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Essays on Economic History and Political Economy

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Dissertation

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To all the missing West Armenians...

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Abstract

This dissertation examines how historical events shape long-term socio-political and economic outcomes, focusing on memory, gender, and human capital formation. I use different historical shocks in quasi-natural experimental settings and apply state-of-the-art empirical methods to investigate the impact of war, memory, and geography on political behavior and economic development.

The first study asks whether family or collective memory plays a greater role in shaping political preferences. Using the case of Armenia it shows that both family memory and collective remembrance of perceived Russian "betrayals"—during World War I and again in 2020—continue to influence contemporary voting behavior. The second study asks how large-scale war affects gendered political behavior. It focuses on interwar Austria and examines the impact of World War I casualties. The findings show that war losses led to increased political engagement among women and contributed to long-term ideological shifts. The third study explores whether geographic variation in mortality drives human capital investment; focusing on 19th-century Armenia, it finds that areas with lower mortality rates experienced higher educational attainment and early demographic transitions. Together, these studies highlight the persistent influence of historical shocks on societies and contribute to research in economic history, political economy, and development.

General Introduction

Societies are often deeply influenced by wars, political alliances and betrayals, demographic shifts, and geographic constraints. My dissertation asks how these historical events leave long-lasting imprints on individual behavior, institutional trust, political preferences, and development paths. By focusing on different historical contexts—ranging from Russian betrayal during wars, to the societal upheaval that followed World War I (WWI), to the geographical determinants of mortality in the 19th century—this dissertation investigates how historical shocks and adverse periods affect subsequent socio-economic outcomes, including their impact today. Each chapter employs rigorous empirical strategies and draws on newly digitized historical data, to examine how past experiences inform contemporary behavior at both individual and community levels. Collectively, these studies contribute to the growing literature on historical persistence, political economy, and the determinants of long-run development.

The first chapter analyzes the role of historical memory—both familial and collective—in shaping political behavior. Memory, though intangible, is a powerful force in shaping political attitudes and choices. Drawing on two key episodes in Armenian history—Russia's failure to support Armenians during WWI and again during the 2020 Nagorno-Karabakh War—this chapter investigates how memories of betrayal influence voting behavior in modern-day Armenia. In both instances, Armenians expected military support from their ally Russia, only to be abandoned at critical moments. These events have become part of the national narrative, and they also operate at a personal level through family stories of trauma and loss. By exploiting the activation of historical memories triggered by the 2020 war, this study isolates the effects of family remembrance (traced through surname-based identification of the descendants of genocide survivors) and collective remembrance (proxied by Soviet-era renaming of localities to commemorate lost Armenian towns).

Using a difference-in-differences approach, the analysis shows that, after the 2020 war, both family memory and collective remembrance are associated with a significant decline in support for pro-Russian political parties. However, the mechanisms differ: family memory leads to reduced support through traumatic recall, while collective memory fosters political change via increased social capital and civic engagement. Only in collective memory localities does voter turnout rise, indicating a community-level mobilization around shared historical narratives. The study further shows that these patterns are not driven by selective migration, strategic campaigning, or other confounding factors. This chapter offers a rare empirical distinction between the roles of family memory and collective remembrance and contributes to the literature on political behavior, trust, social capital, and the economic consequences of historical narratives.

The second chapter (coauthored with Christian Ochsner and Monika Köppl-Turyna) investigates the gendered political consequences of war, with a focus on interwar Austria. The collapse of the Habsburg Empire and the devastating effects of WWI left Austrian society in a state of disarray, with high casualties, political polarization, and a fragile national identity. Using Austria's unique voting system between 1919 and 1931, which recorded electoral participation and party preferences separately for men and women, this chapter examines

how war casualties affected political behavior along gender lines. The data reveal that in municipalities with higher wartime fatalities, women's turnout in national elections increased significantly relative to men's, but no such effect was observed in local elections. This suggests that women were particularly motivated to engage in politics at the national level, possibly in response to questions of state legitimacy and national direction.

More strikingly, this increased participation was initially channeled into higher support for pan-German parties, which sought Austria's annexation to Germany and espoused extreme ethnic German ideology. These results challenge the traditional notion of women as conservative or status-quo voters and instead point to a more complex relationship between the degree to which a voter was affected by war and issues of national identity and political extremism. Over time, however, support for pan-German parties declined among women, indicating a potential shift in political preferences as the immediate effects of the war faded. The findings underscore the importance of considering gender in studies of post-war political behavior and demonstrate that wars do not only disrupt economies and kill soldiers—they also reshape the political landscape in gender-specific ways. This study expands existing research on conflict and political engagement by offering novel insights into the role of women in nation-building and the erosion of democratic institutions in post-conflict societies.

Chapter two is a joint work with Christian Ochsner and Monika Köppl-Turyna. I was responsible for merging and compiling the primary dataset used in this chapter. Monika provided the geocoded list of casualties, which I cleaned further. She also contributed additional data for robustness checks and mechanisms. Christian coordinated the digitization steps and developed the core econometric and historical framework. I conducted multiple rounds of regression analysis, with Christian and Monika collaboratively agreeing on the final specifications. I wrote the initial draft of subsections 2-5, which Christian and Monika revised. The introduction was a joint effort. Christian led the drafting of the initial and final versions of the manuscript, and we carried out subsequent revisions jointly.

The final chapter (coauthored with David Gomtsyan and Éric Roca Fernández) investigates the impact of geographic determinants of mortality on human capital investment in 19th-century Armenia. Using digitized archival census and parish records from a period of limited medical technology and low urbanization, the study explores how altitude-induced variation in disease environments affected mortality rates and, consequently, household decisions regarding fertility and education. Using newly digitized census and parish records encompassing over 22,000 individuals, the study reveals that higher-altitude regions—associated with lower disease prevalence and mortality—exhibited greater educational investment and underwent a fertility transition, shifting from high fertility to a focus on child quality. These findings offer empirical support for unified growth models that link life expectancy to human capital accumulation and economic development. Importantly, the study rules out increased female autonomy as a key driver and underscores the role of exogenous geographic factors in shaping long-term developmental trajectories. This research adds to the literature on geography and development by demonstrating how seemingly static geographic features can have dynamic, long-lasting impacts on human capital formation and demographic change.

Chapter three is a joint work with David Gomtsyan and Èric Roca Fernández. I was responsible for collecting and digitizing the primary dataset used in this chapter. David developed

the core econometric and historical framework and contributed additional data for robustness checks. I conducted multiple rounds of regression analysis, with the final specifications agreed upon collaboratively with David and Èric. Èric contextualized the paper within the broader economic literature and performed several robustness checks. David led the drafting of the initial version, while Èric took the lead in preparing the final manuscript. The subsequent revisions were carried out jointly by all three of us.

Together, these three chapters underscore the profound influence of historical events on modern-day behaviors and institutional outcomes. By employing a variety of empirical strategies—including difference-in-differences, archival data analysis, and innovative proxies for memory and mortality—the dissertation highlights both the direct and indirect channels through which historical shocks continue to shape societies. Thematically, the chapters address the interplay between historical experience and political behavior, the gendered consequences of war, and the role of geography in economic development. Methodologically, the work exemplifies how historical data can be used to answer contemporary economic questions, enriching both theory and empirical understanding.

This research makes several key contributions. First, it advances the literature on historical persistence by providing evidence that the mode of memory transmission—whether familial or collective—matters for political outcomes. Second, it contributes to the field of gender economics and political economy, revealing how war catalyzes gendered political engagement and reshapes state-society relations. Third, it offers novel empirical support for unified growth theories by linking geographic determinants of mortality to human capital investments and fertility transitions in a pre-industrial context.

By integrating historical data with modern econometric methods, this dissertation demonstrates that the past is not merely a backdrop to current events but an active force shaping contemporary economic and political landscapes. Understanding these long-run influences is crucial for both scholars and policymakers, especially in societies grappling with the legacies of conflict, trauma, and underdevelopment. The findings suggest that policies aimed at reconciliation, development, and state-building must account for the deep-rooted historical narratives and geographic realities that continue to shape human behavior today.

Chapter 1

Collective vs. Family Remembrance: Evidence from Two Russian "Betrayal" Policies

1.1 Introduction

The past resonates with the choices of the present. It is well known that memories and stories are important for group identity, coordination, and action.¹ Sociological and anthropological studies discuss behavioral implications of human memory (Halbwachs, 1973; Wagoner, 2018). Recent economic research documents how historical narratives and memories shape human behavior (Cantoni et al., 2020; Arbatli and Gomtsyan, 2019; Fouka and Voth, 2022; Ochsner and Roesel, 2024; Grossmann et al., 2024). However, most empirical studies consider remembrance as a "black box" and do not clarify how memories are formed and transferred and whether they affect the choices made by agents. When memories of a historical event are transmitted by ancestors who personally experienced it, the emotional intensity is much stronger, i.e., the memories of ancestors are often perceived as a part of one's own personal history.² In the case of collective transmission the emotional impact is less intense, more abstract, and less connected to personal identity.³ Behavioral differences

¹Bénabou and Tirole (2011) develop a model showing that identity investments are easily affected by minor manipulations of salience and attention, Bordalo et al. (2016) present a model of stereotypes and show when they cause belief distortions, Michalopoulos and Xue (2021) illustrate the impact of folklore on gender roles, risk attitude, and trust.

²Psychological and economic literature argues that trauma experienced by one generation can affect the psychological and emotional state and behavior of subsequent generations (Gutsell and Inzlicht, 2010; LaCapra, 2014; Alsan and Wanamaker, 2018; Yehuda and Lehrner, 2018).

³Social scientists discuss how societies shape and are shaped by their collective memories, emphasizing the role of education and public commemorations (Zerubavel, 2003; Assmann, 2011).

could be anticipated based on the mode of memory transmission, though this distinction remains largely unexplored in the existing empirical research.

To address the open question of whether remembrance by one's community or story-telling within families is formative for recall and action, an ideal experiment would randomly allocate individuals into families where story-telling about the past happens or into environments that remind individuals about the past. To the best of my knowledge, such settings have not been explored, and implementing an experimental design for this purpose would raise significant ethical concerns. However, two historical episodes from Armenian history provide a context that resembles the features of such a setting.

I study Armenian-Russian relations during World War I (WWI) and the recent Nagorno-Karabakh War (2020). In both episodes, Armenians perceived Russia as the main guarantor of their security. Russian troops initially gained control over Eastern Anatolia from the Ottoman Empire with the help of Ottoman Armenians. The Ottoman troops raped, killed, and kidnapped most of the Armenian population starting in 1915 to quash Armenian support for the Russian troops. These brutal events continued when Russian troops withdrew unexpectedly from the Ottoman Empire after the Revolution in 1917, leaving local Armenians without military protection. This allowed the murder and other related deaths of 1.5 million Armenians in the Ottoman Empire by Ottomans, an event referred to as the Armenian Genocide (1915-1920). As one of the influential Armenian political newspapers (Mshak, 1917) of that time wrote:

"[...] Russian social democracy is sacrificing a whole nation that had the naivety to trust Russia in the belief that it would save it from the centuries-old tyranny of the Sultans."

Following the end of WWI, cooperation between Russia and Turkey (known as a Lenin-Ataturk plan) dashed any hopes Armenians had of establishing joint autonomous Armenia. Under the terms of this agreement, Lenin returned the Western Armenian territories that Russian forces had initially gained to Turkey, and Russia sovietized Eastern Armenia (Nazaroff, 1922).

Around 300,000 Ottoman Armenians who survived the genocide resettled in Eastern Armenia (modern-day Armenia), carrying with them the traumatic memories of the Russian "betrayal" policy.⁵ This first "betrayal" policy of Russia has similarities to the Nagorno-

⁴In search of allies against the Turks, the Tsar visited the Caucasus front on December 30, 1914, telling the head of the Armenian Church that "a most brilliant future awaits the Armenians" (Hovannisian, 1969; Grabill, 1971).

⁵Modern-day Armenia is usually referred to as East Armenia, which includes the territories of historical

Karabakh war in 2020 when Russia once again did not help Armenia despite being its official ally.⁶ According to a Gallup International survey conducted during the war, approximately 80% of respondents anticipated that Russia would provide military support to Armenia (Gallup, 2020). However, Armenia lost the war, facing what many Armenians perceive as a repeated "betrayal" policy by Russia.⁷ For descendants of genocide survivors, this constitutes a second profound betrayal mirroring the experiences their grandparents endured a century ago.

The setting of activated memories allows me to disentangle family memory and collective remembrance of Russian "betrayal" policies. I rely on activation because it enhances the salience of memories, making them more vivid and immediate. Without activation, family memories could potentially merge into collective memories as discussed in the psychological literature (Halbwachs, 1973; Hirst and Manier, 2008). First, I trace the initial resettlement locations of genocide survivors (dummy treatment). Then, due to the distinctive spelling rules of Ottoman Armenian surnames (e.g., "ean" is a typical ending of a Western (Ottoman) Armenian surname, while "yan" is typical for Eastern Armenian), I identify the locations where the descendants of genocide survivors currently live (continuous treatment). Those locations in modern-day Armenia are exposed to Russia's "betrayal" policy through family remembrance. Family memory relies on individual family stories and past experiences of ancestors, which are transmitted intergenerationally (Wagoner, 2018). I show that sorting into settlement localities was arguably exogenous, based on anecdotal evidence of how chaotic and haphazard the resettlement was (Hovannisian, 1971) and the balance check of presettlement control variables.

I define localities with a collective memory of the Russian "betrayal" policy based on the arbitrary renaming of these places. As argued by (Halbwachs, 1973), place names contribute to the formation of collective memory alongside rituals, local stories, historical teachings, local symbols, and monuments. Notably, a number of localities in modern-day Armenia are named after places lost in the Ottoman Empire where Armenians lived before the genocide. Most of the renaming of Armenian localities occurred during the Soviet period in the 1940s,

Armenia in the Russian Empire and does not include the territories that lay in the Ottoman Empire.

⁶Russia has a military presence in Armenia today. Armenia and Russia signed a Treaty on Friendship, Cooperation, and Mutual Assistance in 1997 at the governmental, ministerial, and agency levels.

⁷The term "betrayal" is used here to describe a situation where one party (Armenia) expected another party (Russia) to act in their best interest based on formal alliances and historical ties. Betrayal occurs when latter party instead acts opportunistically, and prioritizes its own interests over the expected support or loyalty (Elangovan and Shapiro, 1998; Bigley and Pearce, 1998), thereby violating the trust of the former. In both World War I and the 2020 Nagorno-Karabakh War, Armenians perceived Russia's failure to provide anticipated support as a "betrayal" policy, given Russia's strategic choices that left Armenia vulnerable despite expectations of assistance.

a process that was highly centralized and controlled by Soviet authorities and did not correlate with the resettlement patterns of genocide survivors (Saparov, 2003). In addition to common names, some localities were renamed using the principle of "New + old name in the Ottoman Empire" (e.g., New Yerznka) or simply retained their "Old name in the Ottoman Empire" (e.g., Ayntap).⁸ A balance check of locality characteristics indicates that places with Ottoman names are not significantly different from those with more common Armenian names in terms of geographical and socio-economic features. I demonstrate that the Ottoman Armenian names of localities foster a collective memory of Russian "betrayal" policies through oral communication and memorial practices, thereby heighten historical consciousness.

Figure 1.1a shows that localities in Armenia can be divided into four different types: places with little-to-no remembrance of Russian "betrayal" policies (N = 690), places with collective remembrance (N = 84), places with family memory (N = 93), and places with both types of memories (N = 24).

[Figure 1.1 about here]

I use voting patterns to see whether family or collective remembrance of past events is more formative. In modern-day Armenia, political parties can be categorized into two camps based on their foreign policy orientation: pro-Russian and pro-European. Pro-Russian parties regard Russia as the primary guarantor of Armenia's military security and support Armenia's membership in the Eurasian Economic Union. In contrast, pro-European parties advocate for Armenia's accession to the European Union and favor reliance on European military support.

I compare localities with family and collective remembrance of Russian "betrayal" policies with localities without strong "betrayal" memory before and after the 2020 war in terms of pro-Russian party voting. Family memory relates to the loss of ancestors' lives, whereas collective remembrance relates to national suffering in general without any personal exposure to trauma. Thus, one would expect these different types of remembrance of "betrayal" could affect pro-Russian party voting differently.

I show that, when echoes of historical events reverberate, voters are reminded of the history and this impacts their votes. Figure 1.1b illustrates that places with family and collective memory voted similarly to those without memory for pro-Russian parties before the war in 2020. However, after memories of "betrayal" policy were activated, those places show a larger decrease in pro-Russian party voting compared to places without such memories.

⁸Yerznka and Avntap were Armenian localities in what became Turkey after 1923.

I estimate a difference-in-differences (DiD) model of pro-Russian party voting across family memory and collective remembrance places. The analysis reveals that, during parliamentary elections before the war, voters with family memory and collective remembrance voted for pro-Russian parties at similar rate to those without such memories and remembrance, indicating a parallel pre-trend. However, after the war, these voters show a decrease in support for pro-Russian parties by approximately 3.0 percentage points compared to those without "betrayal" memories. This change is significant, given that the average vote share for pro-Russian parties after the war is 34%, amounting to a relative decrease of around 9%. The effect size is comparable for both types of memories, with no additional effect observed when the two types of memories interact. So, localities in the collective memory group, which were not directly exposed to Russian "betrayal" policies either geographically or via residents living there, have an equally sizeable negative effect for pro-Russian party voting as family memory localities where individuals suffered from the loss of ancestral lives. Thus, even without any direct exposure, historical narratives embedded in collective memory and transferred solely by place names generate the same effect as the direct exposure of one's ancestors.

I examine whether the underlying mechanism differs for collective and family memories. Even though both types of memories decrease pro-Russian party voting, only collective memory motivates higher turnout rates (1.8 percentage points). Based on the turnout rates of relocated voters, I also find evidence that when voters move to a collective remembrance place, they are more likely to go to the polling stations to vote. In contrast, moving to family memory places does not change these voters' turnout. This indicates that family memory is in the "head" while collective remembrance is in the "shared environment". I also show that voters in family memory places have less trust towards towards state institutions and towards outsiders/people in general. They tend to live in localities with higher family ties (proxied by surname diversity) than those with collective memory. The context analysis of commemoration texts and family stories indicates a significant disparity between family and collective narratives, with family stories predominantly portraying personal tragedies and collective commemoration texts focusing more on positive and forward-looking messages for nation-building. All these factors support the hypothesis that collective memory acts through social capital, while family memory is more traumatic and is more often expressed as a shift from pro-Russian parties to pro-European.

I provide evidence against several concerns that might be thought to explain the results. In particular, I exclude that results are driven by voters with family memory choosing to live in collective memory places. I also show that the presence of residents with family

memory does not predict the collective memory renaming of the locality. The results are robust to alternative definitions of collective and family memory, as well as to the timing of activation, matching, and entropy balancing. I also exclude strategic campaigning as a trigger of memory activation by studying the spatial distribution of party posters during pre-election campaigns. This shows that memory activation was clearly demand-driven. Heterogeneity analysis indicates stronger collective memory effects in small and catchily-named (starting with "New") places.

Survey data shows that willingness to do business with Russians or willingness to marry Russians are not affected by any type of memory. However, the probability of Russia being considered a "main friend country" decreases with family memory of the "betrayal" policy. I suggest that anti-Russian sentiments are more against the state of Russia than they are against the Russian people. This makes anti-Russian sentiments strongly political and generally does not translate into a broader context. However, analysis of schooling outcomes shows that schoolchildren's behavior is expressed in the same direction as their parents in terms of anti-Russian sentiments in collective remembrance places.

This research builds on the theoretical models of remembrance and signaling on under- or over-reaction (Kahneman et al., 1982; Esteban and Ray, 2008; Bordalo et al., 2016) and contributes to the literature that documents empirical evidence on the links between history and current outcomes (Acharya et al., 2016; Cantoni et al., 2020; Arbatli and Gomtsyan, 2019; Ochsner and Roesel, 2020; Dinas et al., 2021; Fouka and Voth, 2022; Williams, 2022; Arbatlı and Gokmen, 2023; Ochsner and Roesel, 2024; Grossmann et al., 2024; Bühler and Madestam, 2024). However, in this study, I decouple the effect of family remembrance from collective remembrance. This contrasts with previous research, where these two types of memories have either not been studied in the same context or have overlapped in ways that obscure how memories are transmitted, in the sense that both place and ancestors were directly exposed to the past event.¹⁰

This study contributes to the literature on historical legacies with non-persistent effects, activated only under specific shocks to make the history salient (Fisman et al., 2014; Fouka

⁹In the Caucasus Barometer survey, people are asked "In your opinion, what is the main friend country of Armenia?"

¹⁰Dinas et al. (2021) combine historical and survey data with an experimental manipulation to show that family history of displacement increases sympathy for refugees. The effect is also present among those without a family history of forced migration who live in places with many refugees. However, this demonstrates the impact of family history spillover (often called *collected* memory) because those residing alongside refugees did not themselves suffer as a group. In the context of my research, people living in collective remembrance places are reminded of their nation's suffering. Moreover, my research is based more on institutional communication than on peer communication.

and Voth, 2022; Ochsner and Roesel, 2024), as opposed to work documenting lasting, permanent influences (Alesina and Fuchs-Schündeln, 2007; Voigtländer and Voth, 2012; Becker et al., 2016). Moreover, in this study, the activation context is studied from a new angle as a precondition for disentangling family and collective memories. I also contribute to the literature that connects naming with political views (Dal Bó et al., 2009; Arbatli and Gomtsyan, 2019; Williams, 2022), national identity (Kersting and Wolf, 2021; Jurajda and Kovač, 2021), labor market outcomes (Williams, 2021), and social mobility (Clark and Cummins, 2014; Olivetti and Paserman, 2015). However, the majority of the previous research treats naming as an outcome variable. Oto-Peralías (2018) documents some correlational evidence on how street naming affects the social and cultural characteristics of Spanish municipalities. My research documents causal evidence on how the naming of localities can activate collective remembrance and shape the political preferences of voters even when the residents of renamed places do not have any personal ties to the historical event.

My research contributes to the existing literature on the economic consequences of wars, conflicts, and hostile events (see Blattman and Miguel (2010); Rohner and Thoenig (2021); Munroe et al. (2023) for reviews). This body of work primarily addresses the direct material losses resulting from conflicts and provides limited evidence on the impact of wars on social structures.¹¹ My study extends this literature by documenting the intangible effects of wartriggered memories rather than direct war exposure.

My research also contributes to the social capital and trust literature (Alesina and La Ferrara, 2002; Tabellini, 2010; Nunn and Wantchekon, 2011; Besley and Reynal-Querol, 2014; Bracco et al., 2015; Mikula et al., 2023; Ramos-Toro, 2023) by illustrating how narratives alter the social fabric of societies, subsequently influencing political preferences. This study also adds to the literature on how traumatic events can durably alter financial (Malmendier and Shen, 2024; Arthi et al., 2024) and health (Alsan and Wanamaker, 2018; Archibong and Annan, 2021) outcomes by documenting an activated effect of intergenerational traumatic recall on political preferences.

Furthermore, this study broadens the economic literature on betrayal aversion (Bohnet and Zeckhauser, 2004; Bohnet et al., 2008), which demonstrates how the potential for betrayal influences decision-making behavior. While previous research has primarily focused on interpersonal betrayal, my study provides new empirical evidence on the perception of repeated "betrayal" policies by a country.

¹¹Bauer et al. (2014) provide evidence on how children in Georgia, shortly after the Russia-Georgia war, expressed egalitarian motivations toward their in-group. Henrich et al. (2019) show that war exposure increases people's religiosity.

Lastly, I also contribute to the literature on voting by showing that historical or quasi-experimental differences in long-past history are novel triggers for political preferences in addition to exposure to media (Gentzkow, 2006; DellaVigna and Kaplan, 2007; DellaVigna et al., 2014), and political protests (Madestam et al., 2013). The magnitude of my results aligns closely with those reported in existing literature.

The remainder of this chapter is as follows. Section 1.2 provides a historical overview. Section 1.3 introduces the data and definition of variables. Section 1.4 introduces the identification strategy. Section 1.5 shows the results of voting outcomes. Section 1.6 adds robustness exercises, including alternative definitions of treatment. Section 1.7 discusses the differential mechanisms of collective and family memories. Section 1.8 concludes.

1.2 Historical Background

I investigate how the activated memories of the Russian "betrayal" policy influence anti-Russian sentiments. I describe two episodes of Armenian history separated by one hundred years. I illustrate how these two events are similar and why the second event could have activated the memories of the first one.

1.2.1 The First Russian "Betrayal" Policy and its Consequences in the Early 20th Century

WWI. I focus on present-day Armenia in the South Caucasus. Before WWI, Armenia was divided between the Russian and Ottoman Empires. During WWI, Armenians in the Ottoman Empire supported Russian troops, in the expectation that, after the war, the Russian Empire would establish an autonomous Armenian state in certain territories of Turkey and Russia. As Hovannisian (1969) mentions, "Armenians are hurrying to enter the ranks of the glorious Russian Army [...] Let the Armenian people of Turkey who have suffered for the faith of Christ receive resurrection for a new free life under the protection of Russia." This, naturally, sharpened anti-Armenian sentiments in the Ottoman Empire. During WWI, the Ottoman Empire passed a Law of Deportation. The goal of the law was to prevent Armenians from supporting Russian troops who were fighting against the Ottoman Empire on the Eastern Front. However, in practice, the deportation involved mass

¹²In 1914, both Ottoman and Russian authorities sent representatives to the main leaders of the Ottoman Armenian community to appeal for Armenian support during WWI. In the end, Armenians ultimately decided to support Russian forces, considering Russia their liberator because Russian officials, including the Foreign Minister Sergey Sazonov, made promises of autonomy to Armenian representatives (Hovannisian, 1971).

expulsions and killings of the Armenian community in the Ottoman Empire. Death marches and killings became even more extensive after Russian troops unexpectedly abandoned the Ottoman Empire in response to the February Revolution in the Russian Empire and the political instability that followed. The ethnic cleansing is commonly referred to as the Armenian Genocide (1915-1920).¹³

The Armenian Genocide Museum has collected individual stories of genocide survivors. Most of them are descriptions of forced marches and killings of relatives. 18 (41%) out of 44 published stories also mention the retreat of Russian troops. For example, the son of a genocide survivor recalls his father's story on how Russian troops were retreating during WWI and what the situation was like in his city:

"Life had already started to recover in Bayazet. They wanted to reopen the school when news came that the Russians were retreating [...] I have no language to describe our situation [...] Retreating soldiers, tens of thousands of people and horses, cows, buffaloes, sheep, and the noise naturally produced by them who has lost his cow, who has lost his calf, who has lost his child or a relative."

