model, we also estimated the baseline association in a non-linear model. We generated a new dummy outcome variable for immigration concerns. The variable takes the value of 1 if the respondent is *somewhat concerned* or *very concerned* about immigration, and 0 if *not concerned at all*. Since the probit model cannot control for person fixed effects, following Mundlak (1978), we additionally controlled for the within-person mean value of all continuous independent variables. Panels (A) and (B) of Table A-1 in the online appendix show the marginal effect of *sadness_fear* and *anger* on the likelihood of being concerned about immigration. All results are qualitatively similar to our main findings.

4.2 Effect heterogeneity

This subsection investigates the effect heterogeneity across the respondent’s labor market status, age cohorts, and the frequency of social media usage. The estimates are presented for the female sample only. Since the first stage results for anger are not as sturdy (low F -statistics) for subsample investigations, we present the heterogeneous effects only for *sadness_fear* as a measure of negative emotions. The results are shown in Table 4.

Labor force status

The respondents’ labor market status is crucial for their view of international immigration.¹¹ We test whether the effect of negative emotions on immigration concerns are distinct among respondents with irregular and regular labor force status. To test this, we divide the sample into the respondents who were “always-working” and “not always-working” for all the years. Column (1) of Table 4 shows the results for female respondents who were *always-working*, whereas column (2) studies those who were *not-always-working*. Although the mean values of the outcome variable for both types of respondents are comparable, the effects of negative emotions on immigration concerns are distinct. The always-working females show no statistically significant effect of negative emotions on immigration concerns. However, we find a statistically significant and positive effect for females who reported to be not-always-working. These results point towards the possibility that working female respondents handle grief better than non-working females and that negative emotions do not affect their immigration concerns.

Cohort

The literature shows that older cohorts are more opposed to immigration.¹² In columns (3) and (4) of Table 4, we estimate results separately for older cohorts and younger cohorts of female respondents. We denote the respondent as older if she was born before 1965 (*baby boomer generation* and before) and younger respondents are born after 1965. The mean value of immigration concerns for females in the older cohort is statistically and significantly larger than the mean value for the younger cohort. The estimate show that the statistically significant and positive impact of negative emotions on immigration concerns holds only for older cohort, and younger females do not show such a relationship.

¹¹For instance, the extended results in Table A2 in Poutvaara & Steinhardt (2018) show that respondents inside the labor force report distinct worries about immigration than those outside the labor force.

¹²For instance, the variable *age* is negatively associated with support for immigration in all specifications employed in Hainmueller & Hiscox (2007).

Online social network

A large portion of the population relies on social media for their news consumption.¹³ At the same time, however, social media websites are often blamed for the dispersion of *fake news* (Silverman, 2016, *as cited in* Allcott & Gentzkow, 2017), leading to political polarization (Bail et al., 2018). Recently, a sizable portion of *fake news* was directed at refugees during the 2015 European refugee crisis (Sängerlaub 2017, cited in Scott 2017) and had real life implications. Müller & Schwarz (2020) show that the German far-right party *Alternative für Deutschland (AfD)* successfully used social media (Facebook) to generate and exploit anti-refugee sentiments, which propagated hate speech and hate crimes in Germany. However, some researchers note that the traditional media’s coverage of the refugees was mostly positive in Germany (Haller, 2017).

Therefore, we test whether the respondent’s access to online social networks intervenes in the causal relationship under investigation. In column (5) of Table 4, we present the estimates for females who use online social networks at least once per month while column (6) shows the estimates for females who rarely or never use online social networks. The results suggest a positive effect of negative emotions on immigration concerns only for females who rarely use the online social network. Our results indicate that the online social network does not always magnify the role of negative emotions in immigration concerns, which are in line with the findings of the earlier research (*see* Boxell et al., 2017). As older cohorts are less likely to use social media, we further divide the sample of column (4) based on their frequency of social media usage. The results are presented in columns (7) and (8). We additionally find that the heterogeneous cohort effects are primarily present among the older population with less-frequent access to social media.

