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S.I.: RECENT DEVELOPMENTS IN FINANCIAL MODELING AND RISK MANAGEMENT

Peer effects in risk preferences: Evidence from Germany

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Abstract
This study uses data from the German Socio-Economic Panel to analyze peer effects in risk preferences. Empirical evidence on the impact of peer groups on individual willingness to take risks ('peer effects') is very limited so far as causality is hard to establish. To establish a causal relationship between individual and community risk preferences, we use an instrumental variables approach where we track the impact of the East–West migration after the German reunification. We find strong support for peer effects in risk preferences. Peer effects seem particularly relevant for women, less educated individuals, the young population, parents, and married individuals. Individuals with higher social interaction tend to have stronger peer effects. Our findings shed light on the origin and stability of risk tolerance and, more generally, on the determinants of economic preferences.

Keywords Peer effects · Willingness to take risks · Risk preferences · Instrumental variable · German SOEP · Migration

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1 Introduction

Ever since the prominent work by Friedman and Savage (1948) as well as Arrow (1962), it is well-known that individuals' risk preferences have a significant impact on their decision-making under risk. Individuals' attitudes towards risk are especially important when it comes to financial decisions, such as insurance and investment choices.[1] Based on Bernoulli's assumptions and utility theory, most studies analyze decision-making under risk at the individual level. However, peers may play a role leading to a deviation from individual decision-making. The existence of peer effects is very well documented in the literature (see, e.g., Sacerdote 2001), and peer effects supposedly exist in different group settings such as workplaces, schools, and universities as well as in local communities. Our peers shape our financial investments (see, e.g., Brown et al. 2008), our work productivity (see, e.g., Falk and Ichino 2006), and our retirement decisions (see, e.g., Duflo and Saez 2002), just to name a few. All these economic decisions have one thing in common: They are all decisions under risk and uncertainty even though previous studies have rather focused on observing actual behavioral outcomes than potential underlying changes in risk preferences. Accordingly, it is still unclear whether peer effects in the area of decision-making under risk operate at the outcome level or by modifying the underlying risk preferences, or both. Knowing how our peers impact our decisions under risk and uncertainty is a crucial factor to better understand economic decision-making.

We are aware of only experimental studies on the influence of peers' risk preferences on individual risk preferences. While two recent small-scale field studies explicitly investigate the strength of peer effects in risk preferences of students (Ahern et al. 2014; Balsa et al. 2015), other studies in this field rather focus on individuals' internal motivation for adapting their behavior to peers, comparing distributional social preferences and social norm-based preferences. We contribute to this literature by investigating peer effects in risk preferences within a large panel survey dataset. We aim to establish a causal relationship between community and individual willingness to take risks (WTR) using a representative sample of the German population from the Socio-Economic Panel (SOEP) study. In contrast to Ahern et al. (2014) and Balsa et al. (2015), we examine peer effects in risk preferences in local communities rather than in academic settings with students. For our purpose, we use data at the federal state level. In addition, we utilize a self-reported measure of risk preference that has been shown to have better stability over time and higher predictive validity than behavioral measures of risk preference, as discussed in a meta study by Mata et al. (2018).[2]

[1] See, for instance, Mossin (1968), Barsky et al. (1997), and Dohmen et al. (2011). Recent research has focused on factors changing risk attitudes of individuals, such as macroeconomic conditions and major life events (see, e.g., Malmendier and Nagel 2011; Hoffmann et al. 2013; Browne et al. 2019; Görlitz and Tamm 2019).

[2] Note that we document the existence of peer effects despite the higher time stability.

We identify peer effects based on the influence of East–West migration on West German communities after the fall of the Berlin wall in 1989.[3] We benefit from the unique historical setting with the German division and its later reunification that offers a natural split. Natural dichotomy makes sure that people moving to West Germany after the fall of the Berlin wall do not share the same background with people living in West Germany before the reunification. We are able to establish a causal relationship between individual and community risk preferences by showing that a native individual adapts to peers' risk attitude.[4] Following Brown et al. (2008)'s instrumental variables approach, we rule out other factors than peer effects, such as same preferences or common reactions to public information, that could lead to a spurious correlation between one's own risk attitude and that of one's neighbors. Since individuals are not randomly assigned to communities, the observed correlation between the WTR of an individual and her community could reflect a variety of unobservable influences that induce a spurious correlation even after controlling for observable characteristics. Unobserved characteristics could drive both individual and community risk preferences. In order to ensure that the independent variable average WTR in a community can be treated exogenously in the second-stage regression, the instrument may only be correlated with the independent variable (i.e., the community WTR), but not with the dependent variable (i.e., the individual WTR). We use the lagged average WTR of non-native neighbors' original federal states as an instrument for community WTR. Our instrument is motivated by Guiso et al. (2004) and Brown et al. (2008), and is thus based on the assumption that the average risk attitude in a person's original federal state is potentially highly correlated with her current risk attitude due to long-lasting effects of the original federal state. Therefore, when an individual moves from one federal state to another, her risk preferences are very likely to be shaped by the federal state in which she has lived for a long time. This is particularly the case for people who have lived in former East Germany all their lives or many years prior to the fall of the Berlin wall. When moving to a western federal state, an individual becomes part of a new community and contributes to this community's average WTR which is correlated with her original federal state's WTR through her influence on this western community. However, there is no reason why a West German native's variation in individual WTR should be influenced by variation in average WTR of East German federal states except through their effects on this individual's non-native neighbors. Particularly in our case, risk attitudes in East and West Germany are unlikely to be correlated with each other prior to the German reunification. This way, we are able to track how differences in risk preferences in the place of origin of the movers impact their local western communities.

This study contributes to prior literature by giving empirical insights into the consequences of peer interaction on individual risk preferences. It improves the understanding of peer effects in risk attitudes by providing causal inference of large-scale community peer

[3] From the erection of the Berlin wall in 1961 until the fall of the Berlin wall in 1989, Germany was physically and ideologically divided into the Federal Republic of Germany (i.e., West Germany) and the German Democratic Republic (GDR; i.e., East Germany). The fall of the Berlin wall in 1989 paved the way for German reunification, which formally took place on October 3, 1990. Before the fall of the Berlin wall, GDR citizens were usually not allowed to migrate to West Germany. Note that we refer to former western or former eastern federal states as western or eastern federal states throughout this article.

[4] We restrict our sample to 'native' individuals, that is, those individuals who have lived in the same federal state in West Germany at least one year prior to and all years after the fall of the Berlin wall. Thus, native individuals have lived in the same western community over the entire panel. This ensures that the results are not contaminated by an individual and her new community members sharing the same background.

effects in a representative measure of the German population. Previous studies in economics have focused on peer effects in different settings. Exploring peer effects in risk attitudes is highly relevant for understanding the stability of individual preferences and, more generally, the determinants of economic preferences. While the impact of peer groups on risk aversion has already been studied experimentally for particular subgroups[5], we estimate peer effects in risk preferences in local communities of grown individuals using a large representative panel dataset of the German population. The representative sample allows for assessing the strength of peer effects for different groups. Our article contributes to growing literature on peer effects in economics over the last 20 years, including an increasing number of papers on risk attitudes or risky choices, while having some innovative features: the representative sample, the opportunity to control for covariates, and the innovative estimation strategy. Following the research body on peer effects, we expect that an individual's risk attitude changes when an interaction with potential peers takes place, which may lead to a deviation from original risk preferences. Our study confirms that a change in overall WTR in a region changes the WTR of the West German native residents in this region. This finding seems to be particularly driven by females, parents, the young population as well as married and less educated people. Individuals with higher social interaction tend to exhibit stronger peer effects.

This article is structured as follows. The next section reviews related literature on the formation of risk attitude, factors associated with changes in risk attitudes, and peer effects; the section also develops general hypotheses resulting from the review. Section 3 introduces the dataset which is suitable for answering the raised research questions and the variables of interest. Our empirical approach is presented in Sect. 4. In Sect. 5, we summarize our empirical results. Section 6 shows a number of robustness checks on the data to confirm the validity of our results. The last section discusses the results and concludes.

2 Related literature and hypothesis development

While almost all economic models assume that individuals only care about their own well-being, there is ample evidence that people also care about others (e.g., Rabin 1993; Trautmann 2009). When it comes to decision-making under risk, peer effects occur if the decision maker chooses not to stay with her individual choice (Lahno and Serra-Garcia 2015). Fairness motives influence the behavior of individuals so that decision-making under risk should not only be examined at an individual level but rather incorporate others' decisions and economic attitudes (see, for instance, Ahern et al. 2014). Recent studies focus on individuals' internal motivation for adapting their behavior to peers, comparing distributional social preferences and social norm-based preferences. Manski (2000), for instance, states that, in an environment with complete information, preference interaction may arise from 'everyday ideas' such as envy (i.e., individuals care about others' outcomes) and conformity (i.e., individuals care about others' choices). Studies in social psychology show that individuals' decisions may be driven by social norms (e.g., Cialdini and Trost 1998; Cialdini and Goldstein 2004) rather than rational expected utility maximization, which supports Festinger (1954)'s idea of a social anchor to which individuals usually conform. However,

[5] See Ahern et al. (2014) and Balsa et al. (2015) for experimental studies on peer effects in academic settings with students.

less attention has been given to preferences where peers' choices have a direct impact on individual behavior. Instead, envy is seen as a central concept in models of distributional social preferences, such as in Fehr and Schmidt (1999)'s model of inequity aversion. Viscusi et al. (2011)'s experimental results indicate that simply observing group investment decisions affects individual decision-making, which leads to a shift away from individual choices in isolation. Lahno and Serra-Garcia (2015) investigate the drivers of peer effects by distinguishing between the two sources envy and conformity. The authors show in an experimental setting that peer effects in risk preferences can be explained by both relative payoff concerns and a preference to conform to others. Peer choices thus are important in generating peer effects and have important policy implications. While the above-mentioned studies examine the drivers of peer effects in risk preferences, relatively little is known about the underlying reason for adaptation of behavior. Do peers influence individuals' behavior, their perception of alternatives and social norms, their risk perception, or their risk tolerance? This paper concentrates on the latter by investigating whether peers do (also) influence the underlying risk attitude of individuals.