Another story recalled by children of a genocide survivor describes how Armenians in the Ottoman Empire were expecting Russian troops to save them:

"My ninety-year-old grandfather was killed in front of my eyes. From morning until sunset, shots were constantly heard from all quarters of the village. [...] The only hope for salvation was the arrival of the Russian army but it was not there. People say it is far away."

The role of Russian policy during WWI is also intensively discussed in Armenian media. For example, one of the most influential political newspapers (Mshak, 1917) of that time writes:

"[...] Russian social democracy is sacrificing a whole nation that had the naivety to trust Russia in the belief that it would save it from the centuries-old tyranny of the Sultans."

These examples demonstrate that Armenians in the Ottoman Empire relied on Russian troop support. However, their expectations were not met, leading to the widespread perception a of Russian "betrayal" policy.

Resettlement. Many Armenians managed to evade the genocide and escaped to Eastern

 $^{^{13} \}mbox{Officially, } 31 \mbox{ countries recognized these events as genocide; source: $https://www.armenian-genocide.org/recognition_countries.html$

¹⁴Source: http://www.genocide-museum.am/arm/personal_histories.php.

Armenia (modern-day Armenia). According to Hovannisian (1971), about 200,000-300,000 genocide survivors resettled, amounting to around 30% of the Armenian population at that time (Korkotyan, 1932). Eastern Armenia was facing security, food shortage, and pandemic crisis. Hence, resettlement of survivors was not carefully planned or organized. After the end of WWI, the Treaty of Sèvres was signed in 1920. According to this treaty, 90,000 km^2 territory from the Ottoman Empire (the Western part of historical Armenia where the Armenian Genocide took place) should have been annexed to Eastern Armenia (the part in the Russian Empire) to establish an independent Armenian state. However, Lenin and Ataturk's cooperation led to the Treaty of Sèvres being frozen and replaced by the Moscow Treaty, ¹⁵ under which Western Armenia remained under Turkish control. In 1922, Eastern Armenia was annexed by the Red Army and became a part of the Soviet Union.

Locality renaming. In 1922, shortly after the resettlement of genocide survivors, 58.2% of Soviet Armenian localities had Turkish names, because, from the 15th century, many Eastern Armenian localities were inhabited by nomadic Turkish tribes, ¹⁶ who also changed Armenian locality names to Turkish ones. However, the Soviet system did not accept these Turkish names, because most were religious in nature (e.g., Molla), and there were many villages with the same name, which complicated postal services (Saparov, 2003). As a result, the Soviet Union initiated a centralized place-naming policy, which was carried out in several stages (Figure 1.A.1). The naming was highly centralized and went through 4 stages from the Geographic Commission of the Armenian Academy of Science to the Presidium of the Union of Soviet Socialist Republics (USSR) Supreme Soviet (Figure 1.A.2). This procedure suggests that local residents had essentially little to no role in deciding the name of their locality. There are several instances in which villagers attempted to rename their villages to reflect their ancestral heritage from Western (Ottoman) Armenia, but these attempts often failed for various reasons, including political and administrative barriers. The new names given to Armenian localities were mostly standard "neutral names" that, with a literal translation, would mean garden, water, forest, etc. However, some of them were given names of localities in the Ottoman Empire that were lost after the genocide. The Ottoman Armenian locality names were retrieved either by "New + old name in the Ottoman Empire" principal (e.g., New Kharberd, New Yerznka, New Hajn) or "Old name in the Ottoman Empire" (e.g., Sasun, Ayntap). After Armenian independence in 1991, there were still 128 (14%) localities with Turkish names that were renamed in a similar centralized way based on the decision of a

¹⁵The Treaty of Moscow, or Treaty of Brotherhood, was an agreement between the Grand National Assembly of Turkey, under the leadership of Mustafa Kemal, and Russia, under the leadership of Vladimir Lenin, signed on 16 March 1921.

¹⁶Turkish tribes residing in Eastern Armenia (also called Tatars) are different from Ottoman Turks.

renaming committee. Retention of a lost Ottoman-Armenian locality name was solely due to the historical awareness of the committee members.¹⁷ Table 1.A.1 summarizes the timing of Ottoman-equivalent renaming. It shows that in 90% of cases, the renaming occurred during the Soviet period.

1.2.2 The Second Russian "Betrayal" Policy in the 21st Century

Armenia declared its independence in 1991 after the collapse of the Soviet Union. However, after 1991, Russia continued to have a military presence in Armenia. Moreover, Armenia and Russia signed a Treaty of Friendship, Cooperation, and Mutual Assistance in 1997 at the governmental, ministerial, and agency levels. Since then, most Armenians have considered Russia to be the main guarantor of their security, and traditionally, pro-Russian parties have gained the majority of vote shares during parliamentary elections. According to available election data, pro-Russian parties gained, on average, 77% of the vote share in 2007-2018 across all localities in the sample studied.

In September 2020, a war escalated in Nagorno-Karabakh.¹⁸ During the war, Armenia appealed for Russian military assistance; however, it was not provided. Armenia also had contracts worth 250 million dollars with Russia, but the weapons ordered were not delivered. The war stopped after an agreement on the 9th of November 2020. According to the agreement, Azerbaijan took the majority of Nagorno-Karabakh under its control. After the war, following the ceasefire agreement, Russia sent a peacekeeping contingent of 1,960 servicemen to Nagorno-Karabakh. As a result of the war, 5,000 people died, 40,000 people lost their homes and property, and more than 17,000 civilian facilities and infrastructure were destroyed. There was a clear perception in Armenian society that they also lost the war to Turkey, because Turkey officially announced its support for Azerbaijan during the war.¹⁹ This was the first time since the independence that Armenians lost a war; this was a large

¹⁷The renaming committee consisted of different specialists, including historians, geographers, and linguists, as well as representatives from state and local institutions. There is anecdotal evidence regarding the naming of New Yerznka and New Kesaria. According to the account, a committee member had a chance encounter with the son of an Armenian genocide survivor from the diaspora. The survivor's son shared stories about his homeland in the Ottoman Empire, specifically Yerznka and Kesaria. This encounter later inspired the committee member to suggest the names New Yerznka and New Kesaria for the renaming. Later, this committee member recalled this event as motivation for his suggestion.

¹⁸The Nagorno-Karabakh conflict is an ethnic and territorial conflict between Armenia and Azerbaijan over the disputed region of Nagorno-Karabakh, inhabited mostly by ethnic Armenians, which was de facto controlled by the self-declared Republic of Artsakh but is internationally recognized as a de jure part of Azerbaijan.

¹⁹For more discussion see, for example, https://www.cbc.ca/news/politics/arms-sales-turkey-canada-1.5984453, https://www.gmfus.org/news/turkeys-overlooked-role-second-nagorno-karabakh-war.

shock to to Armenian society. According to the Armenian defense minister, a major reason for the loss was Turkish assistance to Azerbaijan and the absence of Russian support to Armenia. According to Gallup International surveys during the war, 80% of the respondents considered Russia to be the main guarantor and supporter of military security in Armenia (Gallup, 2020).²⁰ Hence, there were high expectations of Russian military help during the war.

This military loss led to a political crisis in Armenia, which eventually ended with parliamentary snap elections. During this election, pro-Russian parties had on average a 34% vote share across all localities in the sample studied (Table 1.A.3).²¹

1.2.3 Historical Parallels

After the war, narratives about the similarities of the historical events in the 20th and 21st centuries began to circulate in Armenian society and media. The first parallel between the Armenian Genocide and the 2020 war was made by the prime minister of Armenia who, during a speech after the first week of the war, mentioned:²²

"The aim of this war is to continue the Armenian Genocide.[...] However, today, here I want to say that Armenians, citizens of the Republic of Armenia, citizens of the Republic of Artsakh, are no longer travelers of Deir ez-Zor."²³

This speech garnered about 1.1 million views on the prime minister's official Facebook page. During another speech after the war, the Armenian prime minister stated in the Parliament:²⁴

"[...] During the 44-day war, our allies (Russia) have participated in the preparation of this war but not from our side. [...] They created an imitation that they want to help us, but it is not true [...]"

Figure 1.A.4 shows that Google searches of "Armenian Genocide" from Armenia have become more frequent since the 2020 war. Historians have also highlighted many facts and symbolic

²⁰Gallup International held a survey in Armenia during the 2020 war (30.10.2020) and asked the following question: "In your opinion, which country must guarantee the security of Armenia and provide military support?"; source https://gallup.am/.

²¹Historically, pro-Russian parties had large vote shares before 2018. There was a revolution by a pro-European political party, which explains the sharp decline in pro-Russian party voting in 2018. However, this decline does not differ in family and collective memory places compared to those without memory places.

²²Access to the speech in Armenian via https://www.youtube.com/watch?v=_0X4tVX58GQ.

²³The Deir ez-Zor camps were concentration camps in the center of the Syrian desert, where many thousands of Armenian refugees were forced into death marches during the Armenian Genocide.

²⁴Access to the speech in Armenian via https://news.am/arm/news/824834.html.

figures that were similar during the 1920s and 2020.²⁵ Armenian media was also full of narrative drawing parallels between Ruso-Turkish cooperation in the 1920s and 2020. For example, the following narratives appeared in Armenian media (see Figure 1.A.3):

"Russia betrayed us in this war [...] A hundred years ago, the Bolsheviks sold Armenia to the Turks, and now Putin did the same."

"Turkey and Russia are trying to give a second life to the Lenin-Ataturk plan[...]"

In addition, several historians initiated a YouTube channel called the "Russo-Turkish Trap" to highlight the parallels between current and past events in Armenian history from the perspective of Russian-Turkish cooperation. The weekly videos on this channel received around 10,000 views.

Another indication of anti-Russian sentiments is provided by Figure 1.A.5, which shows survey results for "Armenia's main friend country". After the 2020 war, the share of respondents considering Russia a main friend country decreased from 57% (2019) to 35% (2021). Given all these narratives by politicians, historians, and media, as well as survey and Google Trends statistics, I argue that the 2020 war activated memories of the century-old Russian "betrayal" policy.²⁶

1.3 Data and Treatment Definition

1.3.1 Data

I combine a battery of hand-collected archival data with official census and voting data. The main outcome variable is the voting results of national elections. Voting results and turnout rates for 2007, 2012, 2017, 2018, and 2021 for each polling station are publicly available on the official website of the Central Electoral Commission (CEC) of the Republic of Armenia.²⁷

²⁵One of the most discussed similarities is between the loss of Kars in 1918 and the loss of Shushi in 2020. Both were famous fortress cities: Kars in West Armenia (current territory of Turkey) and Shushi in Nagorno-Karabakh (current territory of Azerbaijan). However, both were lost quite quickly in unknown circumstances.

²⁶I do not consider any anti-Russian or pro-Russian sentiments after the first Nagorno-Karabakh war in the 1990s because Armenia won. The intuition is based on attribution, self-defense bias, and defensive attribution theories, which claim that a winner usually assigns the success to himself. In contrast, failures seek to find guilt in others.

²⁷The data for earlier election years (1995, 1999, 2003) is not available either electronically or in the archives. However, all parties that participated in earlier elections were pro-Russian. Hence, the outcome would not vary even if the data were available.

There are around 2,000 polling stations that are aggregated into 891 localities.²⁸ In addition, the CEC publishes signed lists of voters who have participated in elections since 2017. These lists contain the voter's name, surname, date of birth, address, and his/her signature if he/she went to the polling station and voted (see Figure 1.A.7 for an example). This rich dataset, which I digitalize, provides the gender and age structure of registered and participated voters. I create the gender based on the classification of names.²⁹ I also use the precise addresses of voters to construct a measure for Household (HH) size in each locality. I use the availability of surnames to define the ancestry of each voter and create a measure of the ancestral background of each locality as a proxy for family memory.

The other primary data sources for this chapter are two dictionaries: one for Armenian surnames and the other for Armenian geographical places. I use the first to classify surnames as Ottoman-Armenian, and the second to trace name changes of localities. I also use the Caucasus barometer, a repeated bi-annual cross-section survey. This survey contains a direct question about respondents' willingness to marry or do business with different nations, with one of the options being "Russians". I use school grade data of the Ministry of Education from 4 regions (40% of the main sample) to observe some behavioral changes among schoolchildren.

For geographical and historical demographic controls, I use Soviet census data from the Armenian National Archive. I use the Soil caloric suitability index from Galor and Özak (2016) for soil quality. In addition, Chopin (1852) contains data on the number of Muslims and native Armenians by gender and location in the 19th century. It also provides information on the number of domestic animals in each village. I source data on births, deaths, and marriages from 1840 to 1880 from Gharibyan et al. (2025) and further supplemented this data through additional digitization of Armenian parish records, providing a comprehensive basis for balance checks. To control for economic development and demography of localities, I have also collected data on locality budgets from their official websites and Armenian census.

Party classification (pro-Russia, pro-European, Nationalist) is based on the party's officially published election program. Each program has a section about the party's foreign relations direction, and principal partner countries are mentioned according to their relative importance. Being pro-Russian is indicated by considering Russia as the main guaranter of

²⁸I check if the share of invalid votes changes over time. Figure 1.A.6 confirms, that after the 2018 revolution, the share of invalid votes decreases. However, it is not different in family memory and collective remembrance localities over time, ensuring that potential concerns related to election quality changes could not bias the results.

²⁹For more details, see Appendix B.

military security in Armenia and supporting Armenia's membership in the Eurasian Economic Commission (EEC).³⁰ Pro-European parties are identified based on their support for joining the European Union (EU) and relying on European military support. Table 1.A.2 provides the classified list of parties. Appendix B provides more details on data, lists all relevant data sources, and describes the construction of my dataset. Table 1.A.5 shows the summary statistics for main voting outcomes and socio-economic and geographic variables in 2012 (pre-war) and 2021 (post-war). The average total population in the sample studied is around 1,400, with the highest population share in the 35-64 age group. The average per capita local budget annually is 3,200 AMD (\approx 8 EUR), which is relatively low compared to the capital Yerevan (\approx 200 EUR). The comparison of voting results in 2012 and 2021 indicates a sharp decline in turnout and in pro-Russian voting. Finally, the bottom panel shows the geographic characteristics of localities in the sample.

1.3.2 Treatment Definition

I use various historical sources to define the primary treatment variables. Family memory treatment relies on survivors' resettlement patterns and their distinguished surnames. To define collective memory localities, I track the timing of renaming and compare it to the pool of Armenian locality names in the Ottoman Empire.

Family memory. The dictionary of Armenian surnames by Avetisyan (2010) provides information on the origins of more than 18,000 Armenian surnames. Ottoman surnames are usually identified by Turkish word roots (e.g., Mejlumyan, Yakhshibekyan, Nabatyan), spelling rules typical to Western (Ottoman) Armenian³¹ or location roots in surnames (e.g., in surnames: Adanalyan, Yerznkyan, Erzrumtsyan Adana, Yerznka, and Erzrum were Armenian localities in the Ottoman Empire). I use these features to identify the share of voters with Ottoman ancestry. The second source is Hakobyan et al. (1986), which contains historical, geographical, and socio-economic information about Armenia's localities and surrounding areas. It lists the ancestral origins of current residents when it is known that their ancestors migrated from elsewhere. The treatment of family remembrance is defined in two alternative ways:

1. dummy: family memory = 1 if genocide survivors settled in the locality according to

³⁰Currently, there are five EEC countries: The Republic of Armenia, the Republic of Belarus, the Republic of Kazakhstan, the Kyrgyz Republic, and the Russian Federation.

³¹Western Armenian has quite distinct spelling rules from Eastern (current) Armenian. In Eastern Armenian, some groups of letters are not allowed to be written in the middle of a word, while it is allowed in Western Armenian (Eghiayean, 2022). In addition, Western Armenian surnames end with "ean" as compared to typical "yan" for Eastern Armenians, (Ishxanean, 1991).

the historical sources³²

2. continuous: family memory = share of voters with an Ottoman Armenian surname

Figure 1.A.8 illustrates that 2,209 out of 16,909 unique Armenian surnames are classified as Ottoman Armenian, comprising approximately 45% of the total voters. The distribution of Ottoman surname shares across localities shows a minimum value of 0.80%, a mean of 44.88% (with a standard deviation of 10.85), and a maximum value of 82.64%. One piece of evidence that villagers of family memory places are well aware of their ancestral background is documented in field interviews (Arbatli and Gomtsyan, 2019). During the interviews in two villages, which correspond to the family memory treatment in this study, Arbatli and Gomtsyan (2019) document that most villagers know several family stories about their ancestral homelands and the migration and settlement experience of their ancestors.

Collective memory. I define collective memory based on the naming year and the existence of the same or a similarly named Armenian locality in the Ottoman Empire before 1915. Collective memory = 1 if the following two conditions are satisfied at the same time:

- 1. naming year > 1920
- 2. there was an Armenian locality with the same name in the Ottoman Empire before 1920^{33}

Table 1.A.4 illustrates that, in fact, *collective memory* defined on the locality name is highly and positively correlated with the existence of a genocide memorial in the locality. However, the presence of genocide survivors does not increase the probability of genocide memorial construction (the coefficient is negative and insignificant).

There are two main reasons I define collective remembrance based on the locality's name rather than on the presence of a genocide memorial. Firstly, in all localities, naming occurred prior to construction of a memorial. Secondly, the treated sample of collective memory is larger (N = 108) if the definition is based on the locality name compared to the sample with a memorial (N = 24). However, However, I repeat the baseline regression with the collective memory defined on the memorials, and the main results do not differ.³⁴ I use the number of years since acquiring the Ottoman Armenian name as an alternative continuous measure of

³²The original 1926 census data is not available, and I use Hakobyan et al. (1986)'s dictionary, which is based on that census. For each place, the dictionary mentions where and when the ancestors of the current inhabitants came from if they were not natives.

³³There can be some minor spelling differences because of different grammar rules in West and East Armenian languages.

³⁴I perform another robustness check by combining naming and genocide memorial in one "combined collective" memory variable, and again, the main results remain stable.

collective memory in the robustness checks.

1.4 Identification Strategy

In identifying how family and collective memories influence voting preferences, I exploit the ancestral background and the naming of localities in the difference-in-difference (DiD) framework with four pre-treatment and one post-treatment periods. I check the conventional assumption of parallel pre-trend, orthogonality of treatment to observable characteristics, and the stability of demographic and socio-economic covariates after the 2020 war.

1.4.1 The Main Empirical Model

To understand if the repeated history triggers different behaviors across family memory and collective remembrance places, I use a DiD framework with the following specification:

$$Y_{it} = \alpha_i + \gamma_1(C_i \times Post2020_t) + \gamma_2(F_i \times Post2020_t) + X'_{it}\rho + \delta_t + \epsilon_{it}$$

$$i = 1, 2, ...891 \text{ and } t = 2007, 2012, 2017, 2018, 2021$$

$$(1.1)$$

Where Y_{it} describes outcomes (turnout, pro-Russian party vote share, pro-European party vote share) or survey data sentiments (willingness to marry Russians, willingness to do business with Russians, main friend country Russia, etc.) in locality i in national election year t. F_i is a locality-specific dummy that equals one if genocide survivors settled in the locality i according to (Hakobyan et al., 1986). As an alternative measure of family memory, I use the share of voters with Ottoman surnames. C_i is the collective memory dummy variable defined in Section 1.3. The reference group is the localities that do not have connections to the Armenian Genocide and Russian "betrayal" policies either through their residents' ancestry or via place name. The time specific dummy variable $Post2020_t = 1$ for national elections after 2020, and $Post2020_t = 0$ before 2020. γ_1 captures the effect of collective memory, γ_2 represents the effect of family memory.

I include locality fixed effects α_i to control for time-invariant local characteristics and election year fixed effects δ_t to capture political trends and temporal idiosyncrasies. X'_{it} is a set of control variables at the locality level, including the total number of eligible voters (in logs) and socio-demographic and economic covariates (total population (in logs), population shares of females, age group shares, the share of the Yazidi minority, and local budgets per capita). ε_{it} is the vector of the error term. I also run a specification where I interact year fixed effects with district fixed effects, distance to the Turkish border, and distance to the regional

capital. This accounts for potential triggers of specific regional differences that might matter after the war but not before.

The difference-in-differences models are estimated using ordinary least squares (OLS) applying the approach by Colella et al. (2023), which uses spatially clustered standard errors. I use the most conservative inference with a 40km spatial cutoff, which yields the largest standard error in the baseline model.

In the final sample, I include only localities with a population of less than 10,000 as of 2007, the earliest pre-treatment period. The sample comprises 891 localities, predominantly villages. Among these, 25 are small towns with definable ancestral backgrounds. Major cities in Armenia are excluded from the sample due to the predominant pattern of internal migration from villages and small towns to major cities. This migration makes the ancestral backgrounds of major cities ambiguous (i.e., Hakobyan et al. (1986)'s dictionary does not clarify the ancestral makeup of large cities in terms of East/West Armenian, likely due to the mixed heritage of their populations).³⁵

1.4.2 Identification Assumptions

Parallel trend assumption. Firstly, the key identifying assumption of the difference-in-differences approach is that localities with Russian "betrayal" policy memory follow a common trend in vote shares for pro-Russian parties that would have continued in the absence of war in 2020. Figure 1.2 shows the pro-Russian vote shares differences between localities with and without "betrayal" memory from 2007 to 2021 in an event-study setup. Family memory is defined in two alternative ways: i Ottoman surname share ii dummy indicator based on initial settlement as described in Section 1.3.2. Collective remembrance is measured by a dummy indicator based on the locality name. The coefficients of the event-study setup are standardized to the last pre-war election in 2018. The coefficients of differences in pro-Russian party vote shares are not significantly different from zero in the entire pre-war period for all types of treatment. Thus, pre-war trends do not differ between family vs. without memory and collective vs. without memory localities, indicating parallel pre-war trends. After 2020, however, pro-Russian party vote shares decreased in family memory localities compared to the without memory ones. The same pattern applies to collective memory and without memory localities after the war, localities with collective

 $^{^{35}}$ I repeat the main analysis for the full sample, including major cities (N=22). The definitions of continuous family memory treatment and dummy collective memory treatment are identical to those in Section 1.3. All large cities are assigned into the family memory=0 dummy group. The main results remain stable in magnitude and significance, as shown in Table 1.A.18.

memory voted less for pro-Russian parties.

Balance of treatment. The second underlying assumption for identification is the orthogonality of genocide background to observable characteristics before the resettlement of survivors. Oral evidence suggests that resettlement occured in an unsystematic manner (Hovannisian, 1971). What historical sources report about resettlement is more consistent with a haphazard settlement process than planned location choices. Many migrants initially considered their new homes temporary as they had high hopes of returning to their homelands. Thus, I do not expect to find any systematic resettlement patterns other than geographic patterns, such as proximity to the Turkish border. To test this, I collect data on the geographical features of localities. Pure mean comparisons reported in Table 1.A.5 show that family memory localities tend to be closer to the Turkish border. However, there are no significant differences once conditioned on the district fixed effects, as shown in Panel (a) of Figure 1.3.

[Figure 1.3 about here]

Figure 1.3 also provides empirical tests on whether geography predicts collective memory of the localities. All geographic controls, including the soil caloric suitability index (log), minimum and maximum temperature (log), ruggedness of the terrain (log), distance to the Turkish border (log), and distance to regional capital (log) are balanced.

In addition, Figure 1.3 shows the balance of control and treatment groups on pre-settlement (1831-1878) socio-demographic and economic covariates. Most of the features are balanced across treatment and control groups. In particular, average age, average death age (as a proxy for health conditions), female marriage age (as a proxy for female autonomy), and the number of per capita draft animals and cows (as proxies for economic conditions) do not predict the resettlement location. The only exception is that the share of Muslim³⁷ population is higher in family memory localities.³⁸ This is because most of the Muslim

³⁶There might be concerns that genocide survivors would have migrated from Armenia after their resettlement in 1920, following Armenia's annexation into the Soviet Union (1922). However, due to restrictive migration policies enforced by the Soviet Union, only an estimated 5-6% of resettled genocide survivors left Soviet Armenia (source: https://hetq.am/hy/article/80215). Assuming that those who managed to migrate were more anti-Russian than those who stayed, the results presented in this study should be considered a lower-bound estimate.

³⁷The term "Muslim" is a literal translation from 1831 Russian census.

³⁸The data on pre-1915 covariates is not fully available in the Armenian National Archive. For some localities, this is because they did not exist before 1915. However, for some localities, parish records were not saved. I check that the missing data is not correlated with either collective or family memory treatments (for more details, see Appendix B).

populations, who fought on the Ottoman side, left their villages in Armenia after WWI. Afterward, some groups of genocide survivors resettled in those abandoned places.³⁹

Balance of controls. Third, I check the balance of demographic and socio-economic covariates before and after the 2020 war. Figure 1.3 tests for this crucial difference-in-differences assumption. I choose total population (log), and the share of women from the most recent pre-war Census in 2011. Data on age groups, household size, and local budgets are from 2017. I take the latest pre-war election data from 2018 to compare voting behavior.

Panels (a) and (b) show the mean differences between memory (family: continuous and dummy, collective: dummy) and without memory localities, conditioned on district fixed effects for the pre-war and after-war periods, respectively. Panel (c) reports difference-in-differences estimates that compare the change in differences between panels (a) and (b). The first row previews the pro-Russian vote share differences as the main outcome. Pro-Russian vote share decreased from 2018 to 2021 in family and collective memory places compared to those without memory. There are no differences in the numbers of eligible voters, showing that the shift in voting does not result from an extensive margin. For voter turnout, I observe an increase in collective remembrance localities in the after-war period and a decrease (dummy) or no change (continuous) in the family memory localities. The average HH size, female share, total population, and local budget per capita do not differ before or after the war. The number of 2020 war deaths is also balanced across treatment and control groups. The only demographic indicators that differ somewhat are "16-35" and "> 60" age group shares. However, the difference is negligible. I also include age group shares interacted with year fixed effects in the main empirical specification.