4.3 Robustness checks

Positive emotions and immigration concerns

For our baseline results, we focused on the impact of negative emotions. Now, we estimate the impact of positive emotions on immigration concerns. For this exercise, we consider the SOEP question recording the respondent’s frequency of feeling happy in the last four weeks as the measure of positive emotions. The variable is similarly defined, and its summary statistics are as shown in Panel B of Table 1. We re-estimate the baseline specifications using this new endogenous regressor, and the results are shown in Table A-3. Columns (1)-(3) show results from OLS models, which suggests that the respondent’s positive emotions are negatively and significantly associated with her immigration concerns. The coefficient for females is much larger than for males. After we control for person fixed effects in columns (4)-(6), the negative association

¹³Gottfried & Shearer (2016) show that 62% US adults get their news from social media, *as cited in* Allcott and Gentzkow (2017, p.223).

only holds for females and the significance level drops to 10%.

Columns (7)-(9) report the results of the IV fixed effects analysis. Following the existing research on happiness, we exploit the exogenous source of variation induced by sunshine duration in the respondent's residential ROR to estimate the impact of positive emotions on immigration concerns.¹⁴ The data on sunshine duration originates from German Meteorological Service as detailed in section 2 and is summarized in Table 1. In the first stage, we find a statistically significant and positive effect of the average sunshine duration on the frequency of happiness for the whole sample and for male as well as female subsamples. The F statistic is well above 10 for the overall sample, but decreases for the subsamples. The second stage shows a statistically significant and negative effect of happiness frequency on immigration concerns only for the entire sample. In terms of magnitude, a rise in the sunshine duration by one hour increases the frequency of happiness by 0.005 points, which leads to a reduction of immigration concerns by 0.002 ($= 0.005 \times 0.384$) points, about 0.1% of the mean value.

Alternative measures of the death of a parent

In the baseline sample, majority of the respondents that reported the death of a parent were at least 40 years old (80%), and younger respondents were disproportionately excluded from the first stage estimates. Therefore, in column (1) of Table A-4 in the online appendix, we separately estimate the results after restricting the sample to females aged 40 or above. The coefficient of IV in the first stage is smaller in magnitude (but still statistically significant) compared to baseline estimates. It is plausible that older individuals may be less shocked by the death of a parent, especially when their parents were much older and their health was already deteriorating. A consequence of this observation is that the baseline first stage coefficients were larger, primarily driven by the increased negative emotions among younger respondents. The second stage results show that negative emotions statistically and significantly affect immigration concerns.

A crucial concern worth addressing is that the baseline IV does not take into account the exactness of the date of a parent's death. It merely asks respondents to report the month of their parent's death in the current or the last year, which could range anywhere between 0-24 months from the interview month. Therefore, we further exploit the information on the exact month of parent's death and generate a dummy variable that equals one if the individual was interviewed within 15 months after the parent's death, and 0 otherwise. We choose the window of 15 months, as the resultant dummy shares very high

¹⁴For instance, Guven (2012) instruments happiness with unexpected part of daily sunshine changes to answer whether happy people show distinct consumption and savings behavior.

correlation coefficient with the baseline IV.^{15,16} The estimates are presented in column (2), which are closer in magnitude to our baseline results.

It is possible that the parent’s health situation worsened before her actual death and affected the respondent’s negative emotions. In column (3), we re-estimate our baseline results after controlling for this possibility. We generate a dummy variable indicating 15 months before the death of the respondent’s parent. We use this newly generated variable as an additional control to the baseline specification and make two observations. First, the baseline first stage results hold with F statistics comfortably above 10. Second, we note that respondents report increases in the aggregate negative emotions as early as 15 months before the month of her parent’s actual death. In other words, although exogenous, parent’s death is not sudden, hinting at the possibility of worsening parents’ health status. Understandably, the increases in negative emotions are more prominent after the parent’s death than before. The second stage results are also in line with baseline findings, and the size of the coefficient is as large as in column (2).