A growing literature has been focusing on trying to establish causal peer effects when it comes to decision situations. The literature on how peers may impact individuals' decision-making processes stems from diverse disciplines, not only economics and psychology. To summarize, peers are known to have an impact on stock market participation (e.g., Shiller 1984; Hong et al. 2004; Brown et al. 2008), investment decisions such as pension plans, savings, and credits (e.g., Duflo and Saez 2002; Banerjee et al. 2013; Bursztyn et al. 2014; Georgarakos et al. 2014; Heimer 2014) as well as insurance choices (Cai et al. 2015). For instance, Cai et al. (2015) find that social networks have an impact on the adoption of a new weather insurance product and that this network effect is driven by the diffusion of insurance knowledge rather than purchase decisions. Furthermore, there exist peer effects in education (e.g., Sacerdote 2001; Zimmerman 2003), labor market participation (e.g., Card et al. 2012) as well as in health (e.g., Trogdon et al. 2008). We explore a different channel for peer effects by focusing on economic attitudes rather than on behavioral outcomes.

Using experimental approaches, Ahern et al. (2014) and Balsa et al. (2015) find evidence for risk aversion being driven by peer interaction. Ahern et al. (2014) state that peers might generally influence individual risk preferences in a repeated survey on MBA students who were randomly assigned to project groups. They attribute these positive peer effects to a desire for conformity. In contrast, Balsa et al. (2015) estimate peer effects in risk attitudes in a sample of high school students using lottery choices. We test whether we can also observe the existence of peer effects in risk preferences in local communities of grown individuals. Given that peer effects seem to build on the diffusion of information, opinions, and knowledge in a community, we formulate the following hypothesis:

Hypothesis 1 Peer groups affect individual willingness to take risks.

Following Hong et al. (2004) and Brown et al. (2008), we aim to investigate the role of sociability in peer effects in risk preferences. It seems intuitive that individuals with higher levels of peer interaction have greater peer impacts than individuals with less social interaction. This idea follows Scherer and Cho (2003) who find that social linkages in a community play an important role in the formation of individuals' risk perception. Individuals with higher levels of peer interaction, ceteris paribus, are thus predicted to have greater peer impacts when compared to individuals with less interaction. We posit the following hypothesis:

Hypothesis 2 Peer effects are stronger for more sociable individuals.

We then hypothesize about the magnitude of peer effects for male and female native individuals. Interestingly, as shown by Booth and Nolen (2012b), risk preferences of women seem to differ significantly from those of men and may be even more strongly affected by the gender structure of their peer group. This suggests that women are more social, differ in their level of competitiveness when compared to men, and are thus overall more susceptible when it comes to risk preferences. Cárdenas et al. (2012) show that Swedish girls tend to be more competitive than boys in terms of performance change, while boys are more likely to choose to compete in general. However, this is not the case for Colombian children. Booth and Nolen (2012a) also do not find evidence for a difference in the level of competitiveness between men and women. Thus, observed gender differences in behavior under risk and uncertainty might reflect social learning rather than inherent gender traits (Booth and Nolen 2012a). Furthermore, according to Cárdenas et al. (2012) and Charness and Gneezy (2012), females tend to be more risk averse than males. This could lead to females being more likely to ask for advice in the community.

In the studies on gender effects, we cannot find clear evidence for men or women being more prone to peer effects in general, as the findings seem to be context-dependent. With respect to academic outcomes, Hoxby (2000) and Lavy and Schlosser (2011) find that the presence of more females in school classrooms improves male and female learning outcomes equally. The exact mechanism of gender on peer effects is, however, hard to disentangle and gender effects have mostly been examined for children and adolescents. Duflo and Saez (2002) suggest that peer effects in retirement decisions are more dominant among an individual's own gender group. Only one study exists which investigates gender with regard to peer effects in risk preferences: Balsa et al. (2015) show that male adolescents are more prone to peer effects in risk aversion. As there is only one previous paper investigating the difference and there may be some conceptual differences in how gender affects peer effects in risk preferences among grown adults, we formulate the null hypothesis assuming no gender differences and test whether we will have to reject it:

Hypothesis 3 Peer groups have the same impact on female willingness to take risks and male willingness to take risks.

3 Data and variables

3.1 Data

We use the SOEP to test our hypotheses. The SOEP is a representative panel dataset of the resident adult population living in Germany. It is published by the German Institute for Economic Research in Berlin containing information on approximately 30,000 individuals living in about 11,000 households.[6] The survey has been conducted on a yearly basis since 1984. The sample has been extended in 1990 due to the German reunification including around 2000 East German households. Each year between January and May, individuals are asked for a wide range of personal and household information, including financials,

[6] See Goebel et al. (2019) for more information on the German SOEP.

lifestyle, and health status, and for their attitudes on assorted topics including political and social issues. The SOEP contains information on socio-demographic factors such as age, wealth, educational level, and marital status. In addition, it records individuals' self-reported WTR and tracks changes in residence. Data is provided at the federal state level. For our purposes, we use the 2004, 2006, and 2008–2015 waves of the SOEP as they comprise information on the self-assessed WTR. Our dataset consists of 2226 individuals aged 18 years or older (or turning 18 in the year they participate in the survey for the first time) and includes 17,980 person-year observations.

3.2 Willingness to take risks (WTR)

To elicit an individual's risk attitude, the SOEP asks its respondents to self-assess their WTR on a scale from 0 to 10, with 0 representing no tolerance for risks and 10 representing the highest willingness to be exposed to risks. The self-reported WTR was first included in 2004, was included again in 2006, and has been included yearly since 2008. Figure 1 shows the survey question for self-assessment of risk tolerance in the SOEP questionnaire.

We use the individual risk tolerance level as dependent variable. Figure 2 illustrates the distribution of this variable lying between 0 and 10.

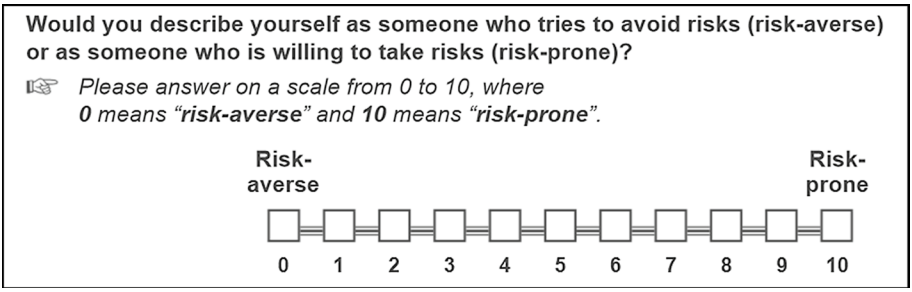

Fig. 1 Self-assessed WTR. *Source:* SOEP v32.1, SOEP (2016)

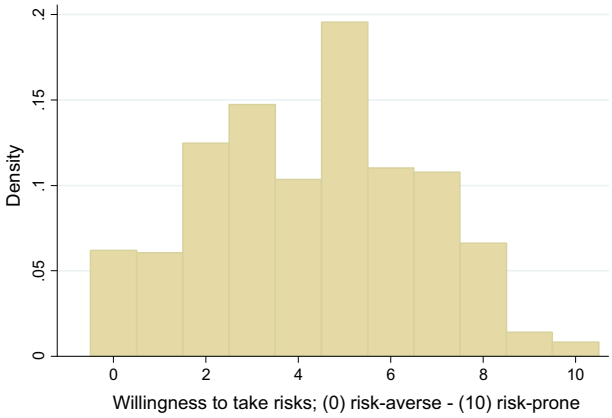

Fig. 2 Distribution of the dependent variable *WTR*. *Source:* SOEP v32.1, 2004–2015

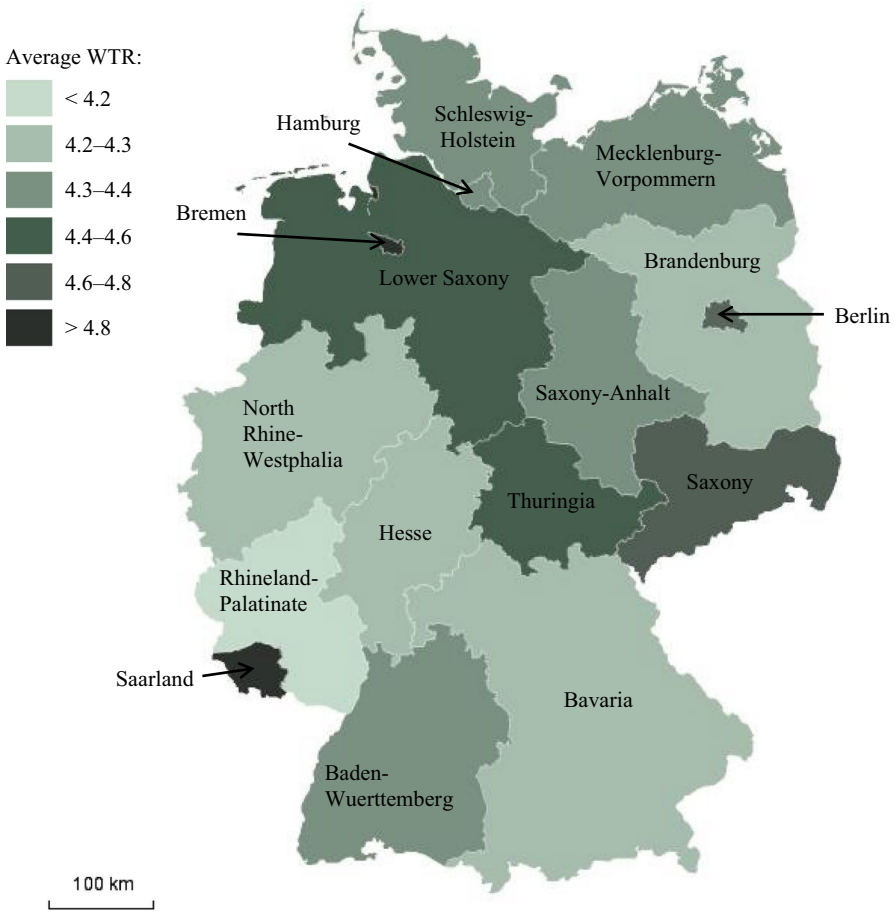

Fig. 3 Average WTR per federal state over the years 2004, 2006, and 2008–2015. *Source:* SOEP v32.1, 2004–2015

Figure 3 shows that the average WTR over years differs between federal states ranging from 4.0 to 5.0. On average, Rhineland-Palatinate is the most risk-averse federal state, while people in Saarland are most willing to take risks.