1.5 Results

Table 1.1 shows the main results from the difference-in-differences estimations. Column (1) shows the difference-in-difference estimate for combined memory (either collective or family) without any control variables except locality and year fixed effects. Column (2) includes district fixed effects interacted with year fixed effects, geographical controls (ruggedness of the terrain, distance to Turkish border (log), distance to the regional capital (log)) interacted with year fixed effects, pre-treatment controls (share of female population, shares of age groups, the share of Yazidi minority, local budget per capita) interacted with year fixed.

³⁹To alleviate concerns that resettlement in previously Muslim-populated areas could be another trigger of remembrance in the robustness checks, I restrict the family treatment to only localities newly founded by genocide survivors, and the main results remain stable in terms of magnitude and significance.

These interaction terms control for potential regional characteristics that may change over time, i.e., regional campaign capacity in the respective region or the role of closeness to the Turkish border in activating memories. The control variable that varies over time is the electorate in the log. The results show negative and statistically significant effects of "betrayal" policy memory (combined) and war interaction on pro-Russian party vote shares.

[Table 1.1 about here]

Columns (3)-(4) compare collective memory and family memory localities with the localities without memory. Columns (5) and (6) also add the interaction of two types of memories. Again, I find a negative and statistically significant effect of family and collective memories on pro-Russian voting. There is no boosting effect when two types of memories interact. However, this result should be interpreted with caution, because only 24 localities have both types of memories in the studied sample and there is insufficient power to estimate it.

Table 1.1 shows that both collective and family remembrance drive voting behavior in the same direction. On average, after the 2020 war, the vote share of pro-Russian parties in family memory localities decreased by around 3.5 percentage points relative to the vote shares in localities without memory. Similarly, after the 2020 war, pro-Russian parties' vote share in collective memory localities decreased by around 3.0 percentage points relative to the vote shares in localities without memory (relative size is 9%). This means that 1 out of 11 (12) voters did not vote for pro-Russian parties due to family (collective) "betrayal" memory. I also test the hypothesis $H_0: \gamma_1 = \gamma_2$ and do not find evidence to reject it (p = 0.82), which confirms that both collective and family remembrance have similar effects on pro-Russian party voting.

Table 1.1 also reports the effect size of both types of memories (partial R^2). Naturally, the combined memory in columns (1)-(2) has the highest effect size. When decoupling the effect size, I find similar effect sizes for both types of memories. So, indirect collective exposure to the Russian "betrayal" policies results in significant negative voting for pro-Russian parties. This effect is comparable to the negative voting observed when the memories of the "betrayal" are activated for those individuals whose ancestors were directly exposed to the "betrayal" policy.

Inferences in Table 1.1 are based on the largest standard errors given by a cutoff of 40 kilometers for spatial-dependent standard errors. In Table 2.B.4, I carry out robustness checks with different cutoffs, and the results are robust to all ways of clustering.

1.6 Robustness

I test robustness in a DiD framework. Section 1.6.1 introduces alternative continuous treatments, Section 1.6.2 addresses voter sorting, Section 1.6.3 balances pre-war covariates, Section 1.6.4 considers pseudo-activation periods, and Section 1.6.5 checks party classification.

1.6.1 Alternative Definitions of Memory

To address concerns about internal migration following the resettlement of genocide survivors and to measure treatment intensity, I define alternative measures of treatment. I construct a continuous treatment variable of family memory based on the surnames of voters in 2021 to address migration concerns related to constructing a categorical family treatment variable based on historical sources. This approach is based on research that documents the informativeness of family names even in ethnically homogeneous populations (Güell et al., 2014). Specifically, I calculate the share of Ottoman surnames for each locality. I also replace the dummy indicator of collective memory with the number of years the locality has held the collective memory name.

Columns (1)-(2) of Table 1.2 repeat the results of columns (3)-(4) of Table 1.1, replacing the indicator variables of family memory and collective remembrance with continuous counterparts. Results are robust to continuous measurement of the treatments. A one percentage point increase in the share of Ottoman surnames among voters (the average share is 45%) decreases pro-Russian voting by 0.09 percentage points (on average $4.0 \approx 0.09 \times 45$ percentage points), and one additional year of a locality being known by a collective remembrance name (the average is 44 years) decreases pro-Russian voting by 0.04 percentage points (on average $2.0 \approx 0.04 \times 44$ percentage points). The latter indicates that earlier renaming signals longer exposure to a symbolic reminder, which plausibly strengthens collective memory. The interaction term remains insignificant as in the main specification.

Through three robustness checks, I address potential concerns related to changes from Ottoman to non-Ottoman surnames. First, I calculate the proportion of households with at least one member holding an Ottoman surname (columns (3)-(4)). The results are both quantitatively and qualitatively consistent with those presented in columns (1) and (2) of Table 1.2. Second, I verify that changes from Ottoman to non-Ottoman surnames are extremely rare (less than 0.1%), making it unlikely that these changes could bias the results. ⁴⁰ Lastly, I conduct simulations in which I increase the number of voters with Ottoman surnames by 10%, 20%, 30%, and 70%, respectively, by randomly assigning Ottoman surnames

⁴⁰For further details, see Appendix B.

to individuals with non-Ottoman surnames. As illustrated by simulations in Figure 1.A.10, the baseline estimate in Table 1.2 serves as a lower bound.

In columns (3)-(4), the family remembrance treatment sample is restricted to the new localities that genocide survivors established, and the localities that just hosted genocide survivors are excluded from the sample. The results are robust in terms of the signs and significance of the main coefficients of interest. Moreover, I observe a slightly higher effect (around 4.0 percentage points) as compared to the main specification (around 3.0 percentage points). This check excludes the alternative explanation that a high share of the Muslim population in the pre-settlement period could be another trigger of genocide and Russian "betrayal" policy memories, as discussed in Section 1.4.

[Table 1.2 about here]

1.6.2 Sorting

I check whether the results are driven by voters with family memory choose to live in collective remembrance places or by their impact on the collective naming of their locality. In columns (1)-(2) of Table 1.A.6, I carry out an analysis for the sample that excludes Ottoman name localities to address some potential concerns connected to the selective migration of genocide survivors' descendants to Ottoman name places. The significance and magnitude of the coefficients remain stable, confirming that the results are not driven by selective migration. Columns (3)-(4) test the effect of collective memory, excluding localities with family memory from the sample, and again, results remain stable. In columns (5)-(6), the collective memory treatment effect is estimated with respect to a subsample of the control group. In this subsample, I keep only those places without memory that were renamed after 1920. This control group is closer to the collective memory group in terms of naming background, and addresses concerns related to the selective renaming process (e.g., localities that were not renamed after 1920, thus keeping their old historical names could potentially have a different social capital structure to resist the decisions of Soviet authorities). As Table 1.A.6 confirms, the negative effect of 2-3 percentage points for pro-Russian voting remains stable. Table 1.A.7 also tests whether collective memory correlates with the continuous family memory measure (share of Ottoman surnames), i.e., if residents with family memory choose to live in collective memory places. I test this for the full sample and restrict the sample to only those localities that were renamed after 1920. The insignificant and negative coefficient of the Ottoman surname share from OLS estimation does not support the selective migration hypothesis.

1.6.3 Matching

As discussed in the Results section, treatment and control groups of localities may have some different characteristics. Among other reasons, this is due to their differences in proximity to the Turkish border and the resulting economic and demographic trends. I have already addressed such concerns by interacting geography variables and pre-treatment controls with year fixed effects. I introduce propensity score matching and entropy balancing (Hainmueller, 2012) to balance localities over pre-war covariates. Table 1.A.8 shows the results of the balancing procedures. In column (1), balancing and matching are done on the 2012 census population, in column (2) on geographical features (ruggedness of the terrain, distance to the Turkish border (log), distance to the regional capital (log)), in column (3) on demography (age groups, household size, female population share, Yazidi minority share), in column (4) on local economic development measured by local budget per capita. All point estimates remain negative and mostly significant. Thus, the effects are not driven by pre-war differences that might act as salient markers to activate history.

1.6.4 Timing of Treatment

I examine whether memories influenced election outcomes prior to the onset of the 2020 war. A potential concern is the 2018 revolution, which brought a pro-European party to power in Armenia. If anti-Russian sentiments had already been gaining traction following the revolution, a decline in pro-Russian voting would be expected as early as 2018. In Table 1.A.9, I interact the 2018 period with two types of memories and do not find any significant effect on the pro-Russian party vote share in 2018. I also add the interaction with the year 2018 in the main specification of Table 1.1, and the main results remain unchanged. These results confirm that both memory (collective and family) and the war (memory activator) are key to shaping anti-Russian sentiments. In addition, I repeat Table 1.1 while excluding parties that were in the government. The results remain stable as shown in Table 1.A.10. This finding rules out the possibility that voters' choices are primarily shaped by government-opposition dynamics. Instead, the persistence of the effect implies that memory activation directly influences attitudes toward Russia, independent of contemporary political considerations. This strengthens the argument that historical narratives, rather than strategic or partisan motivations, play a crucial role in shaping electoral behavior.

1.6.5 Party classification

Finally, I reclassify parties using LLM-based NLI models: facebook/bart-large-mnli (Lewis et al., 2019) and MoritzLaurer/deberta-v3-large-mnli-fever-anli (He et al., 2021). Parties are classified into pro-Russian, neutral, or pro-European, then collapsed into a binary pro-Russian variable. Table 1.A.2 reports results across multiple strategies (Base, Softmax, Polar, Margin, Logit). Coefficients remain similar, confirming robustness to classification.

1.7 Mechanism

This study shows that memories of the distant past transferred either through families or locality names (collective remembrance), once activated, can influence the voting behaviour of individuals. This section investigates the mechanisms at work in more detail. First, I employ other voting outcomes in Section 1.7.1 and show that collective memory motivates post-war turnout while family memory does not. I then study the social fabrics of localities in Section 1.7.2. Section 1.7.3 studies the turnout rates of movers, and Section 1.7.4 describes the contextual differences between family and collective recallections. I also test for strategic campaigning (Section 1.7.5) and employ survey and schooling data for different measures of anti-Russian sentiments (Section 1.7.6). Heterogeneous effects are analyzed in Section 1.7.7. Lastly, I examine the effects of US and Russian ties on voting in Section 1.7.8.

1.7.1 Other Voting Outcomes

First, I investigate the underlying mechanism behind voting behavior. I consider whether voters in the memory places changed their political preferences or whether the effect is due to a change in voting turnout rates. Table 1.3 reports the results for three additional voting outcomes: turnout, and vote shares for pro-European parties and for nationalist parties. Columns (1) and (2) demonstrate that voter turnout increases exclusively in areas associated with collective memory, with no observed effect in localities linked to family memory.

Collective memories of historical events carry significant cultural and symbolic weight. They represent pivotal and challenging moments in a nation's history, evoking a sense of collective responsibility. This feeling may motivate individuals to engage more actively in the democratic process, including voting. Family memories, while meaningful and emotionally significant within the family, may not carry the same level of historical or symbolic weight

that collective memories do, potentially leading to little-to-no effect on turnout rates.

In columns (3)-(4) of Table 1.3, the outcome variable is the share of nationalist parties. Here, neither family memory nor collective remembrance motivate nationalism, and if anything, the effect is negative. However, this observation should be interpreted with caution, because nationalist parties began participating in elections in 2018 and it is not possible to observe the variations in voting for nationalists prior to 2018. In columns (5)-(6), the outcome variable is the share of pro-European parties. Here, both family memory and collective remembrance positively affect share of votes for pro-European parties, with a higher magnitude in family memory places. This finding suggests that family memory of "betrayal" policies can switch political preferences from pro-Russian parties to pro-European parties with the same level of turnout. However, in collective remembrance places, decreased pro-Russian voting could partially result from an increase in voter turnout. 41 To confirm this hypothesis, I split the sample based on turnout differences between the before-war (2007-2018) and after-war (2021) periods. Figure 1.A.11 shows the results for the top 25th and bottom 25th percentiles of the turnout gap together with baseline full sample results. Clearly, in family memory places, there is no differential effect with respect to the turnout gap. However, in collective remembrance places, results are driven by places experiencing a higher turnout gap. Because voter turnout is a widely used outcome-based measure of social capital (Putnam, 1994; Guiso et al., 2004; Lichter et al., 2021) I suggest that the anti-Russian voting of collective memory places acts through social capital.

1.7.2 Social Capital

To further substantiate the claim that collective memory is positively associated with social capital, whereas family memory has a negative relationship, I analyze survey responses related to trust. This approach builds on prior literature that identifies trust as a key proxy for social capital (Coleman, 1994; Putnam, 1994; Glaeser et al., 1999). Panel (a) of Figure 1.4 presents trust levels towards individuals and institutions (parliament, government, and courts), and compares the effects of collective and family memory treatments to those of a control group while controlling for pre-2020 war trust levels. The results indicate that trust declines in localities associated with family memory following the activation of "betrayal" memories. In contrast, trust levels remain stable in collective memory places, with some evidence suggesting a positive effect on trust towards the judiciary. These findings align

⁴¹It should be noted that increased turnout in collective memory places as compared to non-memory places in the after-war period does not necessarily imply that if more people vote, they vote less often for pro-Russian parties.

with the broader literature, which links historical trauma to lower levels of trust (Alesina and La Ferrara, 2002; Nunn and Wantchekon, 2011), making it likely that the erosion of trust in family memory localities stems from the traumatic recall of past betrayals.

Panel (b) of Figure 1.4 further illustrates differences in social structures by showing that community-owned land per capita is significantly higher in collective memory localities compared to family memory localities in 2021. Given that effective community ownership necessitates trust and cooperation among residents, this finding underscores the distinct social fabric of these two types of memory localities.

Additional evidence supporting these social differences is provided in Panel (c) of Figure 1.4, which examines the relationship between surname diversity (measured using the entropy index) and family and collective memory treatments. Surname entropy serves as a proxy for both informational and social-psychological aspects of a community (Bell et al., 2019), with higher surname diversity being associated with weaker family ties and greater trust in strangers (Posch et al., 2023). The results indicate that surname diversity is relatively low in family memory localities, suggesting stronger family ties. Conversely, surname diversity is higher in collective remembrance places, implying greater trust and higher degrees of social capital. These findings are consistent with earlier results on voter turnout and generalized trust.

Overall, the results suggest that the social fabric differs markedly between collective and family memory localities. This distinction implies that anti-Russian sentiments triggered by the activation of "betrayal" memories operate through different mechanisms: in collective remembrance localities, they manifest via strengthened social capital, while in family memory localities, they are driven by the lingering effects of the trauma.

1.7.3 Movers

When individuals relocate, their cultural beliefs, norms, and values move with them, but the external environment they faced is left behind. This idea is intensively applied in the literature to distinguish between factors internal to the individual (like norms and beliefs) and factors external to individuals (like domestic institutions) (Ichino and Maggi, 2000; Nunn and Wantchekon, 2011). I use individual level turnout outcomes of movers from two regions⁴² to test if collective memory is attached to the place and family memory to the

⁴²Because of data digitization constraints I focus on two regions (Aragatsotn and Armavir). It represents 24% of total voters in the sample studied, and voting results for this subsample are similar to the full sample

individuals per se. Movers are defined based on voter lists in 2017 and 2021.

Figure 1.A.12 shows a comparison of turnout rates across four groups of movers: from non-collective places to collective ("NC to C"), collective places to non-collective ("C to NC"), from non-family places to family ("NF to F") and from family places to non-family ("F to NF"). The control group consists of movers who are not included in the previous four groups. As Figure 1.A.12 shows, the differences in turnout remain constant in "NF to F" and slightly decrease in the "F to NF" group as compared to the control group. However, there is a clear shift in the gap sign of the "C to NC" and 'NC to C" groups of movers. On one hand, "NC to C" movers begin to participate more often in voting; on the other hand, "C to NC" movers cease to engage in voting activities. This finding supports the previously stated hypothesis that collective memory is closely tied to the environment, while family memory is internalized within individuals.

DiD estimates in Figure 1.A.13 further confirm that relocation does not alter the voting behavior of "NF to F" and "F to NF" movers. However, "NC to C" movers increase their turnout, a proxy for social capital, while "C to NC" movers show a decrease their turnout. This evidence again supports the immobility hypothesis of collective memory and the mobile nature of family memory, highlighting the distinct characteristics of these memory types.

1.7.4 The Context of Recall

I dive deeply into the context of recalling the Armenian Genocide and Russian "betrayal" policies through family stories and commemorations, to investigate how family and collective recall differ in their nature. For family stories, I use 44 published stories about genocide survivors, which the survivors' children have transferred to the Armenian Genocide Museum. To reveal the collective memory context, I exploit 24 commemoration texts published on the collective memory localities' Facebook pages during 2020-2021.

Figure 1.A.14 shows that 41% of the individual stories mention the retreat of Russian troops and describe the killings of their relatives after the retreat (see examples in Section 1.3). In contrast, none of the published commemoration texts directly mention Russia or Russian troops. However, 90% of these texts emphasize themes such as "not relying on foreign countries" and "learning from history". Using Artificial Intelligence (AI) tools, I also categorize the survivor stories and commemoration texts into groups: "only tragedy" vs. "positive, hopeful" and "individual" vs. "national" tragedy. AI analysis reveals that 72% of survivor stories fall under "individual" tragedy, whereas only 16% of commemoration texts do. Ad-

ditionally, AI classifies 7% of individual stories as "positive, hopeful" compared to 70% of commemoration texts.

These findings highlight a significant disparity between family and collective narratives, with family stories predominantly portraying personal tragedies and collective commemoration texts focusing more on positive and hopeful messages. This is also in line with findings in Sections 1.7.1-1.7.3 which suggest that increased voter turnout and trust in collective remembrance localities result from the positive context of commemorations focusing on historical consciousness and nation-building rather than primarily on tragedy.

1.7.5 Strategic Campaigning

If parties are aware of collective and family memories, their campaigning may differ between places with and without memory. Table 1.A.12 shows whether the distribution of campaign posters differs across these groups. The outcome variable in the first two columns is the number of pro-Russian party posters within a 10 km radius of the locality. The number of pro-European party posters in the last columns is calculated within the same radius. Poisson regression results indicate that there was no strategic campaigning in family and collective memory places before or after the war in 2020. Hence, parties did not target localities to trigger activated history effects. The observed negative effects in Table 1.1 are driven by the demand side rather than by the supply side.

1.7.6 Other Measures of Anti-Russian Sentiments

I employ geocoded survey data from the Caucasus Barometer, which provides a battery of survey questions on respondents' beliefs, values, and social-demographic features. This is repeated cross-sectional data collected every two years. Collective and family treatments are assigned based on respondent's locality. Given some data limitations connected to the consistency of survey questions over time, I concentrate on the following questions: 1. What is the main friend country of Armenia? 2. Is the respondent willing to marry someone of a particular nationality, including Russian? 3. Is the respondent willing to do business with members of particular nationalities, including Russians?

Table 1.4 shows probit estimation results. In columns (1)-(2), the dependent variable takes the value one if the respondent mentions Russia as a main friend country of Armenia and zero otherwise. Column (2) controls for age, gender, education, and economic status of the respondent. I find that places with family memories are less likely to report Russia as a main friend country. In addition, I carry out a similar analysis for the survey question about the

main enemy country of Armenia (not reported) and do not find any increased probability of mentioning Russia as the main enemy. In columns (3)-(4) I investigate the respondents' willingness to do business with Russians. The coefficients are negative; however, they are not significant. Columns (5)-(6) test the change in willingness to marry Russians. Again, I do not find any differential attitude between memory and non-memory places after the war. The results from survey data suggest that there is some anti-Russian sentiment arising from activated family memories. However, this attitude is, firstly, more against the country rather than it is against Russian people, and secondly, it is in the form of decreased friendship rather than increased hostility.

[Table 1.4 about here]

I also use schooling outcomes from 4 regions of Armenia (40% of the original locality sample) to test if anti-Russian sentiments are expressed by schoolchildren about learning Russian. Figure 1.5 shows event study results at the village level. The outcome variable is the ratio of Russian language grades over other foreign language grades averaged across schoolchildren in each locality. I find that in family memory places, there is no differential effect before and after the war. Conversely, in collective remembrance places, there is an activated negative effect after the war, which fades out over time. Schooling outcomes on the student level presented in Table 1.A.13 again confirm that schoolchildren in collective remembrance places perform worse in Russian language course after the war. In contrast, the effect is even slightly positive in family memory places. Overall, anti-Russian sentiments are mainly within political views but extend somewhat into a broader context.

1.7.7 Heterogeneity

One dimension of heterogeneity is the size of the locality. Table 1.A.14 shows the results for two subsamples based on population in 2007. Columns (1)-(2) report the results for the bottom 30th and top 70th quantiles, respectively. I observe that collective memory decreases pro-Russian voting mainly in small places, while the family memory effect is not significant in small places. The results in the top 70th percentile subsample are similar to the baseline full sample results. This aligns with the literature arguing that collective memory is often preserved within small communities through storytelling that reinforces shared historical narratives (Green, 2011; Thomson, 2011). This finding suggests that collective remembrance is well preserved in small places through oral traditions and memorial practices, which increased historical consciousness of Armenia-Russia relations over the last century. As Table 1.A.4 confirms, in fact, in collective memory places, there is a higher probability

of having a genocide memorial.

I also explore the heterogeneity of collective memory locality names. Intuitively, locality names that start with the word "New" could receive more attention and trigger awareness of Russian "betrayal" policy history. In Column (3) Table 1.A.14 I test this by including an interaction between collective names that start with "New" and post-2020 war dummy. The results show that the effect doubles in those places, highlighting the importance of the triggering locality name. Column (4) checks the heterogenous effect of "pseudo New" names, which contain "New" but are not related to lost Armenian places in the Ottoman Empire (e.g., Nor Gyugh, which means new village). The analysis reveals no significant effect, indicating that both the presence of "New" and the association with Ottoman names are crucial in triggering collective memory. I introduce a different set of prominent collective names, determined by whether the locality name is inscribed on the main wall of the Armenian Genocide memorial.⁴³ The results do not show any boosting negative effect in those salient places. I interpret the findings of Columns (3)-(5) in Table 1.A.14 that the naming pattern plays a key role in generating collective remembrance. However, attention-grabbing name triggers the memory —not the weight of its historical background.

1.7.8 Russian and US Ties

The direct presence of Russian military bases may influence local sentiments. I conduct a heterogeneity analysis by splitting the sample based on proximity to Russian military bases in Armenia. Columns (1)-(2) of Table 1.A.15 show results for areas within the median distance from these bases, while columns (3)-(4) cover areas beyond this distance. Localities farther from the Russian military exhibit stronger anti-Russian sentiments due to family memories, whereas collective memory loses significance. This suggests that the Russian presence suppresses anti-Russian sentiments derived from family memories but not from collective memories, highlighting the traumatic nature of family memory. Columns (5)-(6) add distance to Russian military bases, interacted with year fixed effects, to the baseline specification in Table 1.1, showing stable results.

To examine the impact of ties with Russia or the US on anti-Russian sentiments, I restrict the sample in Table 1.A.16 Columns (1)-(2) to the top three regions connected to each country. Russian connectedness is based on Google searches for "Russian Ruble", indicating

⁴³The genocide memorial in Yerevan was founded in 1965. Every year on April 24th, the Armenian Genocide Remembrance Day, thousands of Armenians gather at the memorial to commemorate the victims of the genocide. On the walls of the memorial, a list of around 50 Ottoman Armenian localities is mentioned, where many Armenians were killed during the genocide.

ties through migrants and remittances. US connectedness uses the Facebook Social Connectedness Index, which is only available at the regional level in Armenia.⁴⁴ Results show that Russian remittances do not mitigate "betrayal" policy memories in family or collective contexts, while US connections reduce the impact of family memory and have no effect on collective memory. In Column (3), I add a dummy indicating localities with the above median Google searches of the topic "Russian Ruble". The main results remain stable, while those places also indicate clear pro-Russian voting. In Column (4), I also add the interactions with two treatments and above median Russian connectedness. While the main results remain unchanged, I observe that potential remittances from Russia empower anti-Russian sentiments in collective memory places. This result highlights the social capital background of collective memory, showing that potential economic benefits cannot deactivate "betrayal" memories.

1.8 Conclusion

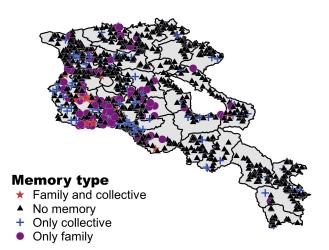
In this chapter, I show how memories of the distant past can be activated and how this activation can translate into real-world outcomes. This research uses historical variation in a difference-in-differences framework to show that, once activated, collective remembrance and family memory shape behavior. Interestingly, collective memory based on the name of a place without any direct individual exposure to past historical events generates an equally sizeable negative effect as family memory (direct exposure) of the same event. In addition, while family remembrance works through a shift in political preferences (from pro-Russian to pro-European parties), only collective remembrance motivates voter turnout. I reveal that the collective remembrance effect has a more social nature, while family memory has a more traumatic or emotional nature. Thus, I bring empirical evidence that how memories of historical events are transmitted is highly important in shaping actions. I also show that collective memory is well preserved in small localities through memorial practices, which increase historical consciousness.

Results documented here highlight the pivotal role of history in forming and shaping public opinion. Understanding how different types of memories affect behavior is essential in social capital formation and policy making. In particular, it could clarify ways to motivate people to vote and receive vaccinations, ways to include different nations in unions, and compensate survivors and their generations of historical traumas. These findings emphasize the potential

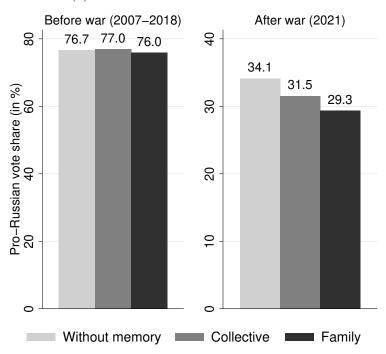
⁴⁴The Facebook Social Connectedness Index measures the relative probability that two individuals across two locations are friends with each other on Facebook. Source: https://data.humdata.org/dataset/social-connectedness-index?

of historical awareness in guiding community engagement and reinforcing societal bonds. Furthermore, they indicate that policymakers could strategically utilize this understanding to formulate interventions to address historical grievances and promote social cohesion in more structured ways.