Alternative weather indexes & new ways of clustering

Next, we test the robustness of our baseline results for the negative emotion of anger. First, we implement an alternative IV for anger. Instead of the average temperature, we use the average of daily minimum temperature in the last two weeks before the interview. Typically, the temperature drops during the evening and nighttime hours. Okamoto-Mizuno & Mizuno (2012) suggest that sleep is disturbed by heat exposure in real-life situations where bed covers and clothing are used. The high temperature at sleep increases the likelihood of wakefulness, which could further lead to more anger. The first stage result in column (1) of Table A-5 in the online appendix provides evidence that the rise in the minimum temperature significantly increases the frequency of anger, which then results in more immigration concerns.

The variation in weather indexes has two dimensions: geographical dimension (ROR) and time dimension. In the baseline analysis, we clustered standard errors at the individual level. However, individuals living in the same ROR may be correlated with each other, since they may choose to live in the ROR depending on the weather conditions. Moreover, young and old generations may have different perceptions of weather, especially towards extreme weather conditions. Using the information on individuals’ birth year,

¹⁵Please note that due to missing values in the variable recording the exact month of a parent’s death, the number of observations is smaller than the baseline specification.

¹⁶Similarly, we also generate dummy variables indicating 6, 12, 18, and 24 months after the death of a parent and re-estimate the baseline specifications. The results are shown in columns (4)-(7). All F statistics in the first stage are well above 10. However, we only find a significant effect on the windows of 18 and 24 months. We argue that this is due to the smaller number of observations who reported variations in the IV, i.e., the dummy variables indicating the 6 and 12 months windows.

we generate nine dummy variables for different cohorts.¹⁷ With all 96 RORs and nine different cohorts, we construct a new variable for clusters that has 799 unique values. The estimation results are shown in columns (2)-(3) of Table A-5.¹⁸ The F statistic in the first stage is above 10 and the positive effect of anger on immigration concerns is still statistically significant.

5 Conclusion

This paper sought to present direct evidence of the essential role played by an individual's emotions in explaining her immigration concerns. Despite smaller magnitudes, the results show a statistically significant and positive association between the respondent's recent experience of sadness, fear, and anger with her immigration concerns. Our causal investigation finds that the respondent's experience of sadness and fear affects immigration concerns primarily among female respondents, whereas anger determines immigration concerns in all respondents. We show that the causal impact of sadness and fear on immigration concerns crucially depends on the female respondent's labor market status, age cohort, and social media usage.

Although transient in nature, emotions can produce long-lasting and pertinent behaviors (Loewenstein, 2000, p. 429). Despite their relevance, individuals often fall short of taking into account the central role played by their emotions in crucial decisions. At higher intensities, emotions can also take over the person's ability to reason. An individual's inability to manage emotions can be particularly evident in her attitudes towards the out-group and may explain tendencies to vote for political parties with anti-immigration rhetoric.

In times when politically motivated *fake news* regularly floods the internet, our findings have important implications for immigration policy. Due to the *filter bubbles* created by social media algorithms, unpalatable political characteristics, such as extreme partisanship and unquestionable nationalism, are commonplace. Our findings highlighting the causal impact of negative emotions on the respondent's immigration concerns may explain why news outlets on both sides of the aisle devote substantial news time addressing emotional aspects of the immigration policy debate and often fail to recognize vast strands of economics research objectively debating the immigration's impact on the host population.

¹⁷We generate dummy variables for individuals who were born before 1920, in the 1920s, 1930s, 1940s, 1950s, 1960s, 1970s, 1980s, and 1990s.

¹⁸We lose some observations as we drop individuals who changed their ROR during the sample period.