Even though incentivized lottery choices are considered the method of choice to elicit risk preferences for many economists, the self-reported WTR has been shown to be a valid measure in large, longitudinal surveys by, for instance, Dohmen et al. (2011), Lönnqvist et al. (2015), and Vieider et al. (2015). Mata et al. (2018) find in a meta study that self-stated risk preferences outperform lab-elicited preferences in terms of retest stability, convergent validity, and predictive validity. As we investigate longitudinal data, relying on a measure with improved retest stability is a crucial factor for increasing the chance of significant results.

3.3 Sociability

As we expect peer effects to be stronger for more sociable individuals, we identify variables that reveal how social people are and how regularly they are in touch with others. For our purpose,

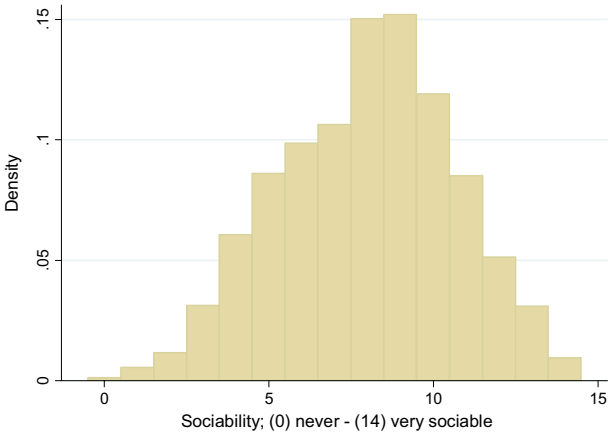

Fig. 4 Distribution of the variable *Sociability*. *Source:* SOEP v32.1, 2004–2015

we define a sociability index that indicates whether individuals tend to ask their community or neighbors for advice when making a decision under risk and uncertainty. Following Hong et al. (2004) and Brown et al. (2008), who show that individuals who visit their neighbors or attend church have higher levels of stock market participation, and that this effect is stronger for individuals who live in more sociable regions, we investigate whether peer effects are stronger for residents interacting socially with others. As argued above, social people can be expected to more likely adapt to neighbors' risk attitude. The SOEP provides information on the following seven variables: *attend church or other religious events*; *attend cultural events; perform volunteer work*; *participate in local politics; attend cinema, pop and jazz concerts; hours spent on hobbies in leisure time (on weekdays);* and *visit neighbors and friends*. We form three categories each–never (0), less frequently (1), and every week (2)–and add up these values to construct our sociability index. For variables that are not defined for all years, we interpolate the missing interim values by using the values for all years given or by forming the mean of the years before and after.[7] Figure 4 shows the distribution of the sociability variable. While 0 indicates an individual not being sociable at all, 14 refers to a very social individual.

3.4 Definition of natives and movers

We differentiate between inhabitants from federal states of former West Germany (i.e., Baden-Wuerttemberg, Bavaria, Bremen, Hamburg, Hesse, Lower Saxony, North Rhine-Westphalia, Rhineland-Palatinate, Saarland, and Schleswig–Holstein) and those of former East Germany (i.e., the newly-formed German federal states Brandenburg, Mecklenburg-Vorpommern, Saxony, Saxony-Anhalt, and Thuringia) in order to establish exogeneity as best as possible.[8] This ensures that the instrumental variable is only correlated with the independent variable (i.e., the community WTR), but not with the dependent variable (i.e., the individual WTR). Since we restrict our sample of western community to natives, there is no reason why a native's WTR should be influenced by the average WTR of East German

[7] Due to interpolation, decimal numbers are also allowed. For reliability analysis, Cronbach's alpha was calculated to assess the internal consistency of the subscale for sociability, which consists of seven SOEP questions. According to Field (2009), the internal consistency lies within an acceptable range, with a Cronbach's alpha for sociability of 0.511.

[8] Note that Germany was divided into the Federal Republic of Germany (former West Germany) and the GDR (former East Germany) from 1961 to 1989.

federal states except through their effects on her non-native neighbors. Particularly in our case, risk attitudes in East and West Germany are unlikely to be correlated with each other prior to the German reunification. Following Hunt (2006), Berlin is excluded from our sample due to its division in East and West Berlin before the fall of the Berlin wall.[9] We exploit the 'reallocation' of many former GDR citizens after the fall of the Berlin wall in 1989. Natural dichotomy makes sure that people moving to West Germany after the fall of the Berlin wall do not share the same background (e.g., a simultaneous, correlated response across regions to the release of new information) with people living in West Germany before the reunification. Consequently, we benefit from the unique historical setting with the German division and its later reunification that offers a natural split.

In contrast to Brown et al. (2008), we cannot observe birth federal states in our sample. Therefore, we utilize the former separation into East and West Germany and denote the East German federal state in which a person lived at least five years before moving to West Germany as original federal state.[10] We track the East German federal states in which the GDR migrants lived and calculate weighted averages for each western community depending on where eastern migrants came from.[11]

The definition of a community and the resulting differentiation between 'movers', 'natives', and 'incoming movers' are crucial for our analysis. We define these terms in the following manner:

- 'Movers' are individuals who move from any one of the 16 federal states to any other federal state,
- 'natives' are individuals that have lived in the same western federal state over the entire observation period from 1989 through 2015 (i.e., even before the fall of the Berlin wall), and
- the term 'incoming movers' refers to those individuals that have lived in former East Germany for at least five years and then moved to any one West German federal state sometime afterwards.

Thus, an 'incoming mover' is always a 'mover', but not vice versa. A 'mover' could be a person moving from Bavaria to Baden-Wuerttemberg, while an 'incoming mover' is a person moving from a former East German federal state (e.g., Saxony) to a former West German federal state (e.g., North Rhine-Westphalia). Furthermore, an individual that is not a 'native' can be classified as 'mover' when referring to the West German population, while only under certain conditions we can also call her 'incoming mover'.[12] To provide a highly simplified example, consider a native individual A who has lived in Munich over the entire observation period from at least 1989 through 2015 and who has therefore lived in the federal state of Bavaria all along.[13] Suppose that individual A has neighbors B, C, and D who currently live

[9] The Berlin wall physically and ideologically divided Berlin from 1961 to 1989 and thus a differentiation between former East and West Germans regarding this particular federal state is impossible.

[10] Note that we drop information on 19 individuals that lived in two different East German federal states during this period.

[11] See Sect. 4.1 for details.

[12] Note that the term 'mover' refers to former East Germans and West Germans moving from any one to another federal state, while the term 'native' covers only West Germans who have lived in the same federal state all their lives.

[13] Our example is very close to the one presented by Brown et al. (2008) to point out the differences to their approach.

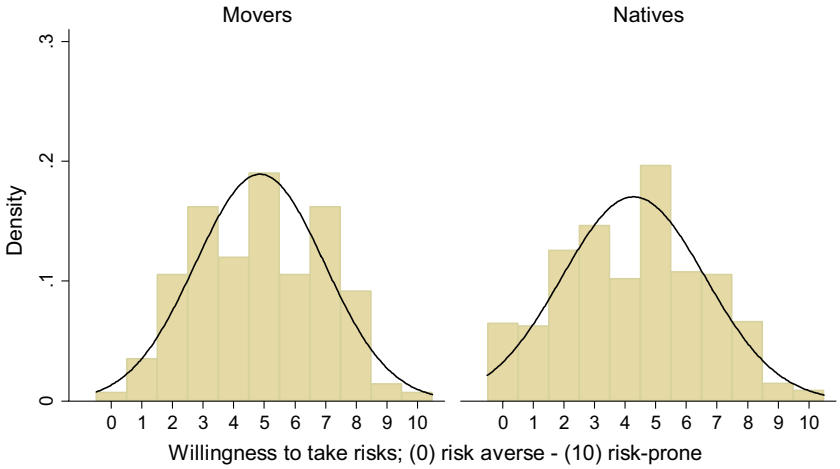

Fig. 5 Distribution of WTR for natives and movers. The black curve shows the normal distribution. *Source:* SOEP v32.1, 2004–2015

in the federal state of Bavaria, and who are originally from the federal states Bavaria, Saxony, and Saxony-Anhalt, respectively. We define the community risk attitude for individual A to be the average WTR of individuals B, C, and D. However, because individual B has lived in Bavaria since at least 1989, we do not include individual B's origin-state WTR as part of our instrument. Individuals C and D, by contrast, are included in our instrument because they are non-natives. Thus, in the first stage of our regression, we regress the average WTR of the community in which individual A lives upon the lagged average WTR in the federal states from which the non-local neighbors came (in this case, the average of the WTR measure in Saxony and Saxony-Anhalt). Consequently, while our sample is restricted to natives, the average WTR in a community is constructed by adding up all inhabitants' WTR in a particular federal state, including former East Germans' risk attitudes (i.e., WTR of incoming movers), and dividing it by the number of inhabitants. The instrument is the one-year lagged average WTR of incoming movers' former eastern federal states.