Figures



(a) Distribution of Armenian localities



(b) Vote share comparison

Figure 1.1: Memory types and pro-Russian voting

Notes: Notes: The map on the left-hand side shows the classification of Armenian localities according to their memory type. Stars have both collective and family memory, crosses have only collective memory, circles have only family memory and triangles are localities with no type of genocide memory. Borders indicate districts. The right-hand side bar chart shows the means of pro-Russian party vote shares in Armenian localities according to their memory type. The means do not differ during the 2007-2018 period $(p=0.82,\ p=0.86)$ but differ in 2021 $(p=0.14,\ p=0.01)$. The analysis is based on 891 Armenian localities

Pro-Russian vote share (in %)

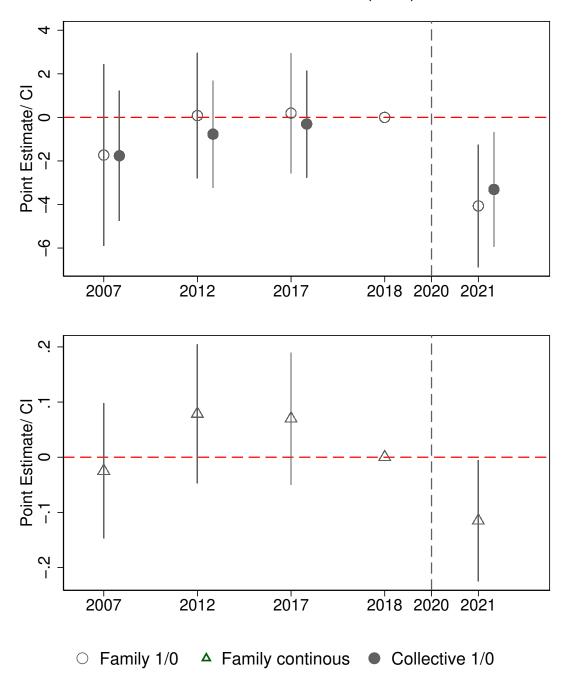


Figure 1.2: Pro-Russian party vote shares differences in memory and no memory places

Notes: The figure shows Pro-Russian vote shares for all national elections from 2007 to 2021 for family memory, collective remembrance, and without memory localities in Armenia. Family continuous is the share of voters with an Ottoman-Armenian surname. Family 1/0 variable is an indicator variable of family memory based on the initial settlement of genocide survivors. Collective 1/0 is an indicator based on the locality name. Vote share differences are standardized to zero for the 2018 election (the last prewar election) and are conditioned on locality-year fixed effects and eligible voters (log). Dashed vertical lines indicate the start of the Nagarno-Karabakh war in 2020. Vertical lines in the event study figures represent the 95% confidence intervals clustered at the district level.

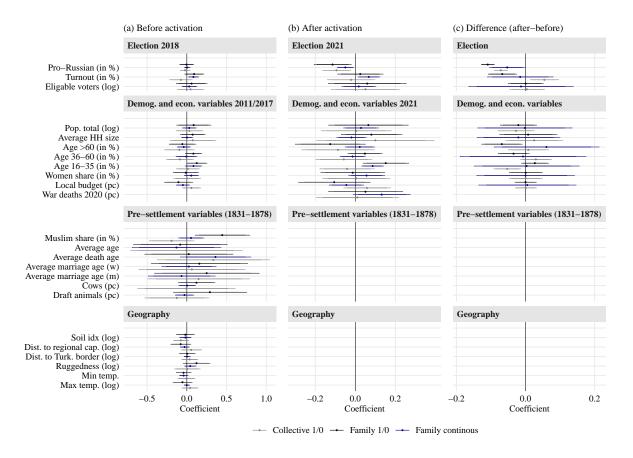


Figure 1.3: Conditional mean differences

Notes: This figure illustrates the balancing of covariates across three distinct periods: the pre-war period (2011/2017), the pre-settlement period (1831-1878), and the post-war period (2021). For the pre-war period, election results are derived from the most recent pre-war election year (2018), while the total population (log) and the share of women are based on the 2011 Census. Data on age groups and household size are sourced from 2017 voter lists. The local budget per capita is also reported for 2017. In the pre-settlement period, the variables including the share of Muslims, average age, and the number of cows and draft animals are obtained from the 1831 Russian census. The average age of death, and the average marriage ages for women and men, are compiled from parish records from 1831 to 1878. All variables in Panel (b) correspond to the year 2021, with war-related deaths recorded in 2020. All variables are standardized using z-scores. Panel (a) depicts the conditional mean differences prior to the 2020 war, while Panel (b) shows the conditional mean differences following the war. Panel (c) reports the corresponding difference-in-differences estimates. The means are conditioned on district fixed effects. The Collective 1/0 variable is a dummy variable indicating collective memory localities. The "Collective (1/0)" variable indicates localities with collective memory, whereas the "Family (1/0)" variable denotes family memory based on the settlement. "Family continuous" variable represents the proportion of voters with Ottoman surnames. Standard errors are clustered at the district level. Horizontal lines represent the 95%(99%) confidence intervals.

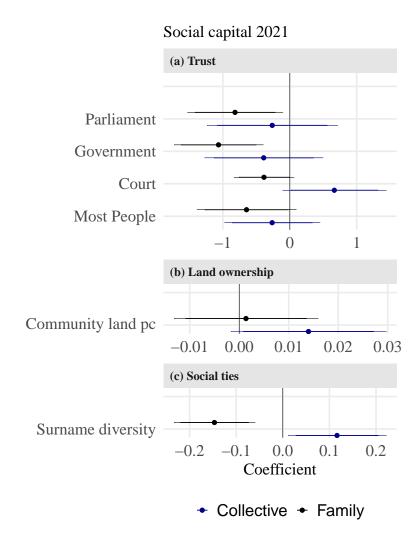


Figure 1.4: Social capital and memory type

Notes: Panel (a) (Trust) shows the results of the Ologit model on survey questions (2013, 2015, 2017, 2019, 2021). The dependant variable for trust in Parliament, Government, and Court is on a 1-5 scale where 1 indicates the lowest trust and 5 indicates the highest. The outcome indicator for trust in "Most people" is in a 1-10 scale where 1 indicates the lowest trust and 10 indicates the highest. All trust regressions include individual controls for age, age squared, gender, education, ethnicity, knowledge of Russian language, and personal income, geographical controls for the distance to the Turkish border (log), ruggedness of terrain (log) and distance to the regional capital (log), and family and collective memory dummy indicators. Standard errors are clustered at the district level. Panel (b) (Land ownership) shows OLS coefficients of per capita municipal land in 2021 (km²) on family and collective memory. Panel (c) (Social ties) shows OLS coefficients of the entropy coefficient in 2021 on family and collective memory. Panels (b) and (c) include distance to the Turkish border (log), ruggedness of terrain (log), distance to regional capital (log), share of women, share of persons aged 16-35, aged 36-60, above 60, and total population (log). Standard errors are spatially clustered at 40km cutoff level. Horizontal lines represent the 95% confidence intervals.

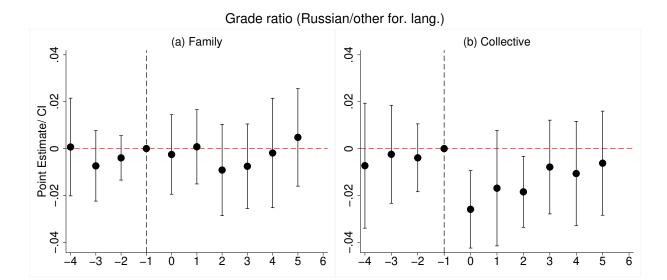


Figure 1.5: Schooling outcomes

Notes: The figure shows the coefficients of an event-study design of Russian/other foreign language grade ratio outcome (left panel: family treatment, right panel: collective treatment). Time indicates semesters from 2018-2019 to 2022-2023 academic years. Outcome differences are standardized to zero for the prewar semester (1st semester of 2020). Vertical intervals represent the 95% confidence intervals (clustered at the municipality level).

Tables

Table 1.1: Difference-in-differences results

	Pro-Russian party vote share (in %)					
	(1)	(2)	(3)	(4)	(5)	(6)
Combined memory \times Post 2020	-3.56***	-3.46***				
	(1.28)	(0.89)				
Family \times Post 2020			-3.51**	-3.00***	-4.08**	-3.54**
			(1.62)	(1.12)	(1.71)	(1.44)
Collective \times Post 2020			-2.26*	-2.66**	-2.88**	-3.29***
			(1.16)	(1.12)	(1.35)	(1.24)
Family \times Collective \times Post 2020					3.06	2.93
·					(2.51)	(2.57)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Locality FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE \times District FE	No	Yes	No	Yes	No	Yes
Year $FE \times Geography Cov.$	No	Yes	No	Yes	No	Yes
Year FE \times Pre-treat Cov.	No	Yes	No	Yes	No	Yes
Controls	No	Yes	No	Yes	No	Yes
Mean of dep. variable (2021)	33.26	33.26	33.26	33.26	33.26	33.26
Partial R^2 (Combined) $\times 10^{-3}$	5.22	5.69				
Partial R^2 (Family) $\times 10^{-3}$			3.33	2.57	3.12	2.40
Partial R^2 (Collective) $\times 10^{-3}$			1.28	2.24	1.12	2.00
Obs	4,453	4,453	4,453	4,453	4,453	4,453

Notes: The dependent variable is the pro-Russian party vote share (in %) at the level of 891 localities from 2007 to 2021. Columns (1) and (2) show difference-in-differences estimates of combined memory (either collective (1/0) or family (1/0)). Columns (3) and (4) show the baseline difference-in-differences estimates for collective and family memory types separately. Columns (5) and (6) add also interaction of family and collective memory treatments. Post 2020 is a dummy for elections after the 2020 war. Columns (1), (3), and (5) control for locality and year fixed effects. Columns (2), (4), and (6) control for district FE interacted with year FE, pre-treatment controls interacted with year FE, geographical covariates interacted with year FE, and time-variant controls. Geographic controls include ruggedness of terrain (log) and distance to the Turkish border (log). Pre-treatment covariates include total population, female population share, average HH size, age group shares, and local budget per capita. Controls include the electorate in the log. Inferences are based on spatial (40km) clustered standard errors. * p < .1, ** p < .05, *** p < .01.

Table 1.2: Difference-in-differences results (alternative treatment)

	Pro-Russian party vote share (in %)					
	(1)	(2)	(3)	(4)	(5)	(6)
Family (continuous ind.) \times Post 2020	-0.15*** (0.04)	-0.11*** (0.04)				
Collective (continuous) \times Post 2020	-0.06^{**} (0.03)	-0.05^{**} (0.02)	-0.06^{**} (0.03)	-0.04^{**} (0.02)		
Family (continuous HH) \times Post 2020			-0.20*** (0.04)	-0.13*** (0.02)		
Family (newly founded) \times Post 2020					-4.90^* (2.70)	-4.61^* (2.51)
Collective \times Post 2020					-2.71** (1.32)	-3.13** (1.26)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Locality FE	Yes	Yes	Yes	Yes	Yes	Yes
Year $FE \times District FE$	No	Yes	No	Yes	No	Yes
Year FE \times Geography Cov.	No	Yes	No	Yes	No	Yes
Year FE \times Pre-treat Cov.	No	Yes	No	Yes	No	Yes
Controls	No	Yes	No	Yes	No	Yes
Obs	4,445	4,445	4,445	4,445	4,028	4,028

Notes: The dependent variable is the pro-Russian party vote share (in %) at the level of 891 localities from 2007 to 2021. The family (continuous ind.) variable is the share of Ottoman surnames after 2020, and the family (continuous HH) variable is the share of HHs with at least one Ottoman surname at the locality level. The collective (continuous) variable is the number of years the locality has had a collective remembrance name. Column (1) shows the baseline difference-in-differences estimates with locality and year fixed effects. In columns (5)-(6), family memory is defined as a dummy variable with value 1 if the locality was founded by genocide survivors after 1920. In columns (5)-(6), the localities where genocide survivors resettled but the locality was not newly founded are excluded from the sample. Columns (2), (4), and (6) add district FE interacted with year FE, pre-treatment controls interacted with year FE, geographical covariates (distance to Turkish border (log), ruggedness (log)) interacted with year FE, and controls (electorate in the log). Pre-treatment covariates include total population, female population share, average household size, age group shares, and local budget per capita. Inferences are based on spatial (40km) clustered standard errors. * p < .1, ** p < .05, *** p < .01

Table 1.3: Other voting outcomes (in %)

	Turnout		Natio	nalist	Pro-Eu	ıropean
	(1)	(2)	(3)	(4)	(5)	(6)
Family × Post 2020	-0.82	-0.77	-0.07	-0.11	3.58**	3.01***
	(1.01)	(0.61)	(0.07)	(0.08)	(1.60)	(1.07)
Collective \times Post 2020	1.48**	1.78***	-0.07	-0.07	2.27**	2.65**
	(0.67)	(0.67)	(0.11)	(0.14)	(1.14)	(1.08)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Locality FE	Yes	Yes	Yes	Yes	Yes	Yes
Year $FE \times District FE$	No	Yes	No	Yes	No	Yes
Year $FE \times Geography Cov.$	No	Yes	No	Yes	No	Yes
Year $FE \times Pre$ -treat Cov.	No	Yes	No	Yes	No	Yes
Controls	No	Yes	No	Yes	No	Yes
Obs	4,453	4,448	4,453	4,448	4,453	4,448

Notes: In Columns (1)-(2) the dependent variable is turnout (in %) at the level of 891 localities from 2007 to 2021. In Columns (3)-(4) the dependent variable is nationalist parties' vote share (in %) at the level of 891 localities from 2007 to 2021. In Columns (5)-(6) the dependent variable is pro-European parties' vote share (in %) at the level of 891 localities from 2007 to 2021. Columns (1), (3), and (5) show the baseline difference-in-differences estimates with locality and year fixed effects. Columns (2), (4), and (6) include district fixed effects interacted with year fixed effects, geographical controls interacted with year FE, pre-treatment controls interacted with year FE, controls (electorate in log). Pre-treatment covariates include total population, female population share, average household size, age group shares, and local budget per capita. Inferences are based on spatial (40km) clustered standard errors. * p < .1, ** p < .05, *** p < .01

Table 1.4: Survey Data Probit Results

	Main friend Russia		Business	with Russians	Marriage with Russians		
	(1)	(2)	(3)	(4)	(5)	(6)	
Family × Post 2020	-0.29**	-0.41***	-0.26	-0.18	-0.03	-0.08	
	(0.13)	(0.16)	(0.18)	(0.18)	(0.16)	(0.18)	
Collective \times Post 2020	0.08	0.04	-0.16	-0.16	0.26	0.27	
	(0.22)	(0.20)	(0.32)	(0.35)	(0.21)	(0.20)	
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	
Region FE	Yes	Yes	Yes	Yes	Yes	Yes	
Controls	No	Yes	No	Yes	No	Yes	
Obs	2,498	2,317	2,810	2,584	2,837	2,611	

Notes: The table shows probit results on survey questions. In columns (1)-(2), the dependent variable is an indicator for the main friend country being Russia. In columns (3)-(4), the dependent variable is an indicator of willingness to do business with Russians. In columns (5)-(6), the dependent variable is an indicator of willingness to marry a Russian. Columns (2), (4), (6) include controls for age, gender, education, ethnicity, knowledge of Russian language, and personal income. Standard errors are clustered at the district level. * p < .1, ** p < .05, *** p < .01.

1.A Appendix: Additional Tables and Figures

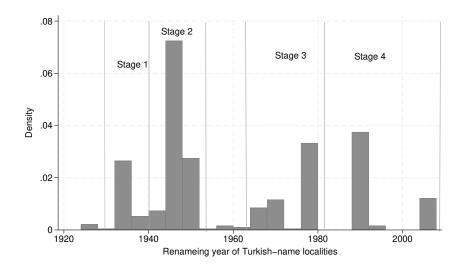


Figure 1.A.1: Years Armenian localities were renamed

Notes: The bar chart shows the frequency of Armenian locality name changes over time. The whole period is roughly divided into four stages in which the renaming happened. Stage1 is the the early years of communist rule, Stage2 is the after-WWII period, Stage3 is the period after Stalin's death, and Stage4 is the period following Armenian independence. Source: author's calculations based on Hakobyan et al. (1986).

Presidium of the
USSR Supreme
Soviet

Presidium of the
Supreme Soviet of the
Armenian SSR

Presidium of the Armenian
Academy of Science

The Geographic Commission of the
Armenian Academy of Science

Figure 1.A.2: Four-level system of place renaming in Soviet Armenia Source: https://journals.openedition.org/monderusse/8604

"Turkey and Russia are trying to give a second life to the Lenin-Ataturk plan regarding Syunik"

The most important news from Armenia on Telegram

① May 20, 2021 4:20 P.m ② 258



"Russia betrayed us in this war." this idea is constantly circulated by some people on social networks and websites and collects many likes and comments. And the main fight looks like this. "100 years ago, the Bolsheviks sold Armenia to the Turks, and now Putin has done the same."



-





"The Turks deceived Lenin in 1920, and now Putin."

□ 03/11/2021

Doctor of physical mathematics, professor Vladimir Harutyunyan wrote:

After 1920-21, when the independent statehood of Armenia was destroyed by the efforts of the Lenin-Ataturk fraternal tandem, and the Armenian territories were successfully divided and divided "from place to place", throughout the existence of the Soviet Union, Armenians were fed with a sad slogan that Ataturk deceived Lenin. And the main mass of Armenians pitied even Lenin who was spending his days in the tomb. The implication of that cheating was not always revealed, but its essence was understandable. "Ataturk

Figure 1.A.3: Armenian media, anti-Russian sentiments

Notes: Examples from Armenian media after the 2020 war showing the narrative around repeated Russian "betrayal" policy. Sources: top left https://www.aravot.am/2021/05/20/1192282/ top right https://hraparak.am/post/2635f91fb155c2ee48fff6b669d5f19d, bottom https://generalnews.am/hy/article/6b73e5f45bd3663f1eab26ccd64efd02

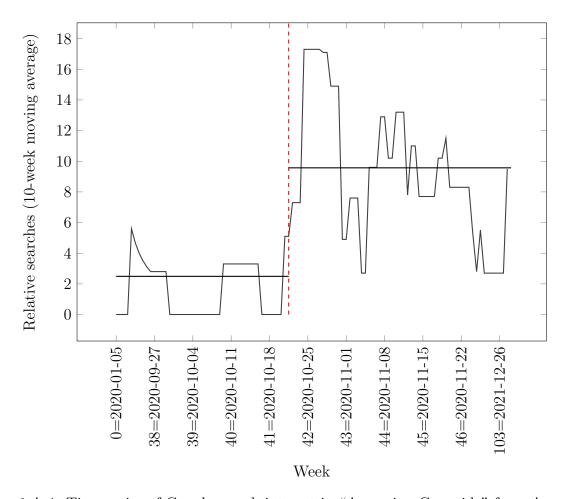


Figure 1.A.4: Time series of Google search interest in "Armenian Genocide" from Armenia.

Notes: The Figure shows the number of Google searches from Armenia. The maximum frequency is set to 100, and the rest of the frequencies are adjusted proportionally. Original Google trend figures are replaced with a 10-week moving average. The red dashed line indicates the first week after the war ended on November 9, 2020. Horizontal lines indicate before and after November 9, 2020 averages.

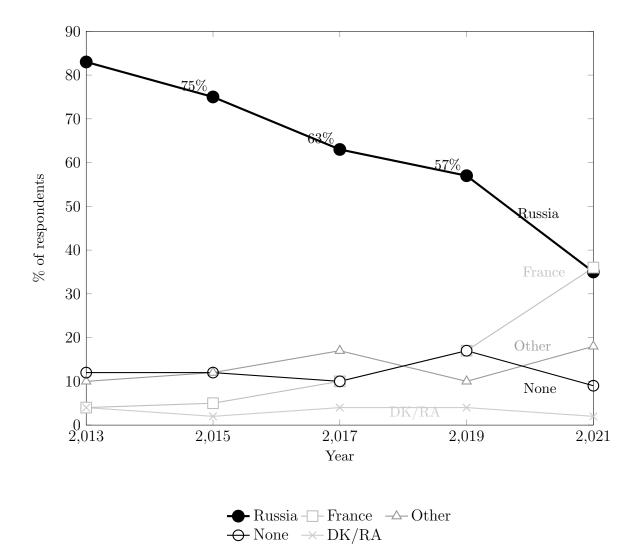


Figure 1.A.5: Main friend country of Armenia

Notes: Survey results from Caucasus Barometer data to the following question: "In your opinion, which country is currently the main friend of Armenia?". Source: https://www.crrc.am/barometer/

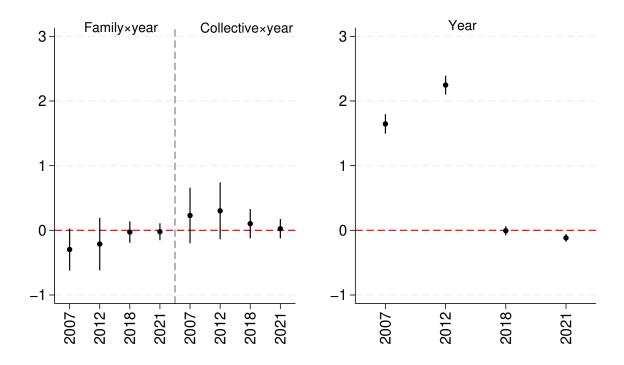


Figure 1.A.6: Invalid vote share over time and by memory type

Notes: The left figure shows the OLS regression coefficient of memory types (family and collective) interacted with year fixed effects, where 2017 (the last pre-revolution year) is the reference year for invalid vote share outcome. The right-hand panel shows the OLS regression coefficient of individual years with respect to 2017. Standard errors are robust. Vertical lines show 95% confidence intervals.

7/7	<i>Uqqшйт</i> .й	Ulmil	Эшрийтй	Ծննդրան Յաշվառման վայրի hwugb օր, ավիս. տարեքիվ		ԱԹՆը Իւսս ուստող փաստաքրքի սերիա եւ համար	արկման37/07 <i>Ընտրող</i> ի ստորագրությունը	<i>Չանձնաժողովի</i>	երացուց, <i>Աշումնե</i> ,
395	Բաբաջանյան	Իսրայել	Գեղամի	20/12/1937	Ռուբեն Սեւակի Ф. 9				
	Մելիքյան	Շողակաթ	Սամսոնի	29/09/1961	Ռուբեն Սեւակի Ф. 9	AN 0553076	m	द्देन-58421	
	խաչատրյան	Սաթենիկ	Գիգոլի	12/04/1929	Ռուբեն Սեւակի Փ. 11				
	Բաբաջանյան	Գառնիկ	Սեւանի	27/03/1965	Ռուբեն Սեւակի Φ. 13	AT0569497	-30	§3-5978	9
	Բաբաջանյան	Ltinû	Գառնիկի	25/09/1990	Ռուբեն Սեւակի Փ. 13	HB03632H	-	\$7-69620	
	Բաբաջանյան	Սանասար	Գառնիկի	12/09/1992	Ռուբեն Սեւակի Φ. 13	730375670	B.	3-69620	
401	1 2 1	Անահիտ	Վոլոդյայի	23/10/1976	Ռուբեն Սեւակի Ф. 13	AM08915 A	Shuff &	23-59789	
	Չիլինգարյան	Արեն	Արծրունի	28/04/2000	Ռուբեն Սեւակի Φ. 23				
_	Չիլինգարյան	Մարիամ	Արծրունի	07/01/2003	Ռուբեն Սեւակի Φ. 23	012269353	- Am	ह्रेन-58421	
404		Սենիկ	Բաղիշի	07/01/1947	Ռուբեն Սեւակի Φ. 23				
405		Մարյամ	Աշոտի	07/01/1951	Ռուբեն Սեւակի Ф. 23				
-	Սարուխանյան	Նունե	Բենիկի	24/11/1977	Ռուբեն Սեւակի Ф. 23				
_	Ծատուրյան	Ալա	Արմենի	29/08/1993	Ռուբեն Սեւակի Ф. 25				-
	Ծատուրյան	UGh	Արմենի	25/07/1999	Ոուբեն Սեւակի Ф. 25				-
409		Արմեն	Ֆրունզիկի	12/11/1970	Ռուբեն Սեւակի Φ. 25				
410	Ծատուրյան	Ռուզաննա	Աշոտի	19/08/1977	Ռուբեն Սեւակի Φ. 25	Tollies !			
411	Չիլինգարյան	Արեւիկ	Բաղիշի	13/09/1951	Ռուբեն Սեւակի Փ. 25		1.11		
412	14.	tրիկ -	Կամոյի	22/02/2003	Ռուբեն Սեւակի Փ․ 27	01/978/60		§ 7-59926)
413	Իսրայելյան	Ошрпц	Կամոյի	06/06/1995	Ռուբեն Սեւակի Փ․ 27	A14063573	2 Mark	£3-58421	-
41/	Իսրայելյան	чшбп	Գուրգենի	06/06/1965	Ռուբեն Սեւակի Φ․ 27				

Figure 1.A.7: Signed list of voters, sample

Notes: Notes: A sample page from voters' signed lists. It contains the name, surname, father's name, date of birth, address of each voter, and the signature of those who voted. Source: https://www.elections.am/

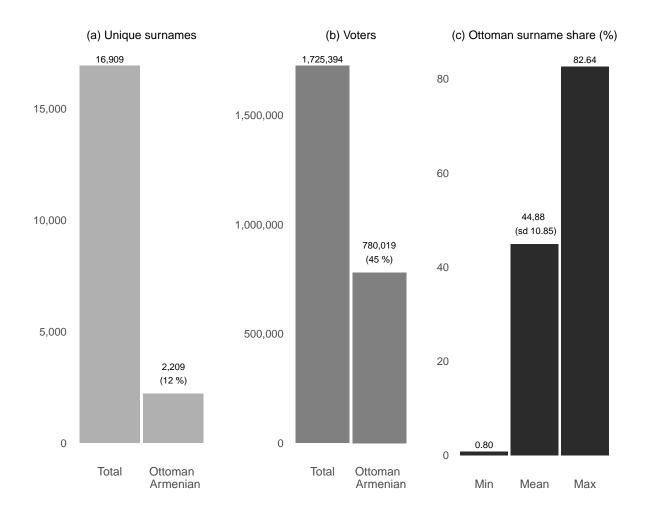


Figure 1.A.8: Classification of voter surnames

Notes: Figure presents summary statistics for Ottoman Armenian surnames within the dataset. Panel (a) shows a count of 16,909 unique Armenian surnames in the 2021 voters list, of which 2,209 are classified as Ottoman Armenian, comprising approximately 12% of the dataset. Panel (b) depicts voter counts, with a total of 1,725,394 voters, including 780,019 voters with Ottoman Armenian surnames, representing 45% of the total. Panel (c) displays the distribution of Ottoman surname shares across localities, with a minimum value of 0.80%, a mean of 44.88% (standard deviation = 10.85), and a maximum value of 82.64%.