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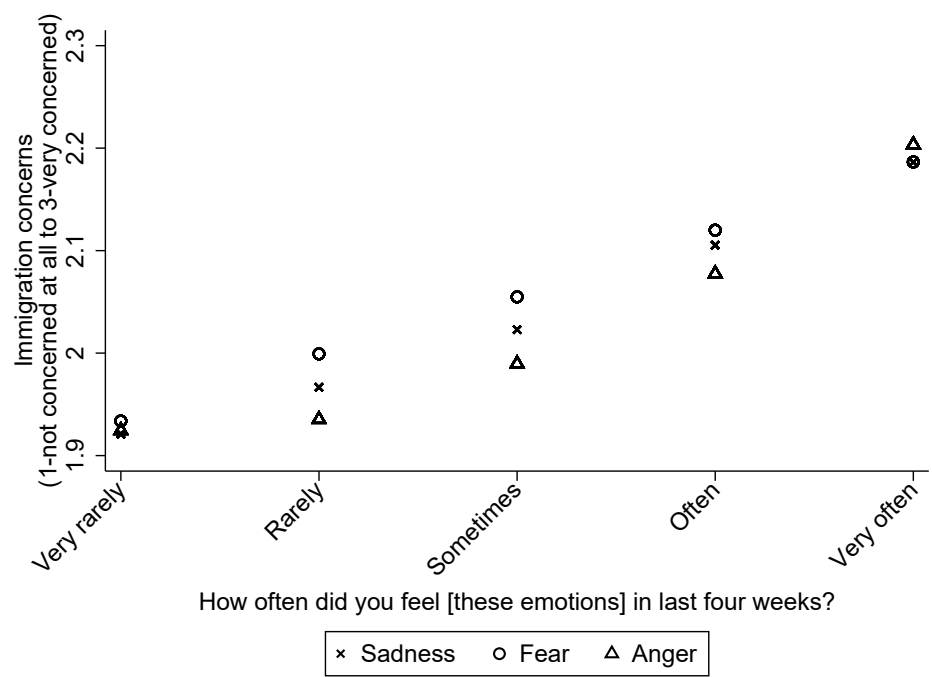
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Appendix

FIGURE 1: Negative emotions and immigration concerns



Source: SOEP v35, estimation sample, own calculation.
Notes: This figure shows the average of respondents' immigration concerns for different levels of negative emotions.

TABLE 1: Summary statistics

	(1)	(2)	(3)	(4)	(5)	(6)
	All		Female		Male	
	mean	std. dev.	mean	std. dev.	mean	std. dev.
Outcome variable						
Immigration concerns	1.9923	0.7571	2.0079	0.7457	1.9742	0.7696
A. Main independent variables: Baseline specification						
Negative emotions						
Sadness	2.3434	1.0152	2.5228	1.0324	2.1370	0.9543
Fear	1.9304	0.9721	2.1113	1.0203	1.7224	0.8681
Anger	2.7691	1.0015	2.8133	1.0067	2.7183	0.9930
State characteristics						
Growth rate of foreigners	-0.0488	0.0537	-0.0493	0.0538	-0.0481	0.0536
Log(GDP)	10.4218	0.2218	10.4236	0.2216	10.4197	0.2220
Unemployment rate	7.0760	2.8369	7.0588	2.8285	7.0959	2.8465
Individual characteristics						
Female	0.5350	0.4988				
Age	51.0436	16.9162	50.7859	16.8817	51.3400	16.9511
Type of region	0.6474	0.4778	0.6501	0.4769	0.6442	0.4788
Married	0.6109	0.4875	0.5794	0.4937	0.6472	0.4778
Years of education	12.3683	2.7299	12.2241	2.6702	12.5342	2.7879
Years of working experience	21.9762	13.7672	19.2827	13.0702	25.0753	13.8963
Labor force status						
Non-working (NW)	0.0813	0.2733	0.1075	0.3097	0.0512	0.2205
NW - aged 65 and older	0.2089	0.4065	0.2080	0.4059	0.2099	0.4073
NW - in education training	0.0185	0.1348	0.0181	0.1334	0.0190	0.1364
NW - maternity leave	0.0158	0.1246	0.0286	0.1667	0.0010	0.0321
NW - military-community service	0.0003	0.0170	0.0003	0.0159	0.0003	0.0181
NW - unemployed	0.0436	0.2042	0.0429	0.2027	0.0443	0.2058
NW - but sometimes sec. job	0.0089	0.0941	0.0080	0.0890	0.0100	0.0996
NW - work but past 7 days	0.0071	0.0837	0.0070	0.0836	0.0071	0.0839
NW - but reg. sec. job	0.0096	0.0974	0.0096	0.0977	0.0095	0.0970
Working	0.5964	0.4906	0.5598	0.4964	0.6385	0.4804
Working but NW past 7 days	0.0096	0.0977	0.0101	0.1002	0.0091	0.0948
Instrument variables: Set I						
Death of a parent	0.0225	0.1483	0.0229	0.1494	0.0221	0.1469
Avg. temperature last 4 weeks	6.4378	6.3473				
Avg. temperature last 3 weeks	6.6837	6.4376				
Avg. temperature last 2 weeks	6.9633	6.5400				
Avg. temperature last week	7.2724	6.6841				
B. Auxiliary specification						
Positive emotions						
Happiness	3.5425	0.8495				
Instrument variables: Set II						
Avg. sunshine duration last 2 weeks	4.5321	2.5109				