We expect risk attitude to be relevant for the choice to move or to stay in a particular federal state. Figure 5 shows the distributions of WTR for West German natives and movers (i.e., people moving from any one federal state to another). We use the two-sample Kolmogorov–Smirnov test to determine if there are differences in the distribution for both groups. The p-value for the combined test is 0.089, such that the hypothesis that the two distributions are equal cannot be rejected. However, movers and natives can still differ, for example, with respect to their median value, which is the case here.[14] The correlation coefficient between being a native resident in former West Germany and WTR is -1.7%, albeit statistically significant. We therefore conclude that there is no economically relevant correlation. In contrast to Jaeger et al. (2010), we find no clear evidence for higher WTR and migration being associated as the relationship does not explain very much. This may stem from the rich dataset that is used.[15]

Figure 6 shows boxplots for the explanatory variable *WTR_community* per federal state. It indicates that there is significant variation of average WTR across federal states.

[14] The median value is 4 for movers and 5 for natives.

[15] Jaeger et al. (2010) investigate the 2004 and 2006 waves of the SOEP.

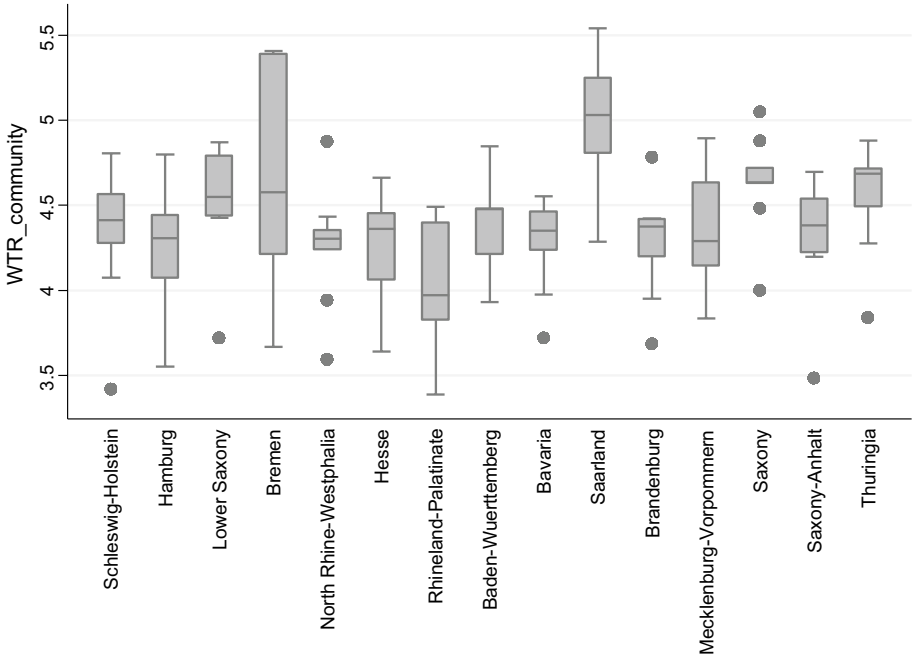

Fig. 6 Boxplots of the variable *WTR_community* per federal state. *Source:* SOEP v32.1, 2004–2015

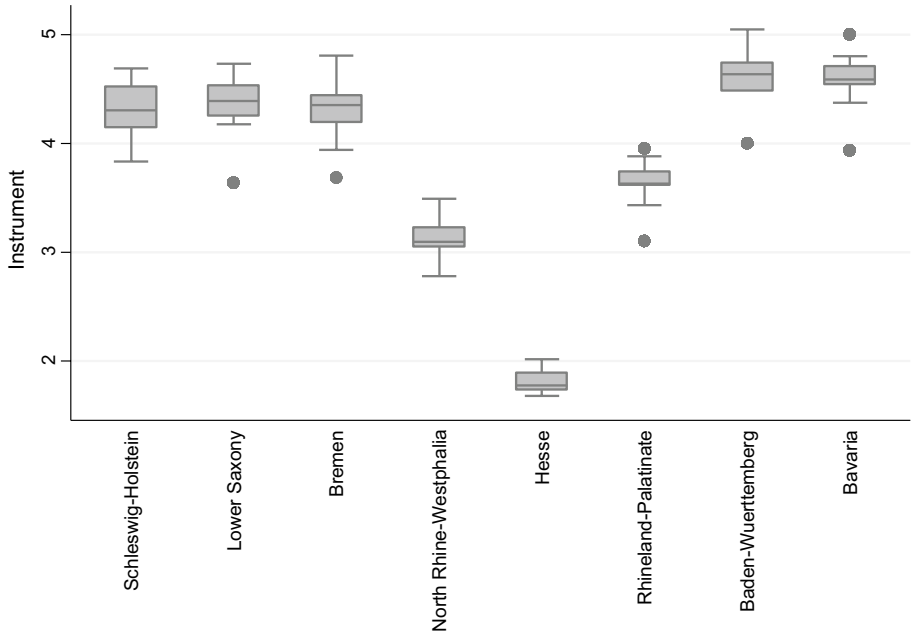

Fig. 7 Boxplots of the instrumental variable per federal state. *Source:* SOEP v32.1, 2004–2015

Variation seems to be even more pronounced in former East German federal states. The instrument uses data on the East German federal states' WTR to estimate community WTR and this variation then draws the identified effects. In order to have a closer look at the instrumental variable used to estimate WTR in the community, Fig. 7 presents boxplots for the instrument across West German federal states.[16] This figure illustrates the variation in our utilized instrument, which then drives the identified peer effects in a second step. Note that the median value as well as the maximum and the minimum of both WTR within community and the instrument significantly differ with respect to federal states.

4 Empirical analysis

4.1 Methodology

We analyze peer effects by investigating the impact of a community's risk attitude on the individual residing in this community. Individuals, however, are not randomly assigned to communities. Thus, the observed correlation between individual and community risk attitude could reflect unobservable influences (e.g., a common reaction to public information) that induce a spurious correlation. Furthermore, a main challenge to adequately capture peer effects is to separate geographic clustering from peer effects. Reverse causality has to be ruled out so that people do not move as they want to live close to people with similar risk attitudes (i.e., geographic clustering), but rather adapt their risk attitudes when moving from one area with a different level of risk attitude to another (i.e., peer effects). Our instrumental variables approach overcomes a potential endogeneity problem.[17]

For our purpose, we use SOEP data at the federal state level, which is representative of the entire German population within almost all areas (Knies and Spiess 2007).[18] Note that it contains only a small number of observations regarding postal or county code analysis due to few people moving from one region to another.[19] Using WTR as dependent variable and average WTR within a community as explanatory variable, we run an instrumental variables regression with clustered standard errors at the individual level to account for

[16] Note that Saarland and Hamburg are not presented in this figure as we do not include them in our analyses for having too few incoming movers.

[17] See Angrist and Pischke (2009) and Wooldridge (2015) for more information on the instrumental variables and two stage least squares (2SLS) estimation. Please refer to Angrist and Krueger (2001) for a brief exposition of the history and applications of the instrumental variable.

[18] It is noteworthy that a more detailed structural analysis would come with the challenge that for geographically smaller regional levels, the case numbers in the regions become too low to allow for statistically significant conclusions (Knies and Spiess 2007). See https://www.diw.de/en/diw_02.c.222519.en/regional_data.html for more information.

[19] This may be due to Germans being less willing to move within Germany. Note that our instrumental variable is constructed by adding up all non-natives' (lagged) average WTR of eastern federal states for each region and dividing it by the number of incoming movers. However, there are many regions in the postal code and county code analyses that do not have incoming movers. Thus, only a small number of observations could be studied due to the instrument having missing values for a large amount of observations.

potential within-individual error correlation.[20] The Hausman test indicates the necessity to use a fixed effects approach. Since our sample is restricted to natives, the individual fixed effects also control for time-invariant community characteristics. In addition, we use a combined measure of individual sociability, which we discussed in Sect. 3.3, to consider social interaction among people located close to each other (Hong et al. 2004; Brown et al. 2008). Hong et al. (2004) and Banerjee et al. (2013), for instance, state that social interaction may serve as a mechanism for information exchange by means of word-of-mouth communication or 'observational learning'. In comparison to Brown et al. (2008), who focus solely on church attendance, our measure of sociability is more targeted at the German population.[21]

Our empirical strategy follows Brown et al. (2008), who use an instrumental variables estimation to analyze the impact of peer effects in investment decisions. The authors suggest that the stock market participation of one's birth region can have long-lasting effects on one's own financial decisions regarding the stock market. They instrument for the average ownership within each native individual's community with the average ownership of the birth states of non-native neighbors. Our focus is on the German population, exploiting the relocation of many former GDR citizens after the fall of the Berlin wall in 1989. We strategically use the East–West migration after the German reunification instead of out-of-state movers in the United States. As briefly mentioned in the introduction, we consider whether individuals living in a West German federal state since 1989 (before and after the German reunification) adapt their WTR to their community's risk attitude by allowing for East–West migration. Former East Germans moving in this western region thereby allow us to define an instrumental variable that is not correlated with a native's WTR.[22]

As we restrict our sample of western community to natives, there is no reason to suspect that a native's individual WTR will be correlated with the average WTR in East German federal states except through their effects on her non-native neighbors. For instance, if one has lived in Frankfurt one's entire life and one's neighbor is from Brandenburg, it is reasonable to think that the level of risk attitude in Brandenburg may be correlated with that neighbor's risk attitude, but there is no reason to think that the level of risk attitude in Brandenburg should affect one's own risk attitude unless word-of-mouth effects are at play (see Brown et al. 2008). The average risk attitude in an individual's original federal state is potentially highly correlated with individual risk attitude due to long-lasting effects of the original federal state. We therefore instrument for the average risk attitude within a community with the average risk attitude of non-native neighbors' original federal states. The one-year lagged instrument looks as follows:

[20] Clustered standard errors account for possible correlations within a cluster and asymptotically equal unclustered standard errors. Since we cannot rule out that clustered standard errors are necessary, we include them to err on the side of caution.