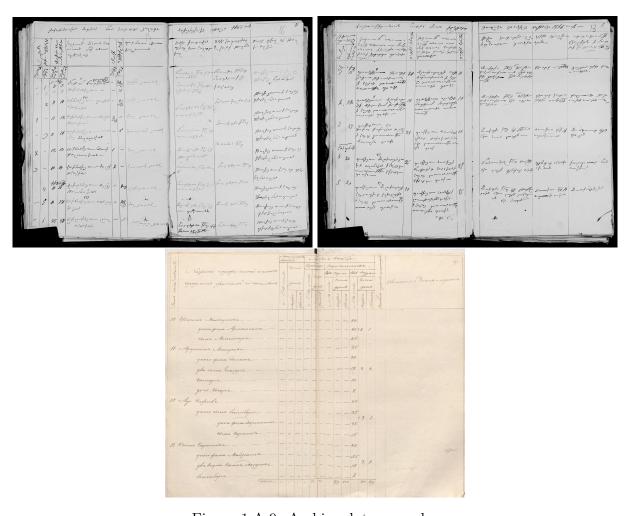


Figure 1.A.9: Archive data, samples

Notes: Notes: Sample pages from death and marriage parish records, and 1836 census data. Source: Armenian National Archives

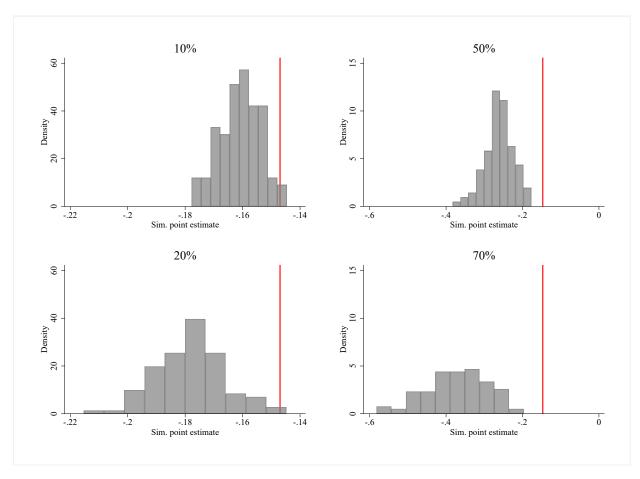


Figure 1.A.10: Simulation of Ottoman surname changes

Notes: The figure displays the distribution of simulated coefficients (N=100) linked to the baseline specification reported in Table 1.2, column (1). In each simulation, we artificially increase the share of voters with Ottoman surnames in a locality by 10%, 20%, 50%, and 70%. This is done by randomly reassigning Ottoman surnames to voters who actually have non-Ottoman surnames, thereby creating placebo scenarios that mimic a stronger presence of Ottoman-origin voters. The resulting distributions illustrate how the estimated effect varies under these counterfactual reallocations. The vertical red line represents the actual baseline coefficient from Table 1.2, column (1), and serves as a benchmark against which the simulated placebo effects are compared.

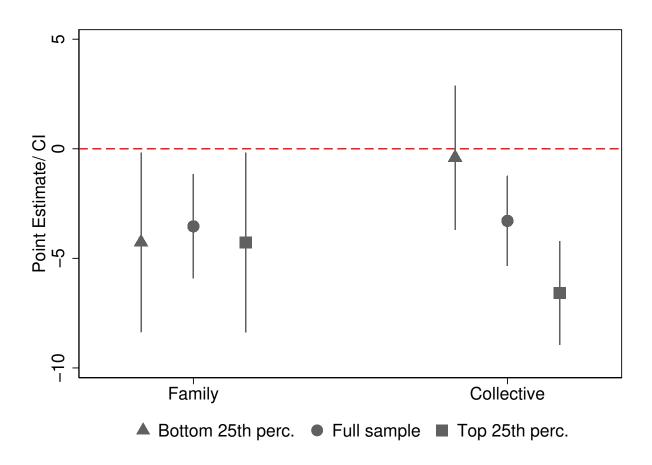


Figure 1.A.11: Hteroegenous effect of voter turnout on pro-Russian voting

Notes: Figure illustrates the heterogeneous effect of turnout on pro-Russian voting. The sample is split into localities with the top 25th percentile (squares) and bottom 25th percentile (triangles) turnout difference following the war in 2020. Turnout difference is the gap between turnout in 2021 and average turnout during 2007-2018. Circles indicate coefficients from full sample baseline regression in Table 1.1. Standard errors are clustered spatially at 40 km cutoff.

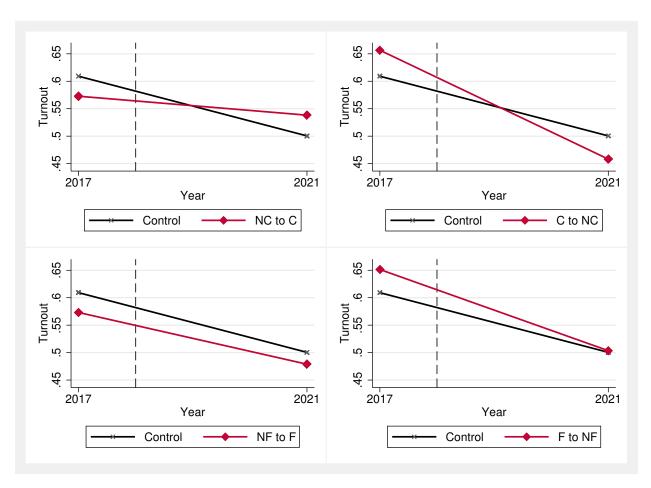


Figure 1.A.12: Turnout of movers

Notes: The outcome variable is the voter turnout (1/0) of individual movers from the Aragatsotn and Armavir regions (24% of voters) in 2017 and 2021. The top left figure compares movers from non-collective localities to collective localities with the rest of the movers (control group). The top right figure compares movers from collective localities to non-collective localities with the rest of the movers (control group). The bottom left figure compares movers from non-family localities to family localities with the rest of the movers (control group). The bottom right figure compares movers from family localities to non-family localities with the rest of the movers (control group). Dashed lines indicate the split before and after the 2020 war.

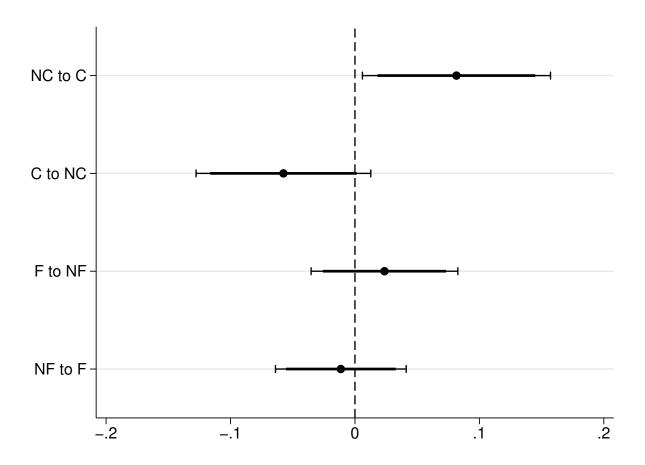


Figure 1.A.13: DiD estimates in movers' turnout

Notes: The outcome variable is the turnout (1/0) of individual movers from Aragatsotn and Armavir regions (24% of voters) in 2017 and 2021. Coefficients are DiD estimates for movers. "NC to C" labels movers from non-collective localities to collective ones, "C to NC" movers from collective localities to non-collective, "F to NF" movers from family localities to non-family, "NF to F" from non-family localities to family. The regression controls for individual fixed effects, time fixed effects, and region fixed effects. Standard errors are clustered at individual level and reported at 95% and 90% levels.

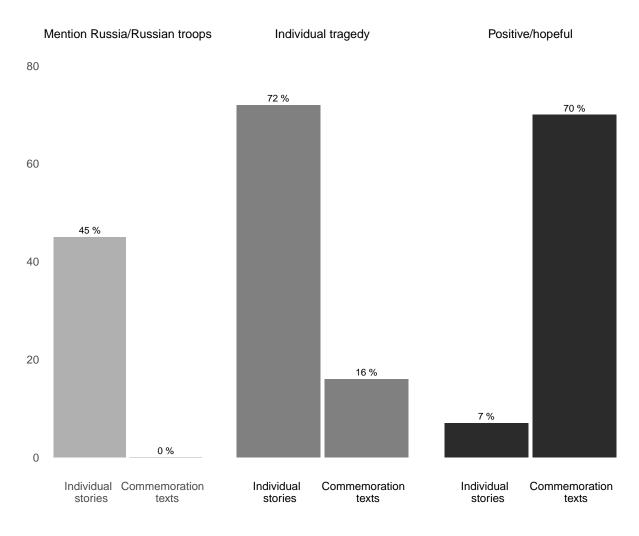


Figure 1.A.14: The context of remembrance

Notes: The figure illustrates the contextual analysis of Russian "betrayal" policy memory through individual stories and commemoration texts. The first plot is based on counting references, showing that 45% of individual stories and 0% of commemoration texts mention Russia or Russian troops. The second and third plots, classified using AI, reveal that 72% of individual stories and 16% of commemoration texts emphasize individual tragedy, while 7% of individual stories and 70% of commemoration texts convey a positive or hopeful sentiment.

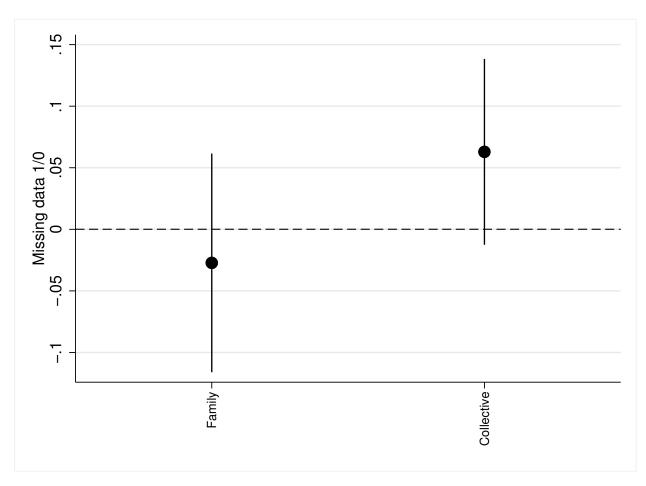


Figure 1.A.15: Missing pre-1915 data

Notes: The outcome variable is a dummy variable for missing data. If pre-1915 data is missing in the majority of sources (five out of three), then the record is coded as missing (1); otherwise, it is 0. Coefficients are obtained from linear regression of missing data on collective and family memory treatment variables (dummy) conditioned on district fixed effects. Vertical lines indicate 95% level confidence intervals clustered at the district level.

Table 1.A.1: Renaming of collective remembrance places

Year	Freq.	Percent	Cumulative
1920	1	0.93	0.93
1926	1	0.93	1.85
1928	1	0.93	2.78
1929	1	0.93	3.70
1930	1	0.93	4.63
1935	8	7.41	12.04
1938	2	1.85	13.89
1939	1	0.93	14.81
1940	2	1.85	16.67
1945	5	4.63	21.30
1946	18	16.67	37.96
1947	3	2.78	40.74
1948	3	2.78	43.52
1949	3	2.78	46.30
1950	3	2.78	49.07
1953	1	0.93	50.00
1956	1	0.93	50.93
1962	1	0.93	51.85
1964	1	0.93	52.78
1965	2	1.85	54.63
1966	2	1.85	56.48
1967	2	1.85	58.33
1968	3	2.78	61.11
1969	1	0.93	62.04
1970	1	0.93	62.96
1972	1	0.93	63.89
1978	6	5.56	69.44
1979	1	0.93	70.37
1982	1	0.93	71.30
1983	1	0.93	72.22
1984	4	3.70	75.93
1989	1	0.93	76.85
1991	15	13.89	90.74
1992	1	0.93	91.67
1995	1	0.93	92.59
2006	8	7.41	100.00
Total	108	100.00	

Notes: The table summarizes the years when the renaming of collective memory places took place.

Table 1.A.2: Party classification

Year	Pro-Russian	Pro-EU	Nationalist
2007	Republican Party of Armenia, National Agreement Party, National Unity Party, Pros- perous Armenia Party, Peo- ple's Party, Democratic Way Party, Armenian Revolution- ary Federation (Dashnaktsu- tyun), Party of the Youth of Armenia, Communist Party of Armenia, Marxist Party of Armenia, United Labor Party, United Liberal National Party, New Times Party, Party Country of Legality	National Democratic Party, Dashink Party, Heritage Party, Impeachment Alliance, People's Party of Arme- nia, Hanrapetutyun Party, Social-Democrat Hnchak Party, Christian-Democratic Renaissance Party	
2012	Republican Party of Armenia, Prosperous Armenia Party, Armenian National Congress Party, Armenian Revolution- ary Federation (Dashnaktsu- tyun), Democratic Party of Armenia, Communist Party of Armenia, United Armenians Party, Party Country of Legal- ity	Heritage Party	
2017	Armenian Renesance Party, Tsarukyan Parties Alliance, Congress-PPA Parties Al- liance, Republican Party of Armenia, Communist Party of Armenia, Armenian Revolutionary Federation (Dashnaktsutyun)	Way Out Parties Alliance (Yelq), Free Democrats Party, Ohanyan-Raffi-Oskanyan Par- ties Alliance	
2018	Republican Party of Armenia, Armenian Revolutionary Federation (Dashnaktsutyun), Party Country of Legality, Prosperous Armenia Party	Citizen's Decision Social- Democratic Party, My Step Parties Alliance, Bright Arme- nia Party, Christian-Popular Renaissance Party, National Progress Party, We Parties Alliance	Sasna Tsrer
2021	Fair Armenia Party, Armenian National Congress Party, Al- liance "With Honour", United Homeland Party, Our Home is Armenia, Hayots Hayrenik, Prosperous Armenia Party, Democratic Party of Armenia, Verelq Party, Liberal Party, Armenia Alliance	Civil Contract Party, Zartonk National Christian Party, Lib- erty Party, Bright Armenia Party, Republic Party, Free Motherhood Party, Citizen's Decision Social-Democratic Party, Shirinyan-Babajanyan Democratic Union, National Agenda Party, European Party of Armenia, Sovereign Armenia Party	"5165 National Conservative Movement" Party, National Democratic Extreme Pan- Armenian Party

Notes: The table shows the classification of parties in Parliamentary elections during the 2007-2021 period. Classification is made based on the parties' official pre-election program.

Table 1.A.3: Mean voting outcomes (%) in 2007-2021

	Γ	urnout	j.	Pro-Russian			Pro-European		
	Mean	SD	N	Mean	SD	N	Mean	SD	N
2007	71.6	12.7	891	91.8	6.8	891	5.7	4.9	891
2012	70.4	11.4	891	97.2	4.0	891	1.3	1.4	891
2017	67.5	10.1	891	94.9	6.2	891	3.3	3.5	891
2018	53.6	9.9	891	24.1	13.0	891	40.7	10.2	891
2021	52.0	10.3	889	34.0	15.2	889	33.6	9.3	889
Total	63.0	13.8	4453	68.4	33.8	4453	16.9	18.05	4453

Notes: The table shows summary statistics of main voting outcomes: voter turnout, vote share for pro-Russian parties, and share for pro-European parties. Mean and standard deviation are calculated over 2007, 2012, 2017, 2018, and 2021 and pooled for all years. In 2021, the voting results for 2 localities are not reported on the official website of the Central Electoral Commission.

Table 1.A.4: Probit regression on genocide memorials

	Genocio	Genocide memorial in the locality $(1/0)$						
	(1)	(2)	(3)	(4)				
Collective	0.50*** (0.17)	0.59*** (0.22)	0.52*** (0.19)	0.59*** (0.19)				
Family	0.06 (0.21)	-0.02 (0.27)	-0.05 (0.21)	-0.20 (0.41)				
District FE Controls	No No	Yes No	No Yes	Yes Yes				
Obs	891	287^{a}	891	287^{a}				

Notes: The table shows the probit results for genocide memorial presence in a locality. The outcome variable is an indicator coded 1 if there is a genocide memorial in the locality. Column (2) includes district fixed effects. Column (3) includes controls for geography (ruggedness of terrain, distance to the Turkish border (in log), distance to regional capital (in log)) demographic (population (in log), electorate (in log), female population share, HH size, age group shares) and economic (local budget per capita) features. Column (4) includes both district fixed effects and controls. Standard errors are clustered at the district level. ^a Observation number 287 falls after controlling for district fixed effects because in some districts, there are no memorials. * p < .1, ** p < .05, *** p < .01

Table 1.A.5: Summary Statistics

		Full Sam	ple		Collecti	ve		Family	7
	N	Mean	\overline{SD}	N	Mean	\overline{SD}	N	Mean	\overline{SD}
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Voting 2012									
Eligible voters	891	1174.84	1412.22	108	1354.78	1526.15	117	1206.69	987.70
Turnout	891	70.36	11.43	108	66.25	12.60	117	69.10	12.15
Pro-Russian vote share	891	97.25	3.95	108	97.09	2.57	117	96.97	2.16
Pro-European vote share	891	2.01	2.19	108	2.27	2.27	117	2.35	1.82
Voting 2021									
Electorate	889	1205.23	1477.08	108	1419.86	1632.24	117	1253.52	1043.54
Turnout	889	51.96	10.26	108	49.39	11.70	117	49.95	8.87
Pro-Russian vote share	889	33.26	15.26	108	30.84	14.98	117	29.34	11.57
Pro-European vote share	889	65.37	15.15	108	67.89	14.79	117	69.39	11.53
Soc-econ figures 2012									
Population	891	1318.26	1616.50	108	1571.81	1893.27	117	1442.82	1270.94
Female share	890	0.57	0.12	108	0.56	0.10	117	0.60	0.10
Average HH size	891	4.18	0.83	108	4.37	1.07	117	4.49	0.51
Age > 65	891	0.13	0.05	108	0.12	0.04	117	0.12	0.02
Age 16-34	891	0.34	0.07	108	0.36	0.07	117	0.36	0.03
Age 35-64	891	0.51	0.08	108	0.53	0.08	117	0.54	0.03
Local budget/population (AMD)	891	3211.60	9629.72	108	2173.89	6824.33	117	441.04	955.48
Soc-econ figures 2021									
Population	888	1487.87	1764.93	108	1762.79	2031.80	117	1646.31	1409.03
Female share	889	0.48	0.04	108	0.47	0.05	117	0.48	0.02
Average HH size	889	4.26	0.80	108	4.45	1.11	117	4.56	0.55
Age > 65	889	0.14	0.04	108	0.13	0.04	117	0.13	0.02
Age 16-34	889	0.31	0.05	108	0.31	0.05	117	0.32	0.03
Age 35-64	889	0.53	0.05	108	0.54	0.07	117	0.55	0.02
2020 war deaths	889	1.49	2.35	108	1.80	2.54	117	1.79	2.56
Local budget/population (AMD)	889	3171.91	9205.50	108	2022.84	6418.70	117	423.11	914.12
Geography									
Distance to regional capital (km)	891	25.07	14.41	108	25.33	14.00	117	22.75	12.47
Distance to Turkish border (km)	891	59.24	50.73	108	39.57	43.52	117	28.38	27.73
Soil caloric suitability index	891	4.16	0.56	108	4.06	0.40	117	4.08	0.40

Notes: The table shows the summary statistics for all 891 localities in Armenia in 2012 and 2021. The descriptive statistics for the overall sample are shown in Columns (1) to (3). Columns (4) to (6) show the summary statistics for Collective memory localities, Columns (7) to (9) for Family memory localities. See data sources in the Appendix B.

Table 1.A.6: Alternative control groups

	Non-collective		Non-	Non-family		ed after 1920
	(1)	(2)	$\overline{(3)}$	(4)	(5)	(6)
Family × Post 2020	-4.08** (1.72)	-3.91*** (1.24)				
Collective \times Post 2020			-2.89**	-2.66**	-2.07^*	-3.03***
			(1.34)	(1.17)	(1.09)	(1.00)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Locality FE	Yes	Yes	Yes	Yes	Yes	Yes
Year $FE \times District FE$	No	Yes	No	Yes	No	Yes
Year $FE \times Geography Cov.$	No	Yes	No	Yes	No	Yes
Year $FE \times Pre$ -treat Cov.	No	Yes	No	Yes	No	Yes
Controls	No	Yes	No	Yes	No	Yes
Obs	3,913	3,908	3,863	3,858	3,518	3,513

Notes: The dependent variable is the pro-Russian vote share (in %) at the level of localities for 2007 to 2021. In columns (1)-(2) the sample excludes localities with collective memory. In columns (3)-(4) the sample excludes localities with family memory. Columns (2), (4) district FE interacted with year FE, pretreatment controls interacted with year FE, geographical covariates interacted with year FE, and controls (electorate in log). Pre-treatment covariates include total population, female population share, average HH size, age group shares, and local budget per capita. Inferences are based on spatial (40km) clustered standard errors. * p < .1, ** p < .05, *** p < .01

Table 1.A.7: OLS results on sorting

	Collective memory (1/0)					
	Full s	ample	Renamed after 1920			
	(1)	(2)	(3)	(4)		
Ottoman surname share	-0.001 (0.001)	-0.001 (0.001)	-0.002 (0.001)	-0.002 (0.001)		
District FE	Yes	Yes	Yes	Yes		
Geography cov.	No	Yes	No	Yes		
Socioeconomic cov.	No	Yes	No	Yes		
Obs	889	889	702	702		

Notes: The table shows OLS regression results of a collective memory indicator on Ottoman surname share (family memory continuous). Columns (1)-(2) show the results for the full sample and columns (3)-(4) restrict the sample to the localities that were renamed after the 1920 resettlement. Columns (2) and (4) include district fixed effects, geographic log distance to the Turkish border, log ruggedness, Soil Caloric Suitability index (Galor and Özak, 2016), and log distance to the regional capital) and socioeconomic (log population, log electorate, Yazidi minority share, female share, HH size, age group dummies, and local budget per capita) covariates. Standard errors are clustered at the district level. * p < .1, ** p < .05, *** p < .01

Table 1.A.8: Matching on pre-war covariates

	Population	Geography	Demography	Income					
	(1)	$\overline{(2)}$	$\overline{(3)}$	$\overline{(4)}$					
Panel A: Propensity score matching									
Family × Post 2020	-3.15*** (0.76)	-2.87*** (0.84)	-3.52*** (0.54)	-2.76*** (0.81)					
Collective \times Post 2020	-2.35* (1.27)	-2.29* (1.33)	-1.66 (1.45)	-2.71^* (1.49)					
Year FE	Yes	Yes	Yes	Yes					
Locality FE	Yes	Yes	Yes	Yes					
Year $FE \times District FE$	Yes	Yes	Yes	Yes					
Year $FE \times Geography Cov.$	Yes	Yes	Yes	Yes					
Year $FE \times Pre$ -treat Cov.	Yes	Yes	Yes	Yes					
Controls	Yes	Yes	Yes	Yes					
Panel B: Entropy balanci	ng								
Family × Post 2020	-3.46*** (0.69)	-2.70^{***} (0.83)	-3.44*** (0.78)	-2.76*** (0.79)					
Collective \times Post 2020	-2.41* (1.24)	-2.25 (1.37)	-1.73 (1.40)	-2.61^* (1.47)					
Year FE	Yes	Yes	Yes	Yes					
Locality FE	Yes	Yes	Yes	Yes					
Year $FE \times District FE$	Yes	Yes	Yes	Yes					
Year $FE \times Geography Cov.$	Yes	Yes	Yes	Yes					
Year $FE \times Pre$ -treat Cov.	Yes	Yes	Yes	Yes					
Controls	Yes	Yes	Yes	Yes					
Obs	4,443	4,443	4,443	4,443					

Notes: The dependent variable is the pro-Russian vote share (in %) at the level of localities for 2007 to 2021. Panel A uses propensity score matching and Panel B applies entropy balancing to balance pre-war covariates. Column (1) matches/balances population, column (3) matches/balances distance to the Turkish border and ruggedness, column (4) matches/balances average HH size, female population share, age cohort shares. Column (4) matches/balances local budget per capita. Inferences are based on spatial (40km) clustered standard errors. * p < .1, ** p < .05, *** p < .01

Table 1.A.9: Timing of treatment

	Pro-Russian party vote shar				
	(1)	(2)	(3)		
Family × Post 2020	-3.00*** (1.12)		-3.49** (1.45)		
Collective \times Post 2020	-2.66** (1.12)		-3.34*** (1.23)		
Family \times Year 2018		0.91 (0.73)	0.17 (0.66)		
Collective \times Year 2018		0.47 (1.12)	-0.21 (1.08)		
Year FE	Yes	Yes	Yes		
Locality FE	Yes	Yes	Yes		
Year $FE \times District FE$	Yes	Yes	Yes		
Year $FE \times Geography Cov.$	Yes	Yes	Yes		
Year $FE \times Pre$ -treat Cov.	Yes	Yes	Yes		
Controls	Yes	Yes	Yes		
Obs	4,453	4,453	4,453		