Notes: This table shows the summary statistics of the estimation sample. Columns (1)-(2) show statistics for the whole sample of 242,582 observations, columns (3)-(4) for 129,786 female observations, and columns (5)-(6) for 112,796 male observations.

TABLE 2: Negative emotions and immigration concerns (OLS & FE estimates)

	(1)	(2)	(3)	(4)	(5)	(6)
	All	Male	Female	All	Male	Female
Panel (A): Sadness						
Sadness	0.050*** (0.002)	0.048*** (0.004)	0.051*** (0.003)	0.008*** (0.002)	0.008*** (0.002)	0.008*** (0.002)
Panel (B): Fear						
Fear	0.052*** (0.002)	0.052*** (0.004)	0.052*** (0.003)	0.008*** (0.002)	0.004 (0.003)	0.010*** (0.002)
Panel (C): Sadness & Fear						
Sadness_fear	0.012*** (0.001)	0.012*** (0.001)	0.012*** (0.001)	0.002*** (0.000)	0.002*** (0.001)	0.002*** (0.000)
Panel (D): Anger						
Anger	0.073*** (0.002)	0.078*** (0.004)	0.067*** (0.003)	0.012*** (0.002)	0.014*** (0.002)	0.011*** (0.002)
Individual FE	No	No	No	Yes	Yes	Yes
Observations	242,582	112,796	129,786	242,582	112,796	129,786
Number of respondents	40,940	19,128	21,812	40,940	19,128	21,812

Notes: In this table we show the effect of sadness, fear, and anger on immigration concerns in Germany in panels (A), (B), and (D), respectively. In panel (C) we implement a measure of negative emotions by combining sadness and fear. OLS estimates are shown in columns (1)-(3) and FE estimates in columns (4)-(6). Columns (1) and (4) show the results for the whole sample, columns (2) and (5) for males, and columns (3) and (6) for females. In each specification we control for the state-level growth rate of foreigners, logarithm of GDP per capita, and unemployment rate. Other covariates include individual's age (in level, quadratic, and cubic term), rural area, gender, marital status, education (in level and quadratic term), working experience (in level and quadratic term), labor market status, month fixed effects, year fixed effects, and state fixed effects. Individual fixed effects are controlled for in columns (4)-(6). Robust standard errors (clustered at individual level) in parentheses: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

TABLE 3: The impact of negative emotions on immigration concerns (IV FE estimates):
Baseline results

	(1)	(2)	(3)	(4)	(5)	(6)
	Sadness & Fear			Anger		
	All	Male	Female	All	Male	Female
<i>Second stage</i>						
Sadness_fear	0.005 (0.006)	-0.009 (0.011)	0.013* (0.007)			
Anger				0.407** (0.192)	0.292 (0.217)	0.558 (0.358)
<i>First stage</i>						
Death of a parent	1.367*** (0.061)	1.062*** (0.083)	1.622*** (0.086)			
Avg. temperature _{12w}				0.003*** (0.001)	0.003*** (0.001)	0.002** (0.001)
<i>F statistic</i>	509.29	162.49	353.22	16.09	11.42	5.61
Observations	242,582	112,796	129,786	242,582	112,796	129,786
Number of respondents	40,940	19,128	21,812	40,940	19,128	21,812