[21] Note that particularly East Germany has low numbers of church members.

[22] Before the fall of the Berlin wall, GDR citizens were usually not allowed to migrate to West Germany. Even though every citizen had the right to apply for a permit to leave the GDR, applying for such permit usually had severe political repercussions from close observance from the *Staatssicherheit* (i.e., the national intelligence agency), job loss, and denial of higher education for the whole family to several years in jail. Despite this, around 250,000 GDR citizens migrated to West Germany between 1961 (erection of the Berlin wall) and 1989 (fall of the Berlin wall).

$$Instrument_{r,t-1} = \frac{\sum_m WTRoriginstate_{m,t-1}}{M}, \tag{1}$$

with $m \in \{1, 2, 3, \ldots, M\}$ representing all incoming movers (i.e., the individuals emigrated from East Germany) to a region r. For each individual in our model, which we introduce later in this section, we assign the corresponding region in which this individual lives. For our purpose, the one-year lagged average WTR of non-native neighbors' original federal states serves as an instrument so that WTR within a community can be treated exogenously in the second-stage regression of the 2SLS estimation.

In the first stage of our instrumental variables estimation, we regress the average WTR of a native individual's community on the average WTR of original federal states of this community's former GDR citizens. This instrument allows us to estimate the WTR in the community in a first step in order to treat this variable exogenously in the second stage of our instrumental variables approach. In this way, we are able to rule out sorting effects, that is, individuals potentially are more likely to move into communities where people have similar preferences. We also add all exogenous controls from the second-stage regression for factors that have been shown to impact the WTR as well as individual fixed effects, α_i, and year fixed effects, δ_t. Accordingly, we have the following first-stage regression model with the instrument average WTR of non-native community members' original federal states (one-year lagged):

$$\begin{aligned} WTR_{r,t} = {} & \pi_0 + \pi_1 Instrument_{r,t-1} + \pi_2 Sociability_{i,t} \\ & + \pi_3 X_{i,t} + \pi_4 X_{r,t} + \alpha_i + \delta_t + \varepsilon_{i,t}, \end{aligned} \tag{2}$$

with $i \in \{1, 2, 3, \ldots, N\}$ and $t \in \{1, 2, 3, \ldots, T\}$ where N is the number of individuals and T is the number of years. Note that r is the region in which individual i lives. $WTR_{r,t}$ refers to the average WTR in the western federal state r in year t.[23] In the following, $WTR_{i,t}$ is our outcome variable—individual i's WTR in year t. Our set of control variables is denoted by $X_{i,t}$ for time-varying individual controls and $X_{r,t}$ for time-varying community controls, which will be presented in Sect. 4.2. $\varepsilon_{i,t}$ represents the error term.

In the second stage, we regress individual WTR on the estimated WTR in the community. For our purpose, we use an individual's level of sociability and interact it with average WTR in the community and additionally include both single variables. We run a year and individual fixed effects model with clustered standard errors. Again, by restricting our sample to natives, individual fixed effects also control for time-invariant community characteristics. We receive the following second-stage regression model:

$$\begin{aligned} WTR_{i,t} = {} & \beta_0 + \beta_1 \widehat{WTR}_{r,t} + \beta_2 Sociability_{i,t} + \beta_3 \widehat{WTR}_{r,t} Sociability_{i,t} \\ & + \beta_4 X_{i,t} + \beta_5 X_{r,t} + \alpha_i + \delta_t + \varepsilon_{i,t}, \end{aligned} \tag{3}$$

with $i \in \{1, 2, 3, \ldots, N\}$ and $t \in \{1, 2, 3, \ldots, T\}$ where N is the number of individuals and T is the number of years. The results of our instrumental variables estimation are shown in Sect. 5. In the following, we introduce our set of control variables $X_{i,t}$ and $X_{r,t}$.

[23] Note that we use this expression synonymously to *WTR_community* throughout this article.

4.2 Control variables

The survey data include a variety of socio-demographic indicators that can be controlled for and that have been found to be associated with risk preferences in previous studies. In the present analysis, we use data for the years 2004, 2006, 2008, 2009, 2010, 2011, 2012, 2013, 2014, and 2015.[24] As individual fixed effects control for unvarying characteristics, we, for instance, do not have to account for individuals' sex.

The data include the control variables inflation-adjusted income[25], educational attainment, occupation, type of employment, home ownership, family status as well as dummy variables for German nationality and living in an urban area[26]. In addition, we account for the number of children per household that qualify for child allowance, age, squared age, as well as a dummy variable for living in one of the five largest German cities (*plz_majorcities*) to differentiate between city dwellers and provincials[27]. Family status, for instance, is found to be associated with the level of risk attitude of individuals (see, e.g., Halek and Eisenhauer 2001; Browne et al. 2019). Furthermore, it has been repeatedly shown that married individuals are more risk averse (see, e.g., Cohn et al. 1975; Riley and Chow 1992; Lin 2009). We include individuals' marital status to account for family structure by differentiating between single, married, widowed, and divorced persons. The omitted category is single.

We differentiate between blue-collar employees, white-collar employees, civil servants, and self-employed individuals to incorporate individuals' occupational status in our analysis. Moreover, we control for trainees[28] and retirees as well as for individuals without any gainful employment. We distinguish between those having no job despite being able and willing to work, which we refer to as unemployed people, and those who are currently not looking for work, such as housewives and disabled people. The omitted category in our analysis is blue-collar workers.

We account for the level of educational attainment by controlling for individuals who received a German Abitur. The German Abitur is the highest certificate awarded to high school graduates.[29] Other school-leaving certificates awarded to graduates, such as a medium school degree (i.e., the German Realschulabschluss) or a low school degree (i.e., the German Hauptschulabschluss), do not qualify for university enrollment. We use the medium school level as a reference category.[30]

Concerning time-varying community characteristics, we include the share of former East Germans in western communities as well as the average income. Furthermore, we control

[24] Risk preferences were not surveyed before 2004 and in 2005 and 2007. Data for 2004, however, is not part of the regression but used to derive lagged variables.

[25] Inflation-adjusted income is defined as the natural logarithm of monthly real after tax household income adjusted for inflation.

[26] The dummy variable *urban* is 1 if a person lives in an urban area, and 0 otherwise (definition according to the German Federal Office for Building and Regional Planning).

[27] Berlin, Hamburg, Munich, Cologne, and Frankfurt are the largest German cities in terms of population size in 2015.

[28] In cooperation with the state governments, German companies have extensive trainee programs where school graduates enroll in a two-year to three-year trainee program. Several weeks of instruction in a public specialized school are followed by several weeks of training on the job.

[29] Students who graduate with the Abitur are allowed to enroll at a university in Germany. An Abitur is comparable to the A-levels in the United Kingdom and the Baccalauréat in France.

[30] The main difference between the lowest and the medium school degree in Germany is related to the fact that most white-collar positions require a medium school degree, whereas certain blue-collar workers only need to have the lowest school degree.

Table 1 Summary statistics

Variable	Definition	Mean	SD	Min	Max
WTR	Individual's willingness to take risks; (0): risk-averse–(10): risk-prone	4.274	2.343	0	10
WTR_community	Average WTR in a given western federal state and year	4.293	0.335	3.385	5.409
Sociability	Individual's sociability index consisting of the variables *attend church*; *visit neighbors and friends*; *participate in local politics*; *attend cinema, pop and jazz concerts*; *hours spent on hobbies*; *perform volunteer work*; *attend cultural events*; (0): never—(14): very sociable	7.983	2.673	0	14
Instrument	Instrumental variable: average WTR of non-native community members' original federal states in a given western federal state and year	3.766	0.920	1.680	5.048
plz_majorcities°	(1): individual lives in one of the five largest German cities (i.e., Berlin, Hamburg, Munich, Cologne, or Frankfurt)	0.234	0.423	0	1
german_nationality°	(1): individual is a German citizen	0.899	0.301	0	1
urban°	(1): individual lives in an urban area	0.754	0.430	0	1
married°	(1): individual is married	0.675	0.469	0	1
widowed°	(1): individual is widowed	0.084	0.277	0	1
divorced°	(1): individual had a divorce	0.081	0.273	0	1
number_children	Number of children in household that qualify for child allowance	0.658	0.958	0	6
propertyownership°	(1): individual owns real estate	0.627	0.484	0	1
ln_real_aftertaxincome	Natural logarithm of monthly real after tax household income adjusted for inflation	7.887	0.575	0	10.343
highlevelschool°	(1): individual has a high level school-leaving certificate	0.212	0.409	0	1
lowlevelschool°	(1): individual has a low level school-leaving certificate	0.495	0.500	0	1
age	Age of individual	54.380	15.797	17	94
age_squared	Squared age of individual	3100.251	1743.423	289	9409
civilservant°	(1): individual is a civil servant	0.043	0.204	0	1
nojob°	(1): individual has no job	0.068	0.251	0	1

Table 1 (continued)

Variable	Definition	Mean	SD	Min	Max
trainee°	(1): individual is a trainee	0.028	0.165	0	1
whitecollar°	(1): individual is a white-collar worker	0.300	0.458	0	1
unemployed°	(1): individual is registered as unemployed	0.034	0.182	0	1
retired°	(1): individual is retired	0.321	0.467	0	1
selfemployed°	(1): individual is self-employed	0.048	0.214	0	1
share_EastInWest	Share of former East Germans in a given western federal state and year	0.014	0.011	0.003	0.133
share_GermanNationality	Share of German citizens in a given western federal state and year	0.899	0.032	0.829	1
mean_income	Average natural logarithm of monthly real after tax household income adjusted for inflation in a given western federal state and year	7.887	0.046	7.475	7.956
share_unemployed	Share of unemployed people in a given western federal state and year	0.036	0.013	0.015	0.182
share_urban	Share of people living in urban areas in a given western federal state and year	0.747	0.220	0.413	1

Notes: Summary statistics for all variables used in our analyses, 2006 and 2008–2015. 2004 data is missing as we use lagged variables. ° denotes indicator variables. *bluecollar*, *mediumlevelschool*, and *single* are used as omitted categories. *Source*: SOEP v32.1, 2004–2015

Table 2 OLS regression results

	Dependent variable: WTR		
	(1)	(2)	(3)
WTR_community	1.002*** [0.041]	0.635*** [0.155]	0.635*** [0.156]
Sociability		−0.094 [0.069]	−0.087 [0.069]
WTR_community × Sociability		0.031* [0.016]	0.029* [0.016]
Individual fixed effects	YES	YES	YES
Year fixed effects	NO	YES	YES
Control variables	NO	NO	YES
Individuals	2226	2226	2226
Observations	17,980	17,980	17,980
Adj. R-squared	0.532	0.533	0.534

Notes: A community is defined as West German federal state. Only native individuals are considered. Robust standard errors are reported in brackets and clustered at the individual level. *** Significant at the 1% level. ** Significant at the 5% level. * Significant at the 10% level. *Source:* SOEP v32.1, 2004–2015

for the share of German citizens, the share of people living in urban areas, and the share of unemployed people in western communities.