Notes: The dependent variable is the pro-Russian vote share (in %) at the level of localities for 2007 to 2021. Column (1) shows baseline results from Table 1.1. Column (2) uses the year 2018 as a pseudo-campaign period. Column (4) shows the combined estimation with two subsequent (pseudo-)campaign periods from 2017 onward. All columns include district FE interacted with year FE, pre-treatment controls interacted with year FE, geographical covariates interacted with year FE, controls (electorate in log). Pre-treatment covariates include total population, female population share, average HH size, age group shares, and local budget per capita. Inferences are based on spatial (40km) clustered standard errors. * p < .1, ** p < .05, *** p < .01

Table 1.A.10: Difference-in-differences results excluding government parties

	Non-government pro-Russian party share					
	(1)	(2)	(3)	(4)	(5)	(6)
Combined memory \times Post 2020	-6.53***	-3.60***				
	(1.60)	(0.90)				
Family \times Post 2020			-7.59***	-3.42***	-7.73***	-3.98***
			(1.87)	(1.30)	(2.10)	(1.54)
Collective \times Post 2020			-3.78**	-2.49*	-3.94**	-3.15**
			(1.51)	(1.37)	(1.74)	(1.36)
Family \times Collective \times Post 2020					0.76	3.09
					(3.55)	(3.54)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Locality FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE \times District FE	No	Yes	No	Yes	No	Yes
Year FE \times Geography Cov.	No	Yes	No	Yes	No	Yes
Year FE× Pre-treat Cov.	No	Yes	No	Yes	No	Yes
Controls	No	Yes	No	Yes	No	Yes
Obs	4,453	4,453	4,453	4,453	4,453	4,453

Notes: The dependent variable is the pro-Russian party vote share excluding parties in the government (in %) at the level of 891 localities from 2007 to 2021. Columns (1) and (2) show difference-in-differences estimates of combined memory (either collective (1/0) or family (1/0)). Columns (3) and (4) show the baseline difference-in-differences estimates for collective and family memory types separately. Columns (5) and (6) add interaction of family and collective memory treatments. Post 2020 is a dummy for elections after the 2020 war. Columns (1), (3) and (5) control for locality and year fixed effects. Columns (2), (4), and (6) control for district FE interacted with year FE, pre-treatment controls interacted with year FE, geographical covariates interacted with year FE, and time-variant controls. Geographic controls include ruggedness of terrain (log), and distance to the Turkish border (log). Pre-treatment covariates include total population, female population share, average HH size, age group shares, and local budget per capita. Controls include the electorate in the log. Inferences are based on spatial (40km) clustered standard errors. * p < .1, ** p < .05, *** p < .01

Table 1.A.11: Party classification based on LLM

		Pro-Russian party share					
	Base	Softmax	Polar	Margin	Logit		
	(1)	(2)	(3)	(4)	(5)		
Family × Post 2020	-2.57**	-2.63**	-2.59**	-2.37**	-2.76**		
	(1.19)	(1.24)	(1.23)	(1.08)	(1.20)		
Collective \times Post 2020	-2.42**	-2.21*	-2.24*	-1.60	-2.24*		
	(1.23)	(1.22)	(1.24)	(1.31)	(1.22)		
Year FE	Yes	Yes	Yes	Yes	Yes		
Locality FE	Yes	Yes	Yes	Yes	Yes		
Year FE \times District FE	Yes	Yes	Yes	Yes	Yes		
Year FE \times Geography Cov.	Yes	Yes	Yes	Yes	Yes		
Year $FE \times Pre$ -treat Cov.	Yes	Yes	Yes	Yes	Yes		
Controls	Yes	Yes	Yes	Yes	Yes		
Obs	4,453	4,453	4,453	4,453	4,453		

Notes: The dependent variable is the Pro-Russian party share in locality i and year t, computed as the vote-share weighted average of party-level pro-Russian scores across all parties on the ballot (0–100 percentage points). "Family × Post 2020" and "Collective × Post 2020" interact pre-defined exposure indicators with a post-2020 dummy. Party-level scores are produced by a text classifier with three labels {pro-Russian, neutral, pro-European}. The five columns use the same underlying model but summarize the party stance in slightly different, easy-to-compare ways: (1) Base — Uses one standard question wording to obtain the party's pro-Russian score. This can be conceptualized as a direct, single-shot reading. (2) Softmax — Same idea as (1), but the question is asked using several slightly different sets of wording, and the average is taken. This reduces sensitivity to the exact phrasing. (3) Polar — Compares only the "pro-Russian" vs "pro-European" pull and ignores neutral language. Values above 0.5 mean the party leans more pro-Russian than pro-Western among the non-neutral content. (4) Margin — The party's pro-Russian score minus its pro-Western score. Positive numbers mean "more pro-Russian than pro-Western," negative numbers mean the opposite; the farther from zero, the stronger the tilt. (5) Logit — Same direction as Margin, but stretched so that very strong cases stand out more distinctly. Interpretation of the sign is the same as Margin (positive = pro-Russian tilt, negative = pro-Western tilt). All columns control for locality and year fixed effects, district FE interacted with year FE, pre-treatment controls interacted with year FE, geographical covariates interacted with year FE, and time-variant controls. Geographic controls include ruggedness of terrain (log) and distance to the Turkish border (log). Pre-treatment covariates include total population, female population share, average HH size, age group shares, and local budget per capita. Controls include the electorate in the log. Inferences are based on spatial (40km) clustered standard errors. * p < .1, ** p < .05, *** p < .06

Table 1.A.12: Poisson regression on strategic campaigning

	Pro-Russian I	party posters	Pro-EU pai	rty posters
	before $war(2018)$	after $war(2020)$	before $war(2018)$	after $war(2020)$
Family	-0.08 (0.16)	-0.09 (0.11)	-0.04 (0.15)	-0.03 (0.18)
Collective	0.18 (0.18)	-0.06 (0.09)	0.06 (0.17)	0.31 (0.23)
Controls	Yes	Yes	Yes	Yes
Obs	887	889	887	889

Notes: In columns (1)-(2) the dependent variable is the number of pro-Russian party posters in 2021 elections within 10 km distance of a locality. In columns (3)-(4) he dependent variable is the number of non pro-Russian party posters in 2021 elections within 10 km distance of a locality. Columns (2) and (4) add geography (ruggedness of terrain, max temperature, min temperature, distance to the Turkish border (in log), distance to regional capital (in log)) demographic (population (in log), electorate (in log), female population share, HH size, age group shares) and economic (local budget per capita) controls. Standard errors are clustered at the district level. * p < .1, ** p < .05, *** p < .01

Table 1.A.13: Schooling outcomes

	Rus	sian	Other foreign lang.			
	(1)	(2)	(3)	(4)		
Collective \times Post 2020	-0.049***	-0.036***	0.012	0.011		
	(0.01)	(0.01)	(0.01)	(0.01)		
Family \times Post 2020	-0.001	0.015^{*}	-0.045***	-0.046***		
	(0.01)	(0.01)	(0.01)	(0.01)		
Semester× Yerar FE	Yes	Yes	Yes	Yes		
Student FE	Yes	Yes	Yes	Yes		
Grade FE	No	Yes	No	Yes		
Semester $FE \times Region FE$	No	Yes	No	Yes		
Year $FE \times Geography Cov.$	No	Yes	No	Yes		
Year FE \times Pre-treat Cov.	No	Yes	No	Yes		
Mean of dep. var.	6.79	6.79	6.65	6.65		
Obs	667,529	667,529	592,924	592,924		

Notes: Table shows difference in difference results on schooling outcomes. In columns (1)-(2) the dependant variable is the Russian language grade. In columns (3)-(4) the dependant variable is another foreign language (English, French, German). In columns (5)-(6) the dependant variable is the Armenian history grade. Columns (2), (4), (6) include controls for grade FE, school FE, semester FE interacted with district FE, semester FE interacted with geography covariates, semester FE interacted with pre treatment control variables. Standard errors are clustered at student level.

^{*} p < .1, ** p < .05, *** p < .01

Table 1.A.14: Heterogenous effects

	<=30p	>=70p	I	Full sample	
	$\overline{(1)}$	$\overline{(2)}$	(3)	(4)	(5)
Family × Post 2020	3.16 (2.11)	-3.51*** (0.53)	-3.66*** (1.31)	-3.48** (1.39)	-3.54** (1.38)
Collective \times Post 2020	-4.64** (1.93)	-2.27^{**} (1.05)	-2.32** (1.06)	-3.22*** (1.24)	-3.24*** (1.25)
Collective NEW names \times Post 2020			-7.32*** (1.33)		
Pseudo NEW names \times Post 2020				2.79 (2.35)	
Collective salient names \times Post 2020					-0.43 (0.89)
Year FE	Yes	Yes	Yes	Yes	Yes
Locality FE	Yes	Yes	Yes	Yes	Yes
Year $FE \times District FE$	Yes	Yes	Yes	Yes	Yes
Year $FE \times Geography Cov.$	Yes	Yes	Yes	Yes	Yes
Year $FE \times Pre$ -treat Cov.	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes
Obs	1,338	1,340	4,453	4,453	4,453

Notes: The dependent variable is the pro-Russian vote share (in %) at the level of localities for 2007 to 2021. Columns (1) and (2) samples include localities with population less than the 30th percentile populations and more than the 70th percentile, respectively, as of 2007. Column (3) adds the interaction between Collective NEW names and a post-2020 war dummy. In Column (4) "Pseudo New" name is interacted a post-2020 war dummy. Column (5) adds salient collective name interacted with a post-2020 war dummy. All columns include locality fixed effects, time fixed effects, district FE interacted with year FE, pre-treatment controls interacted with year FE, geographical covariates interacted with year FE, and controls (electorate in log). Pre-treatment covariates include total population, female population share, average HH size, age group shares, and local budget per capita. Inferences are based on spatial (40km) clustered standard errors. * p < .1, ** p < .05, *** p < .01

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Table 1.A.15: Heterogenous effects (Russian military presence)

	Close to Rus. mil. (\leq median)		Far from	Rus. mil. (\geq median)	Full Sample	
	(1)	(2)	$\overline{\qquad (3)}$	(4)	(5)	(6)
Family × Post 2020	-2.10	-1.63***	-6.71***	-7.26***	-3.53**	-2.96***
	(1.96)	(0.62)	(2.14)	(1.31)	(1.78)	(1.03)
Collective \times Post 2020	-4.60***	-3.51***	0.42	-0.16	-2.27*	-2.59**
	(1.54)	(0.89)	(2.44)	(1.76)	(1.17)	(1.04)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Locality FE	Yes	Yes	Yes	Yes	Yes	Yes
Year $FE \times District FE$	No	Yes	No	Yes	No	Yes
Year $FE \times Geography Cov.$	No	Yes	No	Yes	No	Yes
Year FE × Distance to Russian military (log)	No	No	No	No	Yes	Yes
Year $FE \times Pre$ -treat Cov.	No	Yes	No	Yes	No	Yes
Controls	No	Yes	No	Yes	No	Yes
Observations	2,225	2,220	2,228	2,228	4,453	4,448

Notes: The dependent variable is the pro-Russian vote share (in %) at the locality level for 2007–2021. Columns (1)–(2) restrict the sample to localities with distances to Russian military bases below the median (33.7 km). Columns (3)–(4) cover those above the median. Columns (5)–(6) use the full sample and include year fixed effects interacted with distance to Russian bases. Columns (2), (4), and (6) add district fixed effects × year fixed effects, geographical covariates × year fixed effects, pre-treatment covariates × year fixed effects, and standard controls (log electorate). Pre-treatment covariates include: total population, female share, average household size, age group shares, and income per capita. Standard errors are clustered spatially within 40km. * p < 0.1, ** p < 0.05, *** p < 0.01.

Table 1.A.16: Difference-in-differences results Russian connectedness

	Pro-Russian Party Share			
	Russia US			ample
	(1)	(2)	(3)	(4)
Family \times Post 2020	-3.45**	-1.73**	-3.26**	-3.22**
	(1.70)	(0.87)	(1.39)	(1.38)
Collective \times Post 2020	-4.88**	-0.84	-3.16***	-2.97**
	(2.25)	(2.04)	(1.21)	(1.23)
Russia connected \times Post 2020			5.31**	6.08**
			(2.63)	(2.40)
Collective \times Russia connected \times Post 2020				-8.45***
				(0.29)
Family× Russia connected × Post 2020				2.17
v				(4.35)
Year FE	Yes	Yes	Yes	Yes
Locality FE	Yes	Yes	Yes	Yes
Year $FE \times District FE$	Yes	Yes	Yes	Yes
Year $FE \times Geography Cov.$	Yes	Yes	Yes	Yes
Year FE \times Pre-treat Cov.	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Obs	1,588	1,320	4,448	4,448

Notes: The dependent variable is the pro-Russian vote share (in %) at the level of 891 localities from 2007 to 2021. Column (1) shows the baseline difference-in-differences estimates for only 3 regions (Shirak, Aragtsotn and Gegharkunik) strongly connected to Russia . Column (2) shows the baseline difference-in-differences estimates for only 3 regions (Lori, Armavir and Tavush) highly connected to the US. Column (3) controls for connectedness with Russian based on Google trend searches of "Russian Ruble". Column (4) adds interactions with Russian connectedness with family and collective memory treatments. All columns control for locality and year fixed effects, district FE interacted with year FE, pre-treatment controls interacted with year FE, and geographical covariates interacted with year FE. Geographic controls include ruggedness of terrain and distance to the Turkish border. Pre-treatment covariates include total population, female population share, average HH size, age group shares, budget per capita. Controls include electorate in log. Inferences are based on spatially (40km) clustered standard errors. * p < .1, ** p < .05, *** p < .05

Table 1.A.17: Standard errors with different spatial cut-offs

	Pro-Russian	Turnout	Pro-European
	(1)	(2)	$\overline{\qquad \qquad } (3)$
Family \times Post2020	-3.54	-0.77	1.47
Clustered at district	(1.62)**	(0.56)	$(0.83)^*$
Spatial cutoff 0.0 km	$[1.05]^{***}$	[0.53]	$[0.57]^{**}$
Spatial cutoff 10.0 km	$[1.10]^{***}$	$[0.43]^*$	$[0.56]^{***}$
Spatial cutoff 20.0 km	$[1.47]^{**}$	[0.52]	$[0.59]^{**}$
Spatial cutoff 30.0 km	$[1.48]^{**}$	[0.52]	$[0.60]^{**}$
Spatial cutoff 40.0 km	$[1.38]^{**}$	[0.61]	$[0.51]^{***}$
Spatial cutoff 50.0 km	$[1.24]^{***}$	[0.53]	$[0.46]^{***}$
Spatial cutoff 60.0 km	$[1.05]^{***}$	$[0.46]^*$	$[0.22]^{***}$
Collective \times Post2020	-3.28	1.78	1.19
Clustered at district	(1.43)**	(0.73)**	(0.74)
Spatial cutoff 0.0 km	$[1.17]^{***}$	$[0.56]^{***}$	$[0.61]^*$
Spatial cutoff 10.0 km	$[1.09]^{***}$	$[0.62]^{***}$	$[0.65]^*$
Spatial cutoff 20.0 km	$[1.03]^{***}$	$[0.70]^{**}$	$[0.59]^{**}$
Spatial cutoff 30.0 km	$[1.09]^{***}$	$[0.68]^{***}$	$[0.68]^*$
Spatial cutoff 40.0 km	$[1.22]^{***}$	$[0.67]^{***}$	$[0.68]^*$
Spatial cutoff 50.0 km	$[0.91]^{***}$	$[0.65]^{***}$	$[0.56]^{**}$
Spatial cutoff 60.0 km	$[0.30]^{***}$	$[0.66]^{***}$	$[0.38]^{***}$
Year FE	Yes	Yes	Yes
Locality FE	Yes	Yes	Yes
Year $FE \times District FE$	Yes	Yes	Yes
Year $FE \times Geography$. Cov.	Yes	Yes	Yes
Year FE \times Pre-treat Cov.	Yes	Yes	Yes
Controls	Yes	Yes	Yes
R^2	0.96	0.89	0.94
Obs	4448	4448	4448

Notes: The table shows different standard errors based on different spatial cutoffs and "conventional" standard errors clustered at the district level for the main results in Table 2 and Table 4. Spatial clustering follows Colella et al. (2023). Significance levels: * p < .1, ** p < .05, *** p < .01

Table 1.A.18: Difference-in-differences results (full sample)

	Pro-Russian Party Share				
	(1)	(2)	(3)	(4)	
Family × Post 2020	-4.17** (1.70)	-3.54** (1.38)			
Collective \times Post 2020	-2.98** (1.33)	-3.28*** (1.22)			
Family \times Collective \times Post 2020	3.16 (2.52)	3.16 (2.75)	0.05 (1.69)	-0.75 (1.50)	
Family (continuous) \times Post 2020			-0.15^{***} (0.04)	-0.09** (0.04)	
Collective (continuous) \times Post 2020			-0.07^{***} (0.02)	-0.04** (0.02)	
Year FE	Yes	Yes	Yes	Yes	
Locality FE	Yes	Yes	Yes	Yes	
Year $FE \times District FE$	No	Yes	No	Yes	
Year FE \times Geography Cov.	No	Yes	No	Yes	
Year $FE \times Pre$ -treat Cov.	No	Yes	No	Yes	
Controls	No	Yes	No	Yes	
Obs	4,563	4,448	4,555	4,440	

Notes: The dependent variable is the pro-Russian vote share (in %) of 913 localities from 2007 to 2021. In columns (1) and (2), family and collective memory treatments are dummy variables. In Columns (3)-(4) the family (continuous) variable is the share of Ottoman surnames in 2020, and the collective (continuous) variable is the number of years the locality holds the collective memory name. Column (1) and (3) show the baseline difference-in-differences estimates with locality and year fixed effects. Column (2) and (4) add district FE interacted with year FE, pre-treatment controls interacted with year FE, geographical covariates interacted with year FE, and controls (electorate in log). Pre-treatment covariates include total population, female population share, average HH size, age group shares, local budget per capita. Inferences are based on spatial (40km) clustered standard errors. p < 0.1, p < 0.05, p < 0.05, p < 0.05

1.B Appendix: Data Sources and Definitions

This section lists the data sources of the chapter. Archival data and signed voter's lists are digitized from hard copies. I use Hakobyan et al. (1986) dictionary to trace name changes of localities over time to construct balanced panel data. I trace mergers of localities since 2007 and fix them at the 2017 borders.

1.B.1 Election Data

Voting results are collected from the Central Electoral Commission website (https://www.elections.am/). The election results of only two localities (Verin Shorzha and Nerkin Shorzha) in 2021 are missing. I use signed voter lists to construct age, female share, and household size variables. Calculation of the female share is based on the name classification according to gender. The voters' list consists of 23,044 unique names, out of which 7,185 (31.1%) are not classifiable. However, their frequency is less than 1%. Household size is constructed by calculating the number of registered residents at one address within each locality. Age is calculated based on the date of birth. Whenever the date of birth is not meaningful (e.g., 13/00/00), the age variable is coded as missing.

Surnames are classified as Ottoman-Armenian based on word roots typical to Ottoman Armenians suggested by Avetisyan (2010). In addition, I use spelling rules from Western Armenian to identify Ottoman-Armenian surnames. Those rules include the ability to use certain letters in the middle of a word, and also "ean" and "ian" endings compared to "yan" in Eastern Armenian. I have constructed non-Ottoman surname equivalents for Ottoman surnames whenever possible (cases based on spelling rules and surname endings). I identify only 50 households out of 537,848 with a decomposition of Ottoman and non-Ottoman surnames (e.g., Taslaqean-Taslaqyan). This shows that there have been no systematic surname changes from Ottoman to non-Ottoman ones.

Party poster addresses are also collected from https://www.elections.am/ and geolocated using Google Maps API.

1.B.2 Pre-1915 Data

I digitize the pre-1915 variables from Armenian parish records on births, deaths, and marriages during 1836-1878 (see a sample in Figure 1.A.9). Average age, average death age, average female age at marriage, and average male age at marriage variables are constructed by averaging over year-locality during the 1836-1878 period. I digitize the 1836 census for

population figures and use Chopin (1852) for livestock data for each locality. Draft animals include buffalo and oxen. Sample size varies according to different variables because of unavailable data in the Armenian National Archive.

I check if missing data is correlated with collective and family memory treatments. Because archive data is collected from five different sources (Census 1836, parish records for marriages, deaths, births, and Chopin (1852)), I code the data as missing (1) if the record is missing in three or more sources; otherwise it is coded as non-missing (0). Figure 1.A.15 illustrates that, conditioned on district fixed effects, none of the treatment variables predicts the probability of missing records.

1.B.3 Modern Socio-Economic Variables

Population figures in 2011 (assigned to 2012) and 2021 (assigned to 2021) are based on census data (https://armstat.am/am/). I retrieve the locality budget either from the official websites of regions or separately from regional government offices via email. Whenever the budget was provided as a consolidated number for several localities, the proportion was calculated based on the population census in 2011.

1.B.4 Caucasus Barometer Survey

I use Armenian Caucasus Barometer data from the 2013, 2015, 2017, 2019, 2021/2022 waves from https://caucasusbarometer.org/en/. The respondents' localities are not publicly available and are provided separately by CRRC-Armenia, with the obligation not to disclose them to third parties.

1.B.5 Schooling Data

I purchased data on school grades from the National Center of Education Technologies of the Armenian Ministry of Education, Science, Culture, and Sports. The sample includes four regions (Aragatsotn, Ararat, Armavir, Shirak) for 2018-2023. These four regions make up around 32% of the population of Armenia (without capital Yerevan). Grades in the 2018-2019 academic year are not complete from all schools because electronic grade registration was fully implemented in the 2019-2020 academic year.

1.B.6 Geographic Data

I retrieve locality centroids in longitude and latitude from Google Maps API. District borders, and shape files are provided by The Humanitarian Data Exchange (https://data.humdata.org/dataset/geoboundaries-admin-boundaries-for-armenia?). Distance measures use Euclidean distances from locality centroids and ruggedness, retrieved from the geographic information system QGIS (Version 3.22.9). Soil caloric suitability index is provided by (Galor and Özak, 2016). The index captures the variation in potential crop yield across the globe, as measured in calories per hectare per year. The index I use in this study is based on the average potential yields within each cell, attainable given the set of crops that are suitable for cultivation in the post-1500 period. The original raster data is available for 5' by 5' grid cells, which I average over a 4km-radius circle around each locality centroid. Source: https://github.com/ozak/Caloric-Suitability-Index.

Chapter 2

Gender after War: Casualties, Nation Building, and Victimization after the Collapse of the Habsburg Empire¹

2.1 Introduction

Warfare and state formation have been closely intertwined since the early modern period (Bean, 1973; Tilly, 1975, 1985), and continuously throughout the 20^{th} century. From the dissolution of European Empires after World War I (WWI) to decolonization following World War II (WWII), and the breakup of the Soviet Union and Yugoslavia, new countries often experienced severe conflict during their formation. Since 1900, more than 100 new countries have been formed or newly restored, and around 70% evolved as independent states during or shortly after conflicts. These newly-founded states often aim to establish democratic institutions from the start, including female suffrage.²

Little is known about how conflicts affect voting intentions by gender during the process of state formation, despite the widespread devastation of societies following wars. The psychological literature on grieving suggests that behavioral responses with exposure to human losses diverge between men and women: men tend to use instrumental coping mechanisms,

¹Coauthored with Christian Ochsner and Monika Köppl-Turyna

²Around 60 countries out of 75 newly founded democracies introduced female suffrage from their very beginning. Zooming into Europe after WWI, 13 new countries were established, and all of them were engaged in conflicts, including participation in WWI, civil wars, border conflicts, or wars of independence. Nine countries introduced democracies with full female suffrage. However, only three had not evolved into autocracies by the mid-1930s.

while women may often exhibit more emotional responses (Glick et al., 1974; McDowell et al., 1988; Martin and Doka, 2000; Martin and Wang, 2006). While there is a fast-growing literature on both the effects of war on voting and on gender differences in general, no study has yet brought together these two strands of the literature to understand potential gender gaps in the most crucial period of state formation: the first elections after war.

This study aims to fill this gap by linking local war exposure to subsequent differences in turnout and voting preferences by gender during the process of state formation. We test whether the emotional and psychological impacts of war may have shaped post-war political preferences and identity formation in gender-specific ways. In particular, we look at the suffering due to the loss of young men during wars and how it affects the support or the rejection of the state, by focusing on gendered turnout and vote shares for pro-state versus anti-state/anti-establishment parties.

The main challenge in analyzing war-affectedness on differences in gender voting is data availability—in most cases, turnout and voting intentions by gender can only be observed in polls or surveys and are thus stated rather than actual preferences. We overcome this issue by focusing on the First Austrian Republic (1918-1933). As a part of the Habsburg Empire, young men from what would become Austria after WWI were drafted into the army in WWI. Casualty and death rates for the Habsburg Empire were among the highest in Europe. Almost all war-related deaths occurred outside the borders of Austria, in the Eastern or Southern Front. This allows us to focus on differences by gender with local war exposure outside the ultimate combat zone. After the war, like other countries founded after the collapse of the Habsburg Empire, Austria introduced female suffrage immediately after its proclamation of independence. However, the main political party camps distrusted each other and accused each other of tying women to themselves. As a compromise to monitor women's political behavior, the political parties agreed to count turnout and vote shares by gender separately (Bader-Zaar, 1996, 2002). We use this unique vote count at the municipality level to study how casualties and fatality rates during WWI affect political behavior by gender during the nation-building process.

Post-WWI Austria shares crucial features that parallel the situation in many conflict-affected countries today, such as a weak sense of national identity, disintegration of regions, and political tensions. A weak common identity characterized Austria; parts of the society aimed to reestablish a Danube monarchy, similar to the Habsburg Empire, while others aspired to become part of Germany or Switzerland, and others supported Austrian independence as a

sovereign state.³ Our data allows us to measure these social cleavages by analyzing both national and local elections and the resulting differences thereof as a proxy for state-formation preferences and local versus national identity and voting patterns by gender.