Notes: This table shows the results of IV fixed effects estimates of the impact of negative emotions on immigration concerns. The main independent variable in columns (1)-(3) is an aggregate measure of negative emotions constructed by sadness and fear, and in columns (4)-(6) anger. The instrument variable for *sadness_fear* is a dummy variable for the death of a parent in the current or last year, and for *anger* the average temperature in the last two weeks before the interview day. Columns (1) and (4) show results for the whole sample, columns (2) and (5) for males, and columns (3) and (6) for females. In each specification we control for the state-level growth rate of foreigners, logarithm of GDP per capita, and unemployment rate. Other covariates include individual's age (in level, quadratic, and cubic term), rural area, marital status, education (in level and quadratic term), working experience (in level and quadratic term), labor market status, month fixed effects, year fixed effects, individual fixed effects, and state fixed effects. We additionally control for the average humidity in the last two weeks in columns (4)-(6). Robust standard errors (clustered at individual level) in parentheses: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

TABLE 4: The impact of negative emotions on immigration concerns (IV FE estimates):
Heterogeneous effects among females

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Labor market status		Cohort		Online social network		Old & online social network	
	always-working	not always-working	young	old	often	rarely	often	rarely
<i>Second stage</i>								
Sadness_fear	-0.004 (0.009)	0.032*** (0.010)	0.002 (0.010)	0.020* (0.010)	0.003 (0.010)	0.022** (0.011)	0.006 (0.015)	0.031** (0.013)
<i>First stage</i>								
Death of a parent	1.798*** (0.125)	1.464*** (0.120)	2.164*** (0.186)	1.521*** (0.121)	2.204*** (0.167)	1.455*** (0.127)	1.987*** (0.220)	1.357*** (0.144)
<i>F statistic</i>	207.95	150.01	134.80	159.37	174.45	131.23	81.79	88.74
mean of dep. var.	1.9892	2.0190	1.9317	2.0405	1.9872	2.0062	2.0398	2.0406
Observations	48,018	81,768	31,892	53,210	29,067	56,035	11,183	42,027
Number of respondents	9,071	12,741	3,675	5,638	3,299	6,014	1,155	4,483

Notes: This table shows results of heterogeneous effects of negative emotions on immigration concerns for females in IV fixed effects models. Column (1) shows results for females who have reported to be always-working during their whole observation period. In column (2) we observe females who were not always-working during the observation period. Females observed in column (3) were born before/in 1964 (*old*) and in column (4) after 1964 (*young*). Females in column (5) used the online social network at least once per month (*often*), and in column (6) rarely or never (*rarely*). In columns (7) and (8) we observe females born in early cohort who reported often and rare use of online social networks, respectively. All covariates are the same as in the baseline regression in column (3) of Table 3. Robust standard errors (clustered at individual level) in parentheses: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Suffering and prejudice: Do negative emotions predict immigration concerns?

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Online Appendix

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Appendix A: Tables Cited in the Main Text

TABLE A-1: Negative emotions and immigration concerns
(Probit estimates)

	(1)	(2)	(3)
	All	Male	Female
Panel (A): Sadness & Fear			
Sadness_fear	0.001*** (0.0002)	0.001*** (0.0004)	0.0009*** (0.0003)
Panel (B): Anger			
Anger	0.005*** (0.001)	0.005*** (0.002)	0.005*** (0.001)
Observations	242,582	112,796	129,786
Number of respondents	40,940	19,128	21,812

Notes: In this table we show the effect of *sadness_fear* and *anger* on immigration concerns using a probit model. Column (1) shows the results for the whole sample, column (2) for males, and column (3) for females. In addition to the covariates used in the baseline regression in Table 3, we further control for the within-person mean value of all continues independent variables. Robust standard errors (clustered at individual level) in parentheses: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