4.3 Summary statistics

Table 1 presents the descriptive statistics of the variables used in our analysis. The statistics are reported for the group of West German natives.[31]

5 Results

This section reports and discusses our empirical findings. Table 2 shows the ordinary least squares (OLS) regression results without accounting for an instrumental variable. The effect of average risk attitude in the West German community on the native individual is significant at the 1% level and positive throughout all three models. While Model 1 only includes individual fixed effects, Model 2 adds year fixed effects and Model 3 additional control variables presented in Sect. 4.2.[32] The coefficient estimates are very similar in size in Models 2 and 3, but much greater in Model 1. Year fixed effects seem to be relevant which is not surprising given that the observation period spans the global financial crisis.

As discussed before, we implement an instrumental variable to address a potential endogeneity problem. Table 3 summarizes the results of the first-stage regression. In this first stage of our instrumental variables estimation, a high correlation between the instrumental variable and the average WTR within a community can be identified. More precisely, the one-year lagged average WTR of non-native neighbors' original federal states serves as

[31] Natives are the focus of our analysis, while information on East Germans is used to construct (1) the average risk tolerance in a western federal state and (2) the instrument.

[32] Note that all regression tables including covariates are listed in the Appendix.

Table 3 First-stage regression results (2SLS estimation)

	Dependent variable: WTR_community		
	(1)	(2)	(3)
Instrument: WTR of non-native community members' original federal states (one-year lagged)	0.355*** [0.003]	0.426*** [0.011]	0.462*** [0.010]
Individual fixed effects	YES	YES	YES
Year fixed effects	NO	YES	YES
Control variables	NO	NO	YES
F-statistic of instrument (p-value)	11,851.29 (0.000)	1602.37 (0.000)	1977.55 (0.000)
Individuals	2226	2226	2226
Observations	17,980	17,980	17,980
Adj. R-squared	0.095	0.850	0.855

Notes: A community is defined as West German federal state. Only native individuals are considered. *WTR_community* is instrumented for with the one-year lagged average WTR of non-native community members' origin states. Robust standard errors are reported in brackets and clustered at the individual level. *** Significant at the 1% level. ** Significant at the 5% level. * Significant at the 10% level. *Source:* SOEP v32.1, 2004–2015

an instrument so that WTR within a community can be treated exogenously in the second stage. Model 1 estimates the impact of the instrument without any controls and year fixed effects. We find the instrument to be highly significant, with a coefficient estimate of 0.355. Model 2 adds year fixed effects to the analysis, which can be important as we investigate the WTR during times of the global financial crisis as well as the European sovereign debt crisis. Year fixed effects control for the interdependencies between WTR and economic and financial conditions, which have been shown to be important.[33] Again, we find our instrument to be significant at the 1% level and the coefficient estimate equals 0.426. Model 3 adds additional control variables. We find the results highly comparable to Model 2 in terms of significance levels and coefficient estimates, which should be interpreted as an indicator of robustness of our empirical findings. In summary, the estimates for our instrument are highly robust and we therefore conclude that the instrument is an adequate measure of community's risk preferences for our second-stage estimation.

Table 4 summarizes the results from the second-stage regression. In this main part of our analysis, we find strong empirical evidence for peer effects in risk preferences. Therefore, Hypothesis 1 can be confirmed. A major insight is that the instrumented *WTR_community* is significant at the 1% level in all four models that are used for analysis. As indicated by the fourth column in Table 4, a one-point increase in WTR within a community leads to an increase of individual WTR in this community by 0.810 points. However, we cannot confirm peer effects to be stronger for more sociable individuals as the positive coefficient is found to be significant only at the 10% level throughout all three models that include the interaction term.[34] Evidence is inconclusive with respect to Hypothesis 2.

Table 5 shows the second-stage regression results for the full sample (i.e., column (4)) from Table 4, while columns (4.1) and (4.2) refer to a subsample of male and female

[33] See Coudert and Gex (2008).

[34] When we use clustered standard errors at the federal state level, we obtain similar coefficients for peer effects and the interaction term. Note that the interaction term becomes significant at the 5% level. However, we prefer the more cautious approach with higher standard errors and a higher number of clusters. See Cameron and Miller (2015) for details.

Table 4 Second-stage regression results (2SLS estimation)

	Dependent variable: WTR			
	(1)	(2)	(3)	(4)
WTR_community	0.822*** [0.114]	0.885*** [0.276]	0.921*** [0.293]	0.810*** [0.304]
Sociability	−0.075 [0.055]	−0.065 [0.055]	0.038*** [0.010]	−0.055 [0.056]
WTR_community × Sociability	0.024* [0.013]	0.024* [0.013]		0.022* [0.013]
Individual fixed effects	YES	YES	YES	YES
Year fixed effects	NO	YES	YES	YES
Control variables	NO	NO	YES	YES
Individuals	2226	2226	2226	2226
Observations	17,980	17,980	17,980	17,980
Adj. R-squared	0.531	0.531	0.531	0.532

Notes: A community is defined as West German federal state. Only native individuals are considered. *WTR_community* is instrumented for with the one-year lagged average WTR of non-native community members' origin states. Robust standard errors are reported in brackets and clustered at the individual level. *** Significant at the 1% level. ** Significant at the 5% level. * Significant at the 10% level. *Source:* SOEP v32.1, 2004–2015

Table 5 Second-stage regression results for males and females

	Dependent variable: WTR		
	(4) Full sample	(4.1) Males	(4.2) Females
WTR_community	0.810*** [0.304]	0.473 [0.423]	1.150*** [0.439]
Sociability	−0.055 [0.056]	−0.091 [0.075]	−0.003 [0.081]
WTR_community × Sociability	0.022* [0.013]	0.031* [0.017]	0.009 [0.019]
Individual fixed effects	YES	YES	YES
Year fixed effects	YES	YES	YES
Control variables	YES	YES	YES
Individuals	2226	1068	1158
Observations	17,980	8658	9322
Adj. R-squared	0.532	0.514	0.518

Notes: A community is defined as West German federal state. Only native individuals are considered. *WTR_community* is instrumented for with the one-year lagged average WTR of non-native community members' origin states. Robust standard errors are reported in brackets and clustered at the individual level. *** Significant at the 1% level. ** Significant at the 5% level. * Significant at the 10% level. *Source:* SOEP v32.1, 2004–2015

individuals, respectively. We find that peer effects in risk preferences are particularly relevant for female individuals. For male individuals, the magnitude of peer effects is more than twice as small and nonsignificant.[35] Hence, Hypothesis 3, which states an equal impact of peer groups on the risk preferences of men and women, is rejected. Instead, we conclude that peer effects in risk preferences are stronger for females than for males. Our results are contrary to Balsa et al. (2015), who find evidence of peer effects in risk aversion for male individuals in a sample of adolescent high school students in Uruguay. The authors do not find robust results with respect to females. While Balsa et al. (2015) investigate gender differences experimentally and focus on adolescents, we test those empirically using data from a representative sample of the German population, which may explain the difference in the results.

6 Robustness

6.1 Definition of sociability

When we use another definition of sociability including only two variables (church attendance and neighborhood and friends visits), peer effects in risk preferences remain significant at the 1% level, while the magnitude of the coefficient is similar to our baseline approach.[36] In contrast to the baseline regression, however, the interaction term becomes significant at the 5% level. Peer effects thus are stronger for more sociable people, which confirms Hypothesis 2. Table 6 summarizes these findings using the sum of the variables attend church and visit neighbors and friends as sociability index.[37] Sociability is still negative but becomes significant at the 5% level. This indicates that the more sociable an individual is, the higher her level of risk aversion, ceteris paribus. Consequently, our approach is robust with respect to changes in the sociability index.

6.2 Education

Considering that similar studies (Ahern et al. 2014; Balsa et al. 2015) use an experimental sample based on groups with similar education, we are interested in identifying the impact of the level of education on the strength of peer effects. Table 7 presents our findings. Using two subgroups for people with and without the German Abitur, our results indicate that people without a university-entrance diploma adapt to peers' risk attitude while people with such a diploma do not. We conclude that more educated people have more stable preferences, which is in line with intuition.

[35] Note that for both sub-analyses, we find the instrument to be highly significant in the first stage.

[36] We include attend church (see Brown et al. 2008) and visit neighbors and friends (see Hong et al. 2004) to construct the sociability index. Since church attendance is less frequent in Germany, our definition of sociability here also involves information on how regularly people visit friends and neighbors to account for their local environment. Both activities refer to a person's social activities which are important when it comes to sociability.