We examine whether local war-affectedness outside combat zones impacts voting patterns by gender and investigate potential drivers of gender gaps, including victimization and local cultural and socio-economic characteristics. We focus on the state of Upper Austria because data is available for the universe of national and local elections from 1919 to 1931 at the small-scale municipality level, a unique municipality census in 1910 conducted by the state, and various confounders, including proxies of local social capital, that are not available in other Austrian regions.⁴ We measure local war-affectedness based on the "Lost Lists" of the Habsburg Empire, which include the number of deaths, wounded, and missing soldiers, as well as prisoners of war. Around 9% of all men (given the pre-WWI population counts in 1910) are mentioned in the "Lost Lists", which approximately translates into one out of four men in the respective age cohort. We geo-localized 94% of all casualty cases from Upper Austria during WWI to their municipality of origin. The success rate of geo-localizing casualties is thus much higher than in other studies on WWI affectedness.⁵ However, in most cases, war casualties occurred outside of post-WWI Austria at the Eastern or Southern front lines, which allows us to isolate suffering and grieving from other combat-related factors.

Our empirical identification strategy exploits the variation of war-affectedness among neighboring places in pair-wise cross-sectional regressions, which we later extend to a pair-wise differences-in-difference approach using pre-WWI election results (men only) at the election district (court district) level, to account for potential pre-existing differences in voting patterns. In the main analysis, we focus on the fatality rate as the exogenous variation in war exposure (De Juan et al., 2024), and also present robustness exercises using death rates. Fatality rates are not correlated with pre-WWI local geographic, socio-demographic, and economic characteristics, which gives us confidence that confounders should not drive post-WWI differences in turnout and voting.

³Post-WWI Austria was the "bankruptcy estate" of the former Austrian-Hungarian Empire, and had no national identity of its own. There were strong signs of regional disintegration, i.e., the states of Vorarlberg and Salzburg claimed annexation to Switzerland and Germany, respectively. Political tensions were also rising due to the growing pan-German ideology of Hitler's party, the NSDAP, and civil war-related conflicts in the early 1930s.

⁴For Upper Austria, data are available for both national and local elections at the municipality level. Other Austrian states lack data by gender in local elections or did not store election results by gender at the municipality level for the first elections after WWI.

⁵Most studies have a matching rate to the soldier's place of origin of around 70%. Examples are De Juan et al. (2024) for WWI in German districts, and Carozzi et al. (2023) in Great Britain.

We find that local war-affectedness has large implications in the electoral gender divide in this newborn nation: Turnout of women in national elections is around 1.5 to 2 percentage points higher in places with above-median fatality rates than places with below-median fatality rates. By contrast, gender differences in voter turnout in local elections do not differ by fatality rates, which excludes the possibility that potential local confounders or a general empowerment of women with war-related losses drives our findings. Women thus aim to express their sentiments vis-à-vis the nation and nationwide institutions, but not vis-à-vis the region. These differences in turnout in national versus local elections cannot be interpreted as a general increase in social capital of women affected by war, as turnout is often used as a measure of local social capital. Indeed, we document that the higher turnout rate for women in national elections translates into higher vote shares for pan-German parties, which were opposed to the newly founded state of Austria and sought accession to Germany. Anti-Austrian parties won the votes of women at the cost of the other two main political camps, the Catholic-Conservatives and Social Democrats, equally. These gender differences are particularly pronounced during the first elections after WWI, and fade during the late 1920s and early 1930s, ending up in generally higher support of anti-state parties among those affected by war regardless of gender.

We next investigate underlying drivers of the gender gap in turnout and voting after the war. We find that women express their dislike of the state mainly due to personal victimization. We show that the death of soldiers matters differently depending on the soldiers' status and the place of the war event. For the latter, we find that soldiers who died on the Eastern Front in present-day Poland and Ukraine, i.e., battles primarily representing the imperial ambitions of the Habsburg Empire, show more dislike of the new state by women than by men. Conversely, dying for the sake of their own people, i.e., fighting on the Southern Front for the future of South-Tyrolean Austrians, does not spur any gender divide. The gender divide is pronounced in smaller and remote places, where lost soldiers may have been better known, and in places with high social capital proxied by the number of local associations. We conclude that suffering and grieving during war affects voting and the support for nation-building in a gendered way—a finding that literature has been silent upon thus far.

Our study contributes to several strands of the literature. First, our research is placed within the literature on the impact of conflict, war, and violence on voting. Two seminal studies look at war-affectedness in WWI on subsequent voting patterns and shifts towards extremism. Accomply et al. (2020) shows that WWI casualties had a major impact on

⁶Studies on economic empowerment of women find higher female labor force participation with more missing men, i.e., Goldin and Olivetti (2013) for the US after WWII, and Gay (2023) for France after WWI.

votes for socialist parties, which in turn paved the way for the rise of Italian fascism. Cagé et al. (2020) investigate the role of battle experience at Verdun on the rise of the fascist movement in the 1930s and Nazi collaboration during WWII in France. Other studies focus on WWI exposure and subsequent erosion of democratic forces in Weimar Germany (Koenig, 2023; De Juan et al., 2024). Alacevich and Zejcirovic (2020) for Bosnia and Herzegovina, Blattmann (2009) and De Luca and Verpoorten (2015a,b) find ambiguous effects of war exposure on turnout in Uganda. Studies investigating gender differences in revealed political behavior following wars are absent. Studies on national (versus regional) identity and culture, for example, Akerlof and Kranton (2010); Dehdari and Gehring (2019); Halbwachs (1973); Kranton (2016), also ignore gender aspects. Our findings extend this literature with a gender dimension, showing that women affected by war increase their turnout in national elections more than men, to express their dislike of the nation-state relative to men with war-affectedness. Women thus gain utility from voting, by demonstrating that they do not feel they belong to the state, though such gender differences do not exist in local elections. Gender-specific grieving thus affects national identity, but not regional identity.

Second, our study contributes to the literature on gender divides. Empirical studies have shed light on the present-day gender differences that originate in the distant past (Alesina et al., 2013a), gender differences in preferences (Croson and Gneezy, 2009), in competitive behavior (Niederle and Vesterlund, 2007; Buser et al., 2014, 2023; Zhang, 2018), labor market outcomes (Bertrand, 2011), peer recognition (Card et al., 2022), and risk-taking behavior (Buser and Yuan, 2019). We contribute to this literature by examining how gender-specific grieving impacts voting intention and behavior differently among women and men, as suggested in previous literature. We find evidence that victimization drives the gender gap in anti-nation-building voting. Women are more likely to express their dislike for the nation if the death of soldiers can be regarded as unnecessary. Studies on the effects of victimization focus on crime exposure (Bateson, 2012) and the above-mentioned literature on wars (Bellows, John and Miguel, Edward, 2006; Bellows and Miguel, 2009; Blattman and Miguel, 2010; Voors et al., 2012). Our study fills the gap in understanding how women and men perceive war-related losses differently, which then translates into differences in their actual voting patterns. ⁹ We

⁷In addition to voting, studies link war events to behavioral outcomes and voting intentions (rather than actual voting) (Bellows, John and Miguel, Edward, 2006; Bellows and Miguel, 2009; Blattman and Miguel, 2010; Gneezy and Fessler, 2012; Voors et al., 2012; Bauer et al., 2014; Cecchi et al., 2016; Bauer et al., 2014), reintegration into society, and religious coping (Bauer et al., 2018; Henrich et al., 2019). See Bauer et al. (2016) for a literature review on the societal consequences of wars.

⁸Riker and Ordeshook (1968) provide a conceptual framework for how voters gain utility by asserting partisanship and allegiance by voting. However, the theory cannot explain the differences between national and local elections, leaving the aim of expressing dislike for the nation-state as the likely explanation.

⁹Annan et al. (2011) is somewhat similar to our study. They analyze ex-combatants' reintegration into

can also exclude direct war exposure to explain the resulting gender gap, because war events took place outside of Austria.¹⁰ At the same time, empowerment of women due to labor market opportunities cannot explain higher turnout only in national elections, but not in local ones—women only aim to express their grief against national institutions, but not against local ones.

Lastly, our study is also related to the literature on the "electoral gender gap" that documents and explains voting differences between men and women. Most literature points to two phases of the electoral gender gap in recent decades. While women tended to vote more conservatively than men until the 1960s (Duverger, 1955; Rokkan et al., 1967; Randall, 1987), gender gaps in voting disappeared over the following decades (De Vaus and McAllister, 1989; Jelen et al., 1994; Walker, 1994; Norris, 1996). Listhaug (1985), Rusciano (1992), Togeby (1994), and more recently, Inglehart and Norris (2000) and Abendschön and Steinmetz (2014) show that women in advanced industrial societies have moved to the left, while men tend to support more populist radical-right parties (Spierings and Zaslove, 2015). 11 In addition to the voting behavior, lower turnout rates of women relative to men are widely documented in the literature up to the present day (Morgan-Collins, 2023; Skorge, 2023). 12 We document a large and persistent lower turnout of women through interwar Austria, but a relative increase in women's turnout in national elections when they have been affected by war. Similarly, in absolute terms, women voted more for the Catholic-Conservatives and less for Social Democrats and the pan-German/anti-Austrian parties. However, the gender gap for these anti-establishment parties become smaller with war-affectedness, mainly during the first elections after WWI. We thus provide first evidence on the electoral gender gap in a newborn nation and its diminishing patterns with war-affectedness.

The remainder of this chapter is organized as follows. Section 2.2 introduces the institutional setting and the political camps of the First Austrian Republic. Section 2.3 introduces the data we compiled and discusses coding details. Section 2.4 provides descriptive evidence on voting patterns after WWI. Section 2.5 analyzes the effects of war-affectedness on gender differences in turnout and voting, and provides several robustness and sensitivity analyses.

society by focusing on gender gaps. However, they focus on ex-combatants only.

¹⁰Women are more often victims of health-related effects of conflicts, including trauma (McGinn, 2009; Tolin and Foa, 2008), and have a higher risk of poverty (Brück and Schindler, 2009). Buvinic et al. (2013) survey the related literature and identify different channels of the effects of wars on women.

¹¹The reasons for the gender gap in voting can be divided into individual-level factors (e.g., labor force participation, religious attachment) and macroeconomic factors (e.g., economic development, welfare state), and have been examined by, among others, Abendschön and Steinmetz (2014). See also Giger (2009) for a review of the electoral gender gap.

¹²Some studies use rare data in interwar Germany and document gender gaps in voting for selected large cities (Falter et al., 1986), and for turnout (Lavies, 1973).

Section 2.6 investigates the potential channels at work, which include victimization and locality-specific heterogeneity. Lastly, Section 2.7 concludes.

2.2 Institutional and Political Background

This section briefly provides an overview of the Habsburg Empire during WWI and the proclamation of the First Austrian Republic (Section 2.2.1), the unique vote counting agreement by gender (Section 2.2.2), and the party system of interwar Austria (Section 2.2.3).

2.2.1 World War I and the First Austrian Republic

The Habsburg Empire entered WWI in July 1914, following the assassination of Archduke Franz Ferdinand and subsequent declaration of war on Serbia. Men from across the empire, including Austria, were mobilized to fight against Russia and Serbia on the Eastern Front, and against Italy on the Southern Front after Italy entered the war.¹³ Recruitment was governed by a system of regiment zones, with all municipalities in Upper Austria belonging to the same recruitment district, centered in Innsbruck—ensuring that drafting rules were consistent across the region. The human toll on the Habsburg forces was immense: approximately 1.2 million soldiers died and millions more were wounded or captured.

During October 1918, the last month of WWI, the crown lands of the Habsburg Empire gradually declared their independence, leading to the monarchy's official dissolution and abdication of the emperor. The German-speaking regions of the Habsburg Empire declared the foundation of the "Republic of German-Austria" aimed to become a part of Germany. The general consensus among most Austrian political leaders was that a shrunken German-speaking Austria would not be able to survive as an independent state, due mainly to economic concerns. However, the Treaty of Versailles committed Austria to independence and neutrality, and sealed the loss of some German-speaking territories mainly to Italy and Czechoslovakia (Höbelt, 2018). Thereafter, the First Austrian Republic was declared, and women's suffrage was introduced from its inception. However, national identity was weak, with parts of the country aiming for accession to Germany (Salzburg) or Switzerland (Vorarlberg).

¹³Battles that represent the imperial ambitions of the Habsburg Empire are termed as the "Eastern Front" throughout this study (i.e., the Balkan region and the Eastern Borders of the Habsburg Empire in present day Romania, Ukraine, and Poland). Theaters of war against Italy are labeled as the "Southern Front". Note that soldiers from the Habsburg Empire also fought on the Western Front in France under German leadership. However, their numbers were small.

The new country struggled steadily throughout the interwar period, facing internal disputes, hyperinflation, and economic crises. Politically, Catholic-Conservatives and Social Democrats formed a coalition government in 1919. Thereafter, the Catholic-Conservatives often formed a minority government which was tolerated by the pan-German parties. Upon Hitler's seizure of power in Germany, the Austrian faction of NSDAP gained power and won sizable vote shares in local elections. The Catholic-Conservative chancellor Dollfuss feared losing power to the NSDAP and installed an autocratic government, the so-called Austro-fascism, to preserve Austria's independence (Tálos and Manoschek, 2014). During this authoritarian period, no elections were held, and all the pan-German parties were banned.

2.2.2 Unique Vote Counting by Gender

Universal male suffrage was introduced within Beck's reform in 1907 in Cisleithania, i.e, the Austrian part of the Habsburg Empire. In 1907 and 1911, eligible male voters elected members of the House of Deputies in the Imperial Council. With the proclamation of the "Republic of German-Austria", universal women's suffrage was introduced in 1918, except for prostitutes, who were not allowed to vote until 1923. Women were thus allowed to vote from the very beginning of the republic, including the election for the national council in the "Republic of German-Austria" in 1919, and in the four national elections in the First Austrian Republic in 1920, 1923, 1927, and 1930.

Women's suffrage was highly controversial. Both major camps—the Catholic-Conservatives and Social Democrats—feared the consequences of the female franchise. In the opinion of conservatives, women were radicals at heart and would tend to align with the Social Democrats. According to the Social Democrats, women stood more under the whip of the clergy and would therefore favor the Catholic-Conservative parties (Bader-Zaar, 1996). To monitor the electoral consequences of women's suffrage, the Social Democratic party launched the different-colored ballots to observe potential gender divides (Bader-Zaar, 2002). These colored ballots were used throughout all national elections during the First Austrian Republic, allowing for observations of turnout and vote shares by gender. This procedure has also been used for most regional elections at the state level. However, vote results by gender are not

¹⁴All men above the age of 24 (passive suffrage above 30) with Austrian citizenship for longer than three years who had been living in Austria for at least one year were eligible to vote. Municipal suffrage was introduced later—i.e., not until 1918 for the Viennese city council.

¹⁵The Catholic-Conservative parties initially aimed to combine women's suffrage with compulsory voting. The camp feared that conservatively oriented women would not be able to mobilize as many voters as the Social Democrats. The decision on compulsory voting was left to the states ("Bundesländer"), and it was introduced in two of them: Tirol and Vorarlberg, which typically voted more conservative (Ucakar, 1985).

2.2.3 Politics in Interwar Austria

The political landscape in Austria was divided into three main political camps: Catholic-Conservatives, Social Democrats, and pan-German parties (Ignazi, 2003). This party division provides a unique measure for pro-state parties (establishment) and anti-state parties (anti-establishment) in post-WWI Austria as follows:

Pro-state parties: We label the Catholic-Conservatives and Social Democrats as pro-state parties. Both parties came to terms with an independent Austria after WWI and thus supported the Peace Treaty of Versailles. Catholic-Conservatives were the strongest supporters of an independent Austria rooted in Christianity, i.e., in the Catholic church (Staudinger et al., 1995). The party can be seen as the political entity that brought the values of the monarchy into the republic—it thus advocated most strongly for the old order (Dachs, 1995). Similarly, the Social Democrats supported the state from the beginning, despite their support of the international labor movement and their belief that joining Germany would help Austria economically (Maderthaner, 1995). These two parties formed the first government coalition after dissolution of the Habsburg Empire. The vote shares in the national election of 1920 for both of these parties can thus be seen as pro-state and pro-establishment voting. Thereafter, Catholic-Conservatives often formed the government, sometimes with support or at least tolerance of the pan-German parties. The Social Democrats were mostly in the opposition after the national election in 1920, and fully focused on their socialist experiment in Vienna (Maderthaner, 1995).

Anti-state parties: Anti-establishment parties in interwar Austria included parties with a pan-German ideology (Deutschnationale). Pan-Germans aimed to establish a unified German nation and annex German Austria to Germany. The pan-German movement in Austria began after the Austro-Hungarian Compromise in 1867, when German groups feared losing control over the multi-ethnic monarchy (Dostal, 1995). They opposed the Austrian-Hungarian monarchy and the newly founded state after WWI, thus opposing the Peace Treaty of Versailles. During the First Austrian Republic, the pan-German camp consisted initially of agrarian and non-agrarian parties and was loosely organized. In the 1920s, the pan-German parties formed a joint alliance, which, in 1927, even included the Catholic-Conservatives. In the last democratic election before WWII in 1930, the pan-Germans split into different parties. There was a more democratic and consensus-oriented faction, but

¹⁶At the local level, different ballots were still used after World War II, i.e., for most local council elections in Vienna. Koeppl-Turyna (2021) reports on the electoral gender gap in Vienna.

there were also two radical pan-German parties: the Austrian branch of the German Nazi party (NSDAP) and the Heimatblock, both favouring fascism (Burkert, 1995; Dostal, 1995; Edmondson, 1995). With the outbreak of the Great Depression, the radical pan-German parties won in local elections around the country, leading the Catholic-Conservatives to install an autocratic regime in 1933.

In addition to the main political camps, independents, Jewish parties, regional parties, and the Communist Party participated in elections. However, none of them won more than 1% of total votes in national polls and mostly only put up electoral lists only in larger cities.

2.3 Data and Descriptives

This section describes the data and coding overview of our main data. Detailed data description, summaries, coding details, and access modality are provided in the Online Appendix 2.A, and descriptive statistics are provided in the Online Appendix 2.B.

2.3.1 WWI Casualty and Fatality Rates

We collect casualty data from WWI based on "Loss Lists" (Verlustlisten) of the Austrian-Hungarian Empire provided by Familia-Austria (https://www.familia-austria.at). A total of 720 books document almost 2.7 million entries for the Empire by the type of casualty (death, hurt, prisoner of war (PoW), missing). The "Loss Lists" contain the names of the soldiers, year of birth, the military unit, region, and locality of origin. We scraped all this data for entries from Upper Austria and geolocated all soldiers to their municipality of origin. Out of 38,953 entries from Upper Austria, we uniquely match 94% at the small-scaled municipality level. We keep only the last entry for soldiers with repeating entries to obtain the net casualty numbers. Appendix 2.A.1 offers a detailed overview of coding, restrictions and summaries. For entries of prisoners of war, we can also obtain the place they were detained. With this information, we assigned troops and regiments' locations by months to code whether casualties occured on the Eastern or Southern Front for our mechanism analysis.

We construct net casualty fatality rates, in short $Fatality_i$, for each municipality as a ratio of deaths and missing soldiers over the total number of net casualties as follows:

Net Casualty Fatality Rate_i = Fatality_i =
$$\frac{Deaths_i + Missing_i}{Total\ Net\ Casualties_i} \times 100$$
 (2.1)

We use $Fatality_i$ for our main empirical specification as the treatment variable. Panel A

in Table 2.B.2 shows summary statistics of measures of war-affectedness. Almost 8% of Upper Austrian men (given male population in 1910) were mentioned at least once in the "Loss Lists", and 2.10% died. This results in an average fatality rate of 26.29% in Upper Austria. Figure 2.B.3 shows casualties by reason of entry and year of war. 1915 shows the highest casualty numbers, while 1915 and 1918 have the highest number of deaths. Figure 2.B.13 provides histograms of death and fatality rates at municipality and court-district levels in Upper Austria. Variation is much higher at the small-scaled municipality level, while aggregation to the court-district level reduces the variation of our dependent variables.

2.3.2 Election Results (by Gender)

The main outcome variable of interest in this study is the election results of local and national elections in Upper Austria. We collect all election results from 1907 (the first election in Cisleithania with universal men's suffrage) until 1931 (the last local election before Austrofascism set in). Election results before WWI (for men only) are available only at the court district level. In the interwar period, there were four national elections (1919, 1920, 1927, 1930) and three state elections (1919, 1925, 1931) in Upper Austria. Turnout is available by gender for all of these elections. Party vote shares by gender are available for the three national elections of the Austrian First Republic (1920, 1927, 1930) and for the last local election in 1931. In our estimates, we will mainly focus on the national election 1920 due to its clear distinction between pro-state and anti-state parties. We use the vote shares of pan-German parties, Catholic-Conservatives, and Social Democrats as our main outcome variables. We assigned the competing parties to the three camps of Austrian politics. See Appendix 2.A.2 for details.

Panels B and C in Table 2.B.2 show summary statistics for pooled election outcomes in the pre-WWI and post-WWI periods, respectively, and the upper graphs in Figure 2.1 shows the evolution of turnout and vote shares over time. The average turnout rate after WWI is 82.91%.¹⁷ Upper Austria was a Catholic-Conservative stronghold, with the party winning around two-thirds of all votes after WWI. The Social Democrats and the pan-German camp were similarly strong, with an average vote share of around 16 to 18%, while other parties do not play any role in Upper Austria (i.e., the Communist vote share is slightly above 0.1%).

¹⁷There are two municipalities in which turnout rates are higher than 100%. The reason is that in those municipalities, there were some people (mostly males serving in the military) who voted at a voting point other than the one where they were registered.

2.3.3 Further Variables

Our data contains further variables from various sources. We digitize the municipality census of Upper Austria in 1910 and the country-wide census of 1934 for confounders, including information on the total population and population by gender, religious denomination, number of households, and occupation shares (only available for 1934). We also collect data on court disputes by topic as proxies for local culture and economic hardship, the number of associations for each municipality as a proxy for social capital, the length of railway lines within the territory of the municipality, soil caloric suitability index, and elevation. Panels D to G in Table 2.B.2 show descriptive statistics of these variables. Upper Austria has small municipalities with an average population of 1,652 and agriculture is dominant, with around 52% of residents working in agriculture in 1934, according to head-of-household survey results. See Appendix 2.A.3 for data sources and construction of these variables.

2.4 Voting Patterns and its Drivers

This section discusses turnout and the voting patterns from 1907 to 1931 in Upper Austria, and the absolute gender gaps we find. We also show descriptive evidence based on a cross-sectional OLS regressions of the underlying variables that explain the overall voting patterns, including the effects of WWI affectedness in the national election in 1920.

First, Panel (a) in Figure 2.1 shows absolute turnout and the vote shares of the three main political camps over time. Pre-WWI figures are drawn from court-district data and contain only men's voting; post-WWI figures include men and women at the municipality level. The figure illustrates that voter participation remained consistently high across all elections and that the Catholic-Conservative camp dominated the electoral landscape. Panel (b) shows the resulting gender gap in turnout and voting for the interwar period. The figure plots the difference between women and men (w-m).¹⁸ Women supported the Catholic-Conservative camp much more than men, by around 12 to 15 percentage points. Conversely, the gap is negative for turnout and votes for the pan-German camp and the Social Democrats. These figures align with the literature on the early electoral gender gap (see Section 2.1).

Second, we explore the underlying drivers of the absolute voting preferences, and the role of war-affectedness. To so so, we estimate the following cross-sectional OLS regression:

¹⁸Figure 2.B.4 in the Appendix reports absolute turnout and vote shares by gender.

$$Y_{i} = \alpha + Fatality_{i} + X_{i}^{'}\gamma + \mu_{d} + \epsilon_{i}$$

$$(2.2)$$

 Y_i denotes the Z-standardized turnout rate and voting outcomes by the three main political camps in municipality i in 1920. We focus on the 1920 national election only, as it represents a pivotal moment for observing voters' nation-building behavior after WWI, with a clear-cut distinction between pro- and anti-state parties. Fatality_i measures WWI-affectedness as denoted in Equation 2.1, and is also Z-standardized. The vector X_i comprises three groups of Z-standardized explanatory variables at the municipality level to describe voting behavior based on municipality-level characteristics. These variables include socio-demographic characteristics from the 1910 census, occupational structures from the 1934 census, and additional municipality attributes. To account for unobserved differences across districts that may confound the relationship between voting behavior and the explanatory variables, we include district fixed effects μ_d . ϵ_i is the error term. Standard errors are clustered at the municipality level.

Panels (c) to (f) in Figure 2.1 show the resulting OLS coefficients from Equation 2.2 of all independent variables and their partial R^2 for turnout and the three main political camps separately. We find that higher fatality rates increase overall turnout significantly. The fatality rate also has the third largest partial R^2 of all independent variables, indicating that war exposure matters to the decision to vote or not to vote. However, war-affectedness does not seem to influence party preferences overall—i.e., vote shares by men and women together. Instead, political choices were primarily shaped by occupation (municipalities with a higher agricultural share were more likely to support Catholic-Conservatives), as well as by gender and religious composition. The fact that war-affectedness does not influence absolute voting outcomes does not necessarily imply that it had no impact on gender differences in voting behavior. We thus repeat the analysis of Equation 2.2 on the gender gap in turnout and voting (w-m). Figure 2.B.5 in the Appendix provides correlational evidence suggesting that wartime fatality rates may lead to gender gaps. Specifically, places with higher fatality rates seem to increase turnout and pan-German voting by women relative to men.

The results reported in this section are purely descriptive. To establish more robust causal evidence of the impact of WWI affectedness on the gender gap in voting, we turn to a pairwise comparison of contiguous municipalities as outlined in Section 2.5.

2.5 War-affectedness and the Gender Gap

In this section, we extend the purely descriptive analysis in Section 2.4 with a more causal approach. We discuss our regression model and the respective identifying assumptions for causal inference to test for the impacts of WWI affectedness on the gender gap in voting. We employ pairwise regression estimates with contiguous municipalities for identification purposes.