TABLE A-2: The impact of negative emotions on immigration concerns (IV FE estimates):
Other results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Sadness			Fear			Anger					
	All	Male	Female	All	Male	Female	All	Male	Female	All	All	All
<i>Second stage</i>												
Sadness	0.022 (0.024)	-0.038 (0.047)	0.054* (0.028)									
Fear				0.135 (0.154)	-0.309 (0.408)	0.292* (0.165)						
Anger							0.510 (0.710)	-3.205 (18.847)	0.878 (0.763)	0.214 (0.190)	0.556** (0.257)	0.919** (0.456)
<i>First stage</i>												
Death of a parent	0.328*** (0.014)	0.258*** (0.020)	0.388*** (0.020)	0.053*** (0.012)	0.032** (0.016)	0.072*** (0.017)	0.014 (0.012)	0.003 (0.017)	0.024 (0.017)			
Avg. temperature _{1w}										0.002*** (0.001)		
Avg. temperature _{3w}											0.003*** (0.001)	
Avg. temperature _{4w}												0.002** (0.001)
<i>F statistic</i>	547.44	172.78	382.99	20.67	4.18	17.52	1.32	0.03	1.95	13.32	11.13	6.03
Observations	242,582	112,796	129,786	242,582	112,796	129,786	242,582	112,796	129,786	242,582	242,582	242,582
Number of respondents	40,940	19,128	21,812	40,940	19,128	21,812	40,940	19,128	21,812	40,940	40,940	40,940

Notes: Columns (1)-(9) show results of IV fixed effects models if we use sadness, fear, and anger as main independent variables separately and employ the dummy variable for the death of a parent as the instrument variable. Columns (1), (4), and (7) show results for the whole sample, columns (2), (5), and (8) for males, and columns (3), (6), and (9) for females. We present in columns (10)-(12) the results of IV fixed effects estimates if we instrument anger by the average temperature in the last week, last three weeks, and last four weeks before the interview day, respectively. All covariates are the same as in the baseline regression in Table 3. We additionally control for average humidity in the last week, last three weeks, and last four weeks in columns (10)-(12), respectively. Robust standard errors (clustered at individual level) in parentheses: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

TABLE A-3: The impact of happiness on immigration concerns

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	OLS			FE			IV FE		
	All	Male	Female	All	Male	Female	All	Male	Female
Happiness	-0.027*** (0.003)	-0.015*** (0.004)	-0.037*** (0.004)	-0.001 (0.002)	0.003 (0.003)	-0.005* (0.003)	-0.384** (0.193)	-0.598 (0.406)	-0.255 (0.210)
Avg. sunshine duration _{12w}							0.005*** (0.001)	0.004*** (0.001)	0.006*** (0.001)
<i>F statistic</i>							22.21	6.68	16.01
Observations	242,582	112,796	129,786	242,582	112,796	129,786	235,744	109,618	126,126
Number of respondents	40,940	19,128	21,812	40,940	19,128	21,812	39,872	18,627	21,245

Notes: This table shows results of the impact of positive emotions, measured by happiness, on concerns about immigration. Columns (1)-(3) show results of OLS estimates, columns (4)-(6) fixed effects estimates, and columns (7)-(9) IV fixed effects estimates. Columns (1), (4), and (7) show results for the whole sample, columns (2), (5), and (8) for males, and columns (3), (6), and (9) for females. The instrumental variable applied in columns (7)-(9) is the average of daily sunshine duration in the last two weeks. All covariates are the same as in the baseline regression in Table 3. We additionally control for the average of daily maximum temperature and daily maximum wind gust in the last two weeks in columns (7)-(9). Due to missing values in weather indexes, the number of observations decreases in columns (7)-(9). Robust standard errors (clustered at individual level) in parentheses: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

TABLE A-4: The impact of sadness & fear on immigration concerns (IV FE estimates):
Robustness checks