[37] Note that the instrumental variable is found to be significant at the 1% level in the first-stage regression. This is also the case for the other robustness checks in this section.

Table 6 Robustness check: definition of sociability

	Dependent variable: WTR			
	(1)	(2)	(3)	(4)
WTR_community	0.792*** [0.114]	0.939*** [0.273]	0.971*** [0.295]	0.883*** [0.300]
Sociability (**visit neighbors/ friends + attend church**)	−0.314** [0.134]	−0.319** [0.139]	−0.013 [0.025]	−0.316** [0.141]
WTR_community × Sociability	0.070** [0.031]	0.072** [0.032]		0.071** [0.032]
Individual fixed effects	YES	YES	YES	YES
Year fixed effects	NO	YES	YES	YES
Control variables	NO	NO	YES	YES
Individuals	2226	2226	2226	2226
Observations	17,980	17,980	17,980	17,980
Adj. R-squared	0.531	0.530	0.531	0.531

Notes: A community is defined as West German federal state. Only native individuals are considered. *WTR _community* is instrumented for with the one-year lagged average WTR of non-native community members' origin states. *Sociability* is defined as the sum of attend church and visit neighbors and friends. Robust standard errors are reported in brackets and clustered at the individual level. *** Significant at the 1% level. ** Significant at the 5% level. * Significant at the 10% level. *Source:* SOEP v32.1, 2004–2015

Table 7 Robustness check: level of education

	Dependent variable: WTR	
	(4.1) Abitur	(4.2) No Abitur
WTR_community	−0.077 [0.553]	0.968*** [0.359]
Sociability	−0.075 [0.096]	−0.082 [0.065]
WTR_community × Sociability	0.027 [0.023]	0.028* [0.015]
Individual fixed effects	YES	YES
Year fixed effects	YES	YES
Control variables	YES	YES
Individuals	476	1793
Observations	3810	14,170
Adj. R-squared	0.576	0.519

Notes: A community is defined as West German federal state. Only native individuals are considered. *WTR _community* is instrumented for with the one-year lagged average WTR of non-native community members' origin states. Robust standard errors are reported in brackets and clustered at the individual level. *** Significant at the 1% level. ** Significant at the 5% level. * Significant at the 10% level. *Source:* SOEP v32.1, 2004–2015

Table 8 Robustness check: young vs. elderly population

	Dependent variable: WTR	
	(4.1) Age < 67	(4.2) Age ≥ 67
WTR_community	0.926*** [0.340]	0.651 [0.806]
Sociability	0.009 [0.065]	−0.219* [0.126]
WTR_community × Sociability	0.006 [0.015]	0.058** [0.029]
Individual fixed effects	YES	YES
Year fixed effects	YES	YES
Control variables	YES	YES
Individuals	1860	707
Observations	13,371	4609
Adj. R-squared	0.540	0.503

Notes: A community is defined as West German federal state. Only native individuals are considered. *WTR_community* is instrumented for with the one-year lagged average WTR of non-native community members' origin states. Robust standard errors are reported in brackets and clustered at the individual level. *** Significant at the 1% level. ** Significant at the 5% level. * Significant at the 10% level. *Source:* SOEP v32.1, 2004–2015

6.3 Age

In order to test whether peer effects in risk preferences differ for different age groups, we run an analysis for two subgroups: the young (17–66 years) and the elderly (67–94 years) population. We use the German statutory retirement age as of 2007 as threshold. Table 8 shows that preferences by younger individuals are more malleable, while older ones react less strongly to cues in their neighborhood.

6.4 Children

We include subsamples for parents and people without children to test whether children have an influence on the strength of peer effects. By using an indicator variable for parents, we still have adequate subsample sizes to investigate this question. Table 9 demonstrates the results. We find that peer effects in risk preferences are particularly relevant for parents. This is in line with intuition as parenthood is very likely to have an influence on the acceptance of others' advice.[38]

[38] However, people with children do not necessarily have to be (more) sociable. It is therefore crucial to differentiate between parenthood and sociability in this approach.

Table 9 Robustness check: parents vs. childless individuals

	Dependent variable: WTR	
	(4.1) Children	(4.2) No children
WTR_community	1.144*** [0.434]	0.730 [0.513]
Sociability	−0.067 [0.095]	−0.040 [0.072]
WTR_community × Sociability	0.023 [0.022]	0.019 [0.016]
Individual fixed effects	YES	YES
Year fixed effects	YES	YES
Control variables	YES	YES
Individuals	1658	1754
Observations	6869	11,111
Adj. R-squared	0.555	0.524

Notes: A community is defined as West German federal state. Only native individuals are considered. *WTR_community* is instrumented for with the one-year lagged average WTR of non-native community members' origin states. Robust standard errors are reported in brackets and clustered at the individual level. *** Significant at the 1% level. ** Significant at the 5% level. * Significant at the 10% level. *Source:* SOEP v32.1, 2004–2015

Table 10 Robustness check: married vs. unmarried individuals

	Dependent variable: WTR	
	(4.1) Married	(4.2) Unmarried
WTR_community	0.872** [0.360]	0.859 [0.684]
Sociability	−0.052 [0.068]	−0.060 [0.102]
WTR_community × Sociability	0.020 [0.015]	0.021 [0.024]
Individual fixed effects	YES	YES
Year fixed effects	YES	YES
Control variables	YES	YES
Individuals	1632	913
Observations	12,128	5852
Adj. R-squared	0.527	0.542

Notes: A community is defined as West German federal state. Only native individuals are considered. *WTR_community* is instrumented for with the one-year lagged average WTR of non-native community members' origin states. Robust standard errors are reported in brackets and clustered at the individual level. *** Significant at the 1% level. ** Significant at the 5% level. * Significant at the 10% level. *Source:* SOEP v32.1, 2004–2015

6.5 Marital status

Table 10 presents the results when differentiating between married and unmarried individuals. We identify significant peer effects in risk preferences for married people, while peer effects are similar in size but nonsignificant for unmarried individuals. A potential explanation could be that individuals who actively decide to get married might be more willing to compromise and to interact and agree with others. Moreover, children are still a major motive for marriage in modern German society[39], such that similar results seem plausible for subgroups of spouses and parents.

7 Conclusion

An increasing body of research documents peer effects in several domains of economic decision-making, where individuals' decisions may be driven by others' choices and their social norms rather than following individually rational expected utility maximization. These models of social preferences focus on relative payoff concerns and a preference to conform to others. They can be interpreted as rational behavior in the sense that social conformity may improve long-term utility. Peer groups, therefore, should have an influence on decision-making under risk and WTR. Furthermore, peer effects seem to be important in order to understand individual and group behavior as well. Exploring peer effects in risk attitudes is highly relevant for understanding the stability of individual risk preferences. Our paper contributes to the understanding of peer effects in risk attitudes by providing causal inference of large-scale community peer effects in a representative measure of the German population. We investigate the impact of average WTR in a federal state on an individual's WTR living in this federal state. While the effect of peer groups on risk aversion has already been studied experimentally for particular subgroups, we estimate peer effects in risk preferences using a large representative panel dataset of the German population. We find strong empirical evidence for peer effects in risk preferences. A major insight is that the instrumented WTR within a community is significant at the 1% level in all models that are used for analysis. Peer effects in risk preferences are particularly pronounced for females, less educated individuals, the young population, parents, and married individuals. In addition, peer effects are found to be stronger for individuals with higher social interaction; however, this result is significant only at the 10% level. The interaction term between community WTR and sociability becomes significant at the 5% level when considering only church attendance and neighborhood and friends visits.

The actual channel of how regional peer effects work is a very interesting, yet challenging question. Our analysis is based on the assumption that local cultures somehow exist which is also documented by the differences in the WTR in the different federal states (see Fig. 3). Unfortunately, our data does not enable to determine the actual channel through which WTR of the native individuals varies. The evidence that specifically female community members are affected by peer effects could be caused by two different channels: Either the peers that influence native females have closer bonds to their former eastern German residences (e.g., by family bonds) or native females may be more receptive to peer

[39] This is supported by the fact that the majority of children in Germany is born in families where parents are married (Statistisches Bundesamt (Destatis) 2017).

effects. Our data does not allow us to rule out one or the other possibility. In line with social role theory, women have been found to put more salience on their family role (see, e.g., Gutek et al. 1991). Assuming that peer effects are more pronounced within the same gender group, one channel of the observed gender differences in peer effects can be that former eastern natives who may interact specifically with female natives have closer ties into their former place of residence.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Appendix

Results for covariates

See Tables 11, 12, and 13.