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
IV:	death of a parent	15 months after death of a parent		<i>n</i> months after death of a parent			
				<i>n</i> = 6	<i>n</i> = 12	<i>n</i> = 18	<i>n</i> = 24
<i>Second stage</i>							
Sadness.fear	0.017** (0.007)	0.014* (0.007)	0.014** (0.007)	0.004 (0.006)	0.008 (0.006)	0.013* (0.008)	0.021** (0.009)
<i>First stage</i>							
Death of a parent	1.568*** (0.090)						
15 months after death		1.610*** (0.093)	1.646*** (0.095)				
15 months before death			0.248** (0.097)				
<i>n</i> months after death				2.546*** (0.134)	1.883*** (0.101)	1.433*** (0.086)	1.175*** (0.080)
<i>F</i> statistic	301.08	301.19	298.98	358.56	345.63	275.55	213.93
Observations	101,466	100,684	100,684	100,684	100,684	100,684	100,684
Number of respondents	15,558	15,473	15,473	15,473	15,473	15,473	15,473

Notes: This table shows results of IV fixed effects estimates of the impact of the aggregate measure of negative emotions, constructed by sadness and fear, on immigration concerns for females who ever reported age above 40 during the observation period. The instrument variable in column (1) is the dummy variable for the death of a parent in the current or last year. Due to missing information on the exact time of a parent's death of some individuals, the number of respondents as well as observations decreases in columns (2)-(7). The instrument variable in columns (2) and (3) is a dummy variable for the 15 months after the death of a parent. In columns (4)-(7), as instrument variables, we use the dummy variable for the *n* months after the death of a parent with *n* equal to 6, 12, 18, and 24, respectively. All covariates are the same as in the baseline regression in Table 3. In column (3), we additionally control for the dummy variable for the 15 months before the death of a parent. Robust standard errors (clustered at individual level) in parentheses: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

TABLE A-5: The impact of anger on immigration concerns (IV FE estimates):
Robustness checks

	(1)	(2)	(3)
<i>Second stage</i>			
Anger	0.568*** (0.206)	0.334* (0.180)	0.503*** (0.192)
<i>First stage</i>			
Min. temperature _{12w}	0.003*** (0.001)		0.003*** (0.001)
Avg. temperature _{12w}		0.003*** (0.001)	
<i>F statistic</i>	17.49	16.22	18.11
Observations	242,582	227,370	227,370
Number of respondents	40,940	38,890	38,890

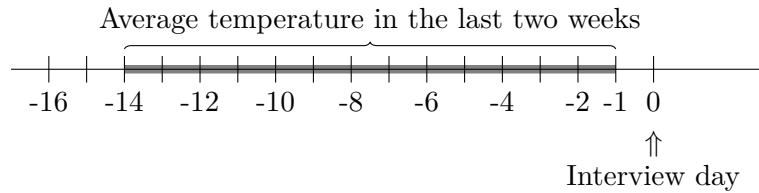
Notes: The instrument variable used in columns (1) and (3) is the average of daily minimum temperature in the last two weeks before the interview day, and in column (2) the average temperature in the last two weeks. All covariates are the same as in the baseline regression in Table 3. We additionally control for average humidity in the last 2 weeks in column (2). Robust standard errors are clustered at individual level in column (1) and at ROR & cohort level in columns (2)-(3) in parentheses: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Appendix B: Weather Variables

German Meteorological Service (“*Deutscher Wetterdienst*”) provides daily weather information gathered from weather stations in Germany on temperature, humidity, sunshine duration, precipitation, snow depth, and so on. The coordinates of the weather station and the federal state where the weather station is located are available. Using the coordinates of weather stations and the coordinates of the population weighted center of German counties, we calculated the distance between a station and the center of German counties within a federal state, and define that the station is located in the county where the distance is the shortest. With the information on German counties and spatial planning regions (“*Raumordnungsregion*”, or ROR), we matched weather stations to each ROR.¹ There is at least one weather station in a ROR.

For each day and ROR, we calculated the average weather indexes. Taking the average temperature in the last two weeks as an example, we first figure out the interview date and residence place (ROR) of all respondents. Second, we calculate the average temperature of the 14 days in the ROR before the interview day (see Figure B-1) and match it to the respondents. Similarly, we also calculate the average temperature in the last one, three, and four weeks.

FIGURE B-1: Weather variable: average temperature in the last two weeks



¹We drop one station that is located above 2000 meters, because the weather information gathered by this station is not representative for residents living in the near regions.