Table 11 OLS regression results including covariates

	Dependent variable: WTR		
	(1)	(2)	(3)
WTR_community	1.002*** [0.041]	0.635*** [0.155]	0.635*** [0.156]
Sociability		−0.094 [0.069]	−0.087 [0.069]
WTR_community × Sociability		0.031* [0.016]	0.029* [0.016]
plz_majorcities			0.084 [0.444]
german_nationality			−0.703*** [0.271]
urban			−0.172 [0.354]
married			−0.335*** [0.120]
widowed			−0.654*** [0.208]
divorced			−0.162 [0.152]
number_children			−0.013 [0.026]
propertyownership			0.082 [0.076]
ln_real_aftertaxincome			0.037 [0.061]
highlevelschool			0.256 [0.265]
lowlevelschool			0.751* [0.417]
age			−0.030 [0.024]
age_squared			0.661* [0.345]
civilservant			−0.369* [0.212]
nojob			0.120 [0.105]
trainee			−0.074 [0.129]
whitecollar			−0.047 [0.080]
unemployed			−0.120 [0.114]
retired			−0.045 [0.110]
selfemployed			0.113 [0.150]
share_EastInWest			−1.857 [7.584]

Table 11 (continued)

	Dependent variable: WTR		
	(1)	(2)	(3)
share_GermanNationality			−1.615 [1.478]
mean_income			−1.185 [0.855]
share_unemployed			−0.782 [1.877]
share_urban			−1.448 [1.488]
year2008		0.038 [0.063]	0.002 [0.062]
year2009		−0.117 [0.116]	−0.180 [0.112]
year2010		−0.051 [0.081]	−0.093 [0.077]
year2011		−0.037 [0.065]	−0.105 [0.066]
year2012		0.055 [0.056]	−0.006 [0.059]
year2013		0.045 [0.081]	−0.019 [0.073]
year2014		−0.023 [0.064]	−0.060 [0.058]
year2015		−0.001 [0.062]	–
Constant	−0.028 [0.177]	1.250* [0.693]	13.985** [7.120]
Individual fixed effects	YES	YES	YES
Year fixed effects	NO	YES	YES
Control variables	NO	NO	YES
Individuals	2226	2226	2226
Observations	17,980	17,980	17,980
Adj. R-squared	0.532	0.533	0.534

Notes: A community is defined as West German federal state. Only native individuals are considered. Robust standard errors are reported in brackets and clustered at the individual level. *** Significant at the 1% level. ** Significant at the 5% level. * Significant at the 10% level. *Source:* SOEP v32.1, 2004–2015

Table 12 First-stage regression results (2SLS estimation) including covariates

	Dependent variable: WTR_community		
	(1)	(2)	(3)
Instrument: WTR of non-native community members' original federal states (one-year lagged)	0.355*** [0.003]	0.426*** [0.011]	0.462*** [0.010]
Sociability			0.001 [0.001]
plz_majorcities			0.021 [0.024]
german_nationality			− 0.024 [0.026]
urban			− 0.002 [0.023]
married			− 0.019* [0.010]
widowed			− 0.005 [0.017]
divorced			− 0.023 [0.015]
number_children			− 0.004** [0.002]
propertyownership			− 0.002 [0.007]
ln_real_aftertaxincome			− 0.003 [0.005]
highlevelschool			− 0.045 [0.037]
lowlevelschool			− 0.027 [0.041]
age			− 0.028*** [0.002]
age_squared			0.066* [0.034]
civilservant			0.009 [0.016]
nojob			0.001 [0.009]
trainee			0.010 [0.011]
whitecollar			0.002 [0.006]
unemployed			0.000 [0.009]
retired			− 0.006 [0.009]
selfemployed			− 0.016 [0.012]
share_EastInWest			− 10.066*** [1.764]

Table 12 (continued)

	Dependent variable: WTR_community		
	(1)	(2)	(3)
share_GermanNationality			−0.571*** [0.202]
mean_income			0.282*** [0.095]
share_unemployed			−1.349*** [0.229]
share_urban			−0.095 [0.125]
year2008		−0.440*** [0.005]	−0.417*** [0.006]
year2009		−0.985*** [0.004]	−0.920*** [0.006]
year2010		−0.323*** [0.008]	−0.225*** [0.009]
year2011		−0.284*** [0.004]	−0.177*** [0.005]
year2012		−0.136*** [0.004]	−0.002 [0.006]
year2013		−0.570*** [0.006]	−0.397*** [0.006]
year2014		−0.278*** [0.005]	−0.088*** [0.003]
year2015		−0.221*** [0.006]	–
Constant	2.958*** [0.012]	3.057*** [0.040]	2.858*** [0.791]
Individual fixed effects	YES	YES	YES
Year fixed effects	NO	YES	YES
Control variables	NO	NO	YES
F-statistic of instrument (p-value)	11,851.29 (0.000)	1602.37 (0.000)	1977.55 (0.000)
Individuals	2226	2226	2226
Observations	17,980	17,980	17,980
Adj. R-squared	0.095	0.850	0.855

Notes: A community is defined as West German federal state. Only native individuals are considered. *WTR_community* is instrumented for with the one-year lagged average WTR of non-native community members' origin states. Robust standard errors are reported in brackets and clustered at the individual level. *** Significant at the 1% level. ** Significant at the 5% level. * Significant at the 10% level. *Source:* SOEP v32.1, 2004–2015

Table 13 Second-stage regression results for a full sample (1–4) and a subsample of males (4.1) and females (4.2) (2SLS estimation) including covariates

	Dependent variable: WTR					
	(1)	(2)	(3)	(4) Full sample	(4.1) Males	(4.2) Females
WTR_community	0.822*** [0.114]	0.885*** [0.276]	0.921*** [0.293]	0.810*** [0.304]	0.473 [0.423]	1.150*** [0.439]
Sociability	−0.075 [0.055]	−0.065 [0.055]	0.038*** [0.010]	−0.055 [0.056]	−0.091 [0.075]	−0.003 [0.081]
WTR_community × Sociability	0.024* [0.013]	0.024* [0.013]		0.022* [0.013]	0.031* [0.017]	0.009 [0.019]
plz_majorcities			0.079 [0.446]	0.082 [0.448]	−0.321 [0.379]	0.990 [1.027]
german_nationality			−0.703*** [0.272]	−0.713*** [0.274]	−0.723* [0.273]	−0.694* [0.375]
urban			−0.169 [0.351]	−0.169 [0.354]	−0.158 [0.269]	−0.250 [0.638]
married			−0.339*** [0.120]	−0.332*** [0.121]	−0.364** [0.162]	−0.304* [0.184]
widowed			−0.655*** [0.208]	−0.648*** [0.209]	−0.596 [0.382]	−0.654** [0.267]
divorced			−0.165 [0.152]	−0.159 [0.153]	−0.104 [0.223]	−0.193 [0.216]
number_children			−0.013 [0.027]	−0.012 [0.027]	0.005 [0.038]	−0.030 [0.038]
propertyownership			0.081 [0.075]	0.079 [0.075]	0.015 [0.107]	0.153 [0.106]
ln_real_aftertaxincome			0.036 [0.062]	0.037 [0.061]	0.095 [0.084]	−0.016 [0.085]
highlevelschool			0.254 [0.275]	0.245 [0.276]	0.488 [0.358]	0.123 [0.356]
lowlevelschool			0.755* [0.426]	0.748* [0.425]	1.076 [0.776]	0.525 [0.458]
age			−0.029 [0.025]	−0.023 [0.026]	−0.036 [0.037]	−0.019 [0.035]
age_squared			0.648* [0.349]	0.593* [0.349]	0.878* [0.508]	0.473 [0.478]
civilservant			−0.366* [0.214]	−0.373* [0.213]	−0.150 [0.317]	−0.652** [0.273]
nojob			0.120 [0.104]	0.122 [0.105]	−0.037 [0.236]	0.044 [0.126]
trainee			−0.072 [0.128]	−0.072 [0.128]	−0.051 [0.188]	−0.162 [0.179]
whitecollar			−0.048 [0.081]	−0.047 [0.081]	0.049 [0.112]	−0.158 [0.116]
unemployed			−0.121 [0.114]	−0.122 [0.114]	0.040 [0.158]	−0.348** [0.162]
retired			−0.043 [0.110]	−0.039 [0.110]	0.016 [0.167]	−0.111 [0.145]
selfemployed			0.116 [0.150]	0.114 [0.150]	0.274 [0.208]	−0.085 [0.219]

Table 13 (continued)

	Dependent variable: WTR					
	(1)	(2)	(3)	(4) Full sample	(4.1) Males	(4.2) Females
share_EastInWest			−1.505 [7.954]	−1.514 [7.959]	−8.383 [12.784]	4.539 [9.421]
share_GermanNationality			−1.578 [1.530]	−1.719 [1.538]	−1.085 [2.110]	−2.341 [2.250]
mean_income			−1.282 [0.859]	−1.287 [0.862]	−2.463* [1.317]	−0.313 [1.118]
share_unemployed			−0.837 [1.894]	−0.664 [1.892]	1.228 [2.701]	−2.189 [2.626]
share_urban			−1.451 [1.522]	−1.492 [1.521]	−2.631 [2.227]	−0.495 [2.081]
year2008		0.103 [0.105]	0.007 [0.102]	0.031 [0.102]	−0.040 [0.149]	0.094 [0.140]
year2009		0.082 [0.280]	−0.142 [0.285]	−0.077 [0.286]	−0.418 [0.410]	0.234 [0.402]
year2010		0.061 [0.166]	−0.075 [0.156]	−0.042 [0.156]	−0.092 [0.226]	0.004 [0.216]
year2011		0.039 [0.117]	−0.098 [0.100]	−0.080 [0.099]	−0.217 [0.142]	0.044 [0.139]
year2012		0.095 [0.075]	−0.008 [0.061]	−0.005 [0.061]	−0.007 [0.089]	−0.005 [0.084]
year2013		0.154 [0.162]	−0.000 [0.125]	0.021 [0.125]	−0.019 [0.179]	0.057 [0.175]
year2014		0.044 [0.107]	−0.057 [0.071]	−0.048 [0.070]	−0.065 [0.101]	−0.034 [0.099]
year2015		0.047 [0.087]	–	–	–	–
Constant	0.509 [0.494]	0.098 [1.294]	13.430* [7.233]	13.822* [7.264]	24.903** [10.997]	4.484 [9.573]
Individual fixed effects	YES	YES	YES	YES	YES	YES
Year fixed effects	NO	YES	YES	YES	YES	YES
Control variables	NO	NO	YES	YES	YES	YES
Individuals	2226	2226	2226	2226	1068	1158
Observations	17,980	17,980	17,980	17,980	8658	9322
Adj. R-squared	0.531	0.531	0.531	0.532	0.514	0.518

Notes: A community is defined as West German federal state. Only native individuals are considered. *WTR_community* is instrumented for with the one-year lagged average WTR of non-native community members' origin states. Robust standard errors are reported in brackets and clustered at the individual level. *** Significant at the 1% level. ** Significant at the 5% level. * Significant at the 10% level. *Source:* SOEP v32.1, 2004–2015

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