2.5.1 Empirical Model and Identification

To investigate the relationship between WWI fatalities and the gender gap in voting, we apply an empirical specification that uses the variation in war-affectedness among contiguous municipality pairs in Upper Austria. This approach exploits the fatality treatment among neighboring municipalities on subsequent voting outcomes. We match each municipality into a pair with its direct geographical neighbors. These pairwise estimates are based on Holmes (1998) and Dube et al. (2010) or more recently Lichter et al. (2021) and Galofré-Vilà et al. (2021). The cross-sectional pairwise estimates with contiguous municipalities take the following form:

$$Y_{i,p} = \alpha + \beta Fatality_{i,p} + \mu_p + X_i'\gamma + \epsilon_p$$
(2.3)

 $Y_{i,p}$ is the gender gap (women minus men) in voting in municipality i in the contiguous pair p. The main outcome variables are turnout and vote shares for the political parties. Our treatment variable, $Fatality_{i,p}$, is a continuous measure defined by Equation 2.1. The coefficient of interest is β , which tests whether higher fatality rates affect the gender gap in voting. We will show that our results are not dependent on the definition of the main treatment variable by looking at other definitions of war-affectedness, including dummy specifications and death rates rather than fatality rates. X_i' is a vector of municipality control variables. These controls are socio-demographic, economic, and geographic variables. We estimate all models with pair fixed effects, μ_p , to ensure that we compare differences in fatality rates within neighboring places only, i.e., to use the variation of war-affectedness among neighboring units. These pair-fixed effects will control for unobserved regional heterogeneity that might drive the outcome. The error term is denoted by ϵ_p . We estimate Equation 2.3 using ordinary least squares (OLS) and apply standard errors clustered at the contiguous municipality-pair level. We report alternative clustering approaches and spatially clustered standard errors (Conley, 1999, 2010) in the robustness exercises. We run the Equation 2.3 over all national (1919, 1920, 1927, 1930) and local (1919, 1925, 1931) elections separately,

and also pool national and local elections to find potential differences in local versus national polls.

Local war-affectedness should be purely random for a causal interpretation of our β -coefficient. However, draftees, casualties, and dead soldiers often have common socio-economic characteristics correlated with their place of origin, including various pre-war social, political, and economic factors that likely influenced military recruitment, volunteering during WWI, soldiers' rank, and combat behavior. We illustrate these concerns in Figure 2.2. The maps in Panel (a) and (b) show that net-casualty and death rates are spatially correlated, with municipalities experiencing high death and casualty rates often being surrounded by similarly affected areas.

We address these identification concerns as follows. First, we use the fatality rate as the exogenous part of war-affectedness. In practice, whether a soldier was killed or survived depended on inherently random events on the battlefield — such as whether a bullet proved lethal or not — and thus provides a credible source of exogenous variation. The map in Panel (c) depicts the spatial distribution of fatality rates. Here, we find lower spatial clustering—municipalities with high fatality rates are interspersed among those with moderate and low fatality rates. This visual finding is in line with the literature that also argues for fatality rates as the exogenous part of war exposure (see De Juan et al. (2024)). Second, we use pairwise estimation techniques that compare variation among adjacent units, which reduces the concerns that regional characteristics are potential drivers of the results. Third, our main treatment variable, the fatality rates, should be orthogonal to pre-treatment regional characteristics, including socio-economic, political, or geographic variables.

[Figure 2.2 about here]

We illustrate our three main identifying assumptions with a battery of balance tests that compare fatality rates with other measures of war-affectedness and also compare the pairwise estimates with standard cross-sectional regressions. The lower section of Figure 2.2 presents the balance of pre-war electoral outcomes, court cases statistics (serving as a proxy for local culture, crime, and economic hardship), census data from 1910 and 1934, and time-invariant geographic characteristics across the three measures of WWI exposure. We employ Equation 2.3 to test the balance of these municipality confounders, restricting the sample to municipality pairs that share the longest common border. Additionally, we estimate a specification using a standard sample (without pairs), while incorporating district fixed effects to

¹⁹Election results from 1911 and court statistics from 1910 are only available at the court district level, with all municipalities within a district assigned the same values. Figure 2.B.7 also shows the balance of these variables at the court district level. The identifying assumptions are not challenged by this data constraint.

account for potential regional patterns in army recruitment. Table 2.B.3 provides evidence that municipality characteristics did not influence the assignment of soldiers to the Eastern or Southern front, reinforcing the credibility of our identification by ruling out systematic sorting into fronts with different fatality risks.

We find that municipalities in Upper Austria with a high number of casualties or deaths per male population are generally more agricultural and less industrial. Additionally, these municipalities exhibit lower levels of social capital, as proxied by the number of municipal associations per capita, and have less railway connectivity, measured by the length of railway lines within the municipality. Because all of these factors are plausible predictors of voting behavior, the relationship between the casualty share and electoral outcomes is likely subject to confounding. Contrary to measures scaled by the male population size, variations in the fatality rate arise from a quasi-random combination of battlefield dynamics, troop deployment, and soldier recruitment practices. These characteristics suggest that the fatality rate is plausibly exogenous to socio-economic, geographical, and political attributes of soldiers' home municipalities, as demonstrated in panel (c) of Figure 2.2. Moreover, the pairwise estimation technique shows a higher balance than the standard cross-sectional regression with district fixed effects. We conclude that the fatality rate, combined with the pairwise estimation technique, provides exogenous variation of local war-affectedness. This argument is further confirmed in Figure 2.B.6. It illustrates that the fatality rate is orthogonal to the casualty rate, while death rates are highly correlated with total casualties. This further supports our choice of the fatality rate as an exogenous measure of WWI exposure.

2.5.2 Results

We examine the impact of war-affectedness on the voting behavior of men and women separately, and highlight potential gender gaps. Figure 2.3 presents our main results with the fatality rate as the measure of war-affectedness. We estimate Equation 2.3 with multiple outcomes and with single and pooled election years. The panels on the left-hand side show the pooled results of national and local elections separately. The panels on the right-hand side report the effect for each election separately, and highlight national and local elections with different shades of grey. For each election type, we report three coefficients and their confidence bands: triangles represent the effects on women, squares the effects on men, and the boxes the effects on the resulting gender gap (w-m).

We first discuss the effects on turnout in Panels (a) and (b) of Figure 2.3. We find large gender gaps in turnout with war-affectedness in national, but not in local elections. Higher

fatality rates are associated with increased turnout among women relative to men. A rise in women's participation primarily drives this effect, whereas men's turnout remains largely unchanged in response to WWI exposure. Based on the most pivotal election of 1920, we find that a one percentage point increase in the fatality rate increases the gender gap in turnout (women minus men) by around 0.04 percentage points. In other words, women increase their turnout by around one percentage point when we compare the mean affected municipality (fatality rate of 26.3%) with a non-affected one. We also estimate a specification in which we measure WWI exposure using a binary indicator for whether the fatality rate is above or below the median, as shown in Figure 2.B.9. The results indicate that municipalities with above-median fatality rates exhibit a 1.2 percentage point higher gender gap in turnout compared to those below the median. Interestingly, the gender gap is close to zero for local elections throughout the interwar period. This indicates that the positive gender gaps in national elections do not suggest that women care relatively more about politics in general or aim to raise their voices more with war-affectedness. In fact, women relatively aim to make their statement vis-à-vis the nation, but not vis-à-vis the local unit.

[Figure 2.3 about here]

We next test how higher women's turnout in the national elections translates into vote share differences by gender for the three main political camps. Panels (c) and (d) in Figure 2.3 report vote shares by gender and the resulting gender gaps for the pan-German camp. This camp is in strongest opposition to the newly-founded state. The pan-German camp can be labeled as an anti-state and anti-establishment party group, in particular, in the most pivotal election during the nation-building process in 1920. We find that the gender gap is particularly pronounced in this most pivotal election. The higher turnout of women relative to men in the 1920 national election translates almost one-to-one into higher support for anti-state parties. We interpret this finding to mean that women aimed to express their dislike of the ruling order and the establishment, while men relatively did not. The gender gap in pan-German voting fades out through the 1920s, resulting to a general increase in anti-state party voting irrespective of gender.

Panels (e) to (h) in Figure 2.3 show the effects on the other main parties that support the newly-founded state, which formed a coalition until the 1920 national election. We observe that the pan-German camp won at the cost of the other camps, particularly in the pivotal election of 1920. In contrast, gender gaps in the local election in 1931, the only local election for which we have voting outcomes by gender, show almost no gender divide. This is surprising given the radicalization of the pan-German camp in the early 1930s.

We also check the gender gap in voting for the Communist party in Figure 2.B.12 another anti-state/anti-establishment camp. We observe a negative gender gap in voting for the Communists, mainly driven by men's increased support in places with high war-affectedness. However, these results should be interpreted with caution, given the small overall vote share of the communist party. Nevertheless, it appears that men—more than women—were politically mobilized toward radical leftist alternatives in response to war fatalities.

We conclude that war-affectedness matters for voting after wars and that women are mobilized differently than men with local war-affectedness. Women aimed to express their dislike of the ruling order, particularly in the early period of the newly founded state. This can be seen through higher relative turnout by women and a higher vote share for the pan-German camp, but only in the national and not in the local elections. In Section 2.6, we will explore on the drivers of this gender gap in the national election in 1920.

2.5.3 (Pseudo)Differences-in-Difference

Thus far, our results are based on cross-sectional regressions only, raising the risk that unobservable pre-WWI political preferences by gender might determine our results. However, we can largely rule out this concern with our identification strategy. Moreover, we find a gender gap only in national elections, but not in local ones, ruling out potential historical gender differences, except differences in the WWI fatality rate. We next extend the setting by including election results prior to WWI, when only men could vote, to test potential shifts in voting with war-affectedness.

We control for potential pre-WWI differences in political preferences with a pairwise Difference-in-Differences (DiD) approach using national election results from 1907 and 1911 (pre-WWI) that we link to national elections after the war. A key limitation is that pre-war data is only available at the higher administrative level of court districts. We thus run the DiD regressions at the level of court districts, which may reduce variation due to the aggregation. Moreover, because universal suffrage before WWI was granted exclusively to men, the classical DiD design applies strictly to men (and therefore total) voting. However, we also implement a pseudo-DiD design for women by assuming that their pre-war voting behavior would have resembled that of men.

Table 2.1 presents the pairwise DiD and pseudo-DiD estimates at the court district level for turnout and for support for the pan-German camp. We restrict our reported estimates in Table 2.1 to elections from 1907 to 1920, i.e., until the most critical moment for understanding post-war nation-building behavior. We also report an event-study plot in Figure 2.B.14,

which includes all national elections from 1907 until 1930. The results indicate that greater war-affectedness increases turnout among both men and women, with a stronger effect for women. This leads to a positive gender gap in turnout, as shown in Column (4) of Table 2.1, which reports the difference in coefficients between women and men. Regarding pan-German voting, women reduce their support for this camp less than men, resulting in a positive (albeit statistically insignificant) gender gap. Thus, our DiD estimates do, in fact, qualitatively support our main findings of the pairwise cross-sectional regressions above.

The smaller effect sizes relative to our main municipality-level results are largely attributable to aggregation, particularly for pan-German votes. As shown in Figure 2.B.13, war fatalities vary substantially across municipalities (0 to 100), but exhibit far less variation at the court district level. Additionally, our event study analysis in Figure 2.B.14 confirms an absence of pre-trends in the pre-WWI period and shows similar post-war dynamics in turnout and pan-German voting. Overall, the DiD results are consistent with the findings in Section 2.5.2, supporting the conclusion that exposure to WWI increased the gender gap in both turnout and anti-state/anti-establishment voting.

2.5.4 Robustness and Sensitivity Analysis

We show that our findings in Section 2.5.2 are robust to alternative treatment and variable definitions and estimation approaches. The respective figures and tables are reported in Appendix 2.B. First, we show the effects of war-affectedness on voting with an adapted definition of the fatality rate. Figure 2.B.9 and Figure 2.B.11 report a dummy specification of the fatality rate (above versus below the median fatality exposure) and a Z-standardized specification, respectively. The results are qualitatively unaffected. Second, we replace the fatality measure of WWI exposure with death rates scaled by the male population. The results in Figure 2.B.8 are qualitatively similar to the main specification in terms of direction and main dynamics. Moreover, we observe a substantially larger effect estimate for this treatment measure, indicating that cases of deaths mainly drive the results. However, we caution against a causal interpretation of the death rate measurement, as it is likely endogenous to various municipality-level characteristics as discussed above. Third, we migrate from a pairwise sample to a standard cross-sectional sample and include district fixed effects in the regressions. This standard sample ensures that repeated entries of crucial municipalities do not drive our main findings. The results in Figure 2.B.10 are quantitatively and qualitatively similar to the main results, showing that our findings are not reliable only with the pairwise regression method. Lastly, we employ alternative specifications to cluster the standard errors, including clustering at the municipality and district levels and spatially dependent standard errors (Conley, 1999, 2010). Table 2.B.4 reports the estimates of our main outcomes with these alternatively specified standard errors.

2.6 Mechanism

We explore potential mechanisms that drove the gender gap in voter turnout and the support for the pan-German camp as a proxy for anti-state sentiments. We focus on the first national election during the First Austrian Republic in 1920, which is pivotal for observations of pro- or anti-state sentiments with war-affectedness. Our mechanism analysis follows two approaches. First, we focus on heterogeneous treatment analysis to understand the underlying suffering/grieving of WWI losses (Section 2.6.1). Second, we aim to understand local characteristics that might drive differences in gender gaps (Section 2.6.2).

2.6.1 Treatment Heterogeneity

We examine treatment heterogeneity in fatality rates. In particular, we are interested in whether certain characteristics of lost soldiers matter for the impact on voting. Our detailed data from the "Lost Lists" allows us to investigate differences in soldiers' characteristics and the war event. We consider locations of war events (Eastern versus Southern Front), timing of casualties, and the age, status, and rank of soldiers who died, were wounded, went missing, or became prisoners of war. This helps us to identify which types of WWI casualties contribute most to the gender gap.

Panel (a) in Figure 2.4 replicates the main findings from Figure 2.3, disaggregating fatalities by subcategories. First, we distinguish between casualties on the Eastern (e.g., Poland, Ukraine) and Southern (Italian) Fronts using information on the place of captivity of PoWs to assign regiments and troops by months to the respective front. We find a larger gender gap in both voter turnout and pan-German voting associated with Eastern front casualties, suggesting that women perceived these losses as more senseless and victimizing, and that this perception drove higher civic engagement and anti-state sentiments. The intuition is that soldiers on the Eastern front were likely to be less motivated, as they were fighting more for imperial aims than to protect their own homeland or people. In contrast, those on the Western front fought for German-speaking South Tyrolians, a region with stronger local ties. Second, the gender gap widens for casualties that occurred in the mid- and later-war periods, likely reflecting the war's peak intensity. Third, the gender gap is also

larger for fatalities among younger soldiers (20–30 years old) and draftees, reinforcing the victimization narrative that women expressed dislike of the ruling order in response to the losses of "innocent" soldiers. In contrast, deaths among older or higher-ranked soldiers—who were more likely to be military professionals—elicit weaker gender gaps. Notably, fatalities among volunteers are associated with a huge gender gap in pan-German voting. We interpret this finding as a picture of deep disillusionment with the state by women relative to men.

[Figure 2.4 about here]

2.6.2 Effects of Local Characteristics

Second, we conduct a sample split analysis based on municipal characteristics (above and below the median value). We investigate proxies of local cultural, economic, demographic, and geographic characteristics to understand the gender gap we observe.

Panel (b) in Figure 2.4 highlights the role of local characteristics in shaping the gender gap. Each coefficient in the plot shows the difference between the fatality coefficient for the above-median subsample and that for the below-median subsample, based on estimates from equation 2.3. Cultural factors—including social capital (proxied by per capita associations), religiosity (share of Protestants), and loyalty to imperial values (proxied by the number of Habsburg-named soldiers)—significantly amplify the gender gap in voter turnout. Social capital also increases the gender gap in pan-German voting, adding a gender dimension to the broader pattern identified by Satyanath et al. (2017), who show that strong civic networks can mobilize political extremism.

In contrast, economic factors like sectoral employment shares have limited explanatory power. The only notable effect is that areas with higher industrial employment exhibit a smaller gender gap in both turnout and pan-German voting, which may reflect less reliance on traditional social structures in industrialized communities. Furthermore, the gender gap in pan-German voting is most pronounced in small, sparsely populated, and remote (lacking railway access) municipalities. In these places, dead soldiers are likely to be more widely known by other community members, i.e., their death is more visible and can thus affect grieving.

In sum, our analysis shows that the gender gap in turnout and anti-state voting is driven by the nature of WWI casualties—especially by losses that are perceived as unnecessary—and by local cultural ties in smaller and remote places. These findings suggest that women's political responses to wars relative to those of men—shown in the context of state-formation—were shaped not only by personal loss but also by the strength of local social ties.

2.7 Conclusion

We analyze how women and men responded differently to war exposure in the context of nation-building. Focusing on interwar Upper Austria, we link local WWI fatality rates to voter turnout and support for pan-German parties. Our findings show that, in municipalities with higher war-affectedness, women exhibited significantly higher turnout rates in national elections, but not in local ones. At the same time, the relatively higher turnout of women translates into higher vote shares for anti-state/anti-establishment parties. Women thus appear to perceive war-related losses differently, inspiring them to vote to express their dislike with the ruling order. These gender differences are most pronounced in the immediate aftermath of the war and diminish somewhat in later years, leading to a general increase in anti-state support with war-affectedness independent of gender.

We interpret these patterns as evidence of a deeper mistrust among women toward the newly established First Austrian Republic and its ruling parties (the establishment) in areas with greater war-affectedness. This gender gap is largely driven by the deaths of low-ranked soldiers and casualties on the Eastern Front, which served the imperial ambitions of the empire rather than its people more directly. Our findings highlight how personal and collective loss can shape political behavior differently across gender lines.

While our study provides novel insights into the gendered dynamics during nation-building after wars, it is important to note its limitations. Our analysis is confined to Upper Austria, a single federal state, which may constrain the generalization of our findings. Future research should explore whether similar patterns hold across other post-war contexts, to better assess the external validity of our conclusions.

Figures and Tables [Main text]

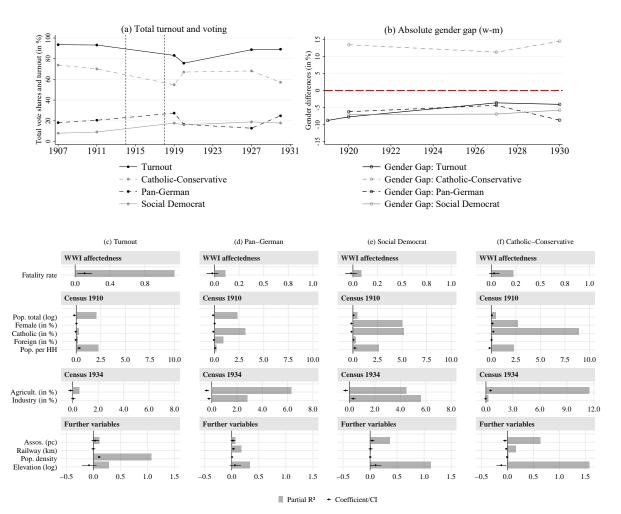
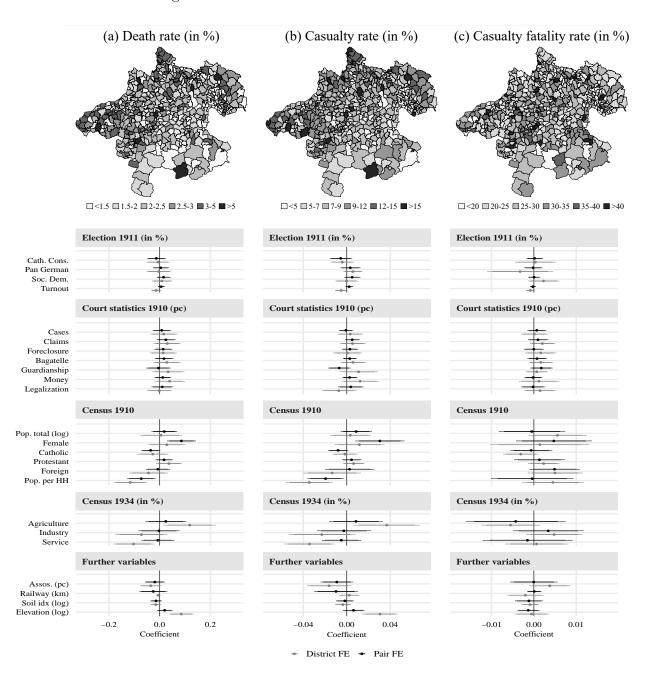


Figure 2.1: Absolute voting/turnout and its drivers

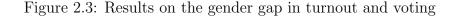
Notes: The figure shows turnout and vote shares and their decompositions. Graph (a) shows absolute turnout and vote shares for the three main political camps in Austria from 1907 to 1930. Graph (b) shows the gender gap in turnout and voting (since 1919). Data for 1907 and 1911 are based on election district data and include men's votes only. Data after 1919 are based on municipality-level data and contain votes by women and men. Graphs (c) to (f) show the regression coefficients from separate OLS regressions of total turnout, pan-German, Social Democrat, and Catholic- Conservative party vote shares in the national election in 1920 (the first national election with vote share data by gender). Each graph shows the coefficients of explanatory variables (fatality rate in WWI, socio-demographic variables (based on the 1910 census), economic controls (based on the 1934 censuses), and further local variables) of separate multivariate OLS regressions. Each regression controls for district fixed effects. All variables are Z-standardized. The horizontal lines represent the 90% (in bold) and 95% (thin) confidence intervals with standard errors clustered at the municipality level. Shaded gray bars show partial R^2 s of respective explanatory variables.

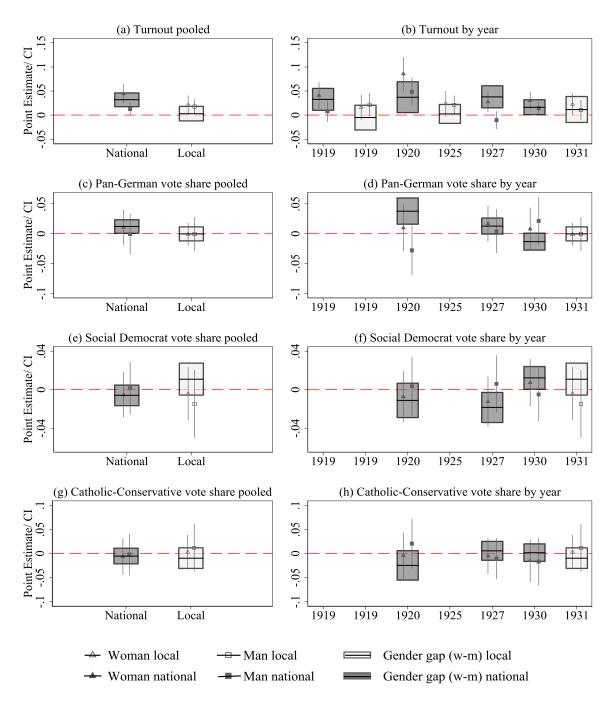
Figure 2.2: Local war-affectedness and balance



Notes: The figure displays local war-affectedness during WWI and a balance test with various local characteristics at the level of 502 municipalities in Upper Austria. The maps display the distribution of death rate (Graph (a)), causality rate (Graph (b)), and fatality rate (Graph (c)). The death rate is defined as the ratio of dead soldiers to the 1910 male population, causality is defined as the ratio of the total number of World War I casualties (including deaths, missing, prisoners of war, and wounded) to the 1910 male population, fatality is defined as the ratio of soldiers reported dead or missing to the total number of WWI casualties during the 1914–1919 period. Bottom panels represent the coefficients from pairwise and non-pairwise OLS regressions of different municipality characteristics on the death rate, causality rate, and fatality rate. All variables are Z-standardized. Pairwise regressions include the pairs with the longest border and control for pair fixed effects. Non-pairwise regressions control for district fixed effects. The horizontal lines represent the 90% (in bold) and 95% (thin) confidence intervals with standard errors clustered at the pair/district level.

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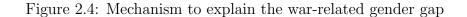


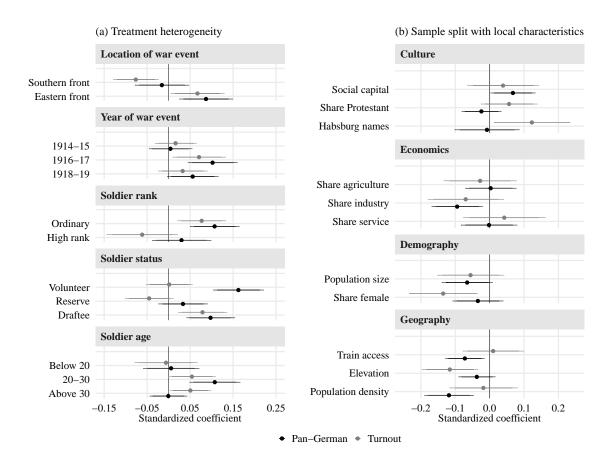
Notes: The figure displays coefficients from pairwise OLS regressions of voter turnout and party vote shares on a measure of wartime fatality. Fatality is defined as the ratio of soldiers reported dead or missing to the total number of World War I casualties (including deaths, missing, prisoners of war, and wounded) during the 1914–1919 period. The graphs illustrate the effects of fatality on voter turnout and on the vote shares of the pan-German, Social Democratic, and Catholic-Conservative parties. Results are shown pooled across national and local elections (Graphs (a), (c), (e), and (g)) and across election years (Graphs (b), (d), (f), and (h)). All regressions control for pair fixed effects, 1910 Census characteristics (log population, population per household, female population share, religious composition, and share of foreigners), as well as geographic factors (railway access indicator and log elevation). Vertical lines and boxes represent 95% confidence intervals, with standard errors clustered at the pair level.

Table 2.1: Difference-in-differences results in turnout and pan-German voting

	Turnout				Pan-German camp			
	Total (1)	Women (2)	Men (3)	Diff (w-m) (4)=(2)-(3)	Total (5)	Women (6)	Men (7)	Diff (w-m) (8)=(6)-(7)
Fatality × Post WWI	0.622** (0.142)	0.744** (0.183)	0.503* (0.125)	0.241*** (0.075)	-0.522** (0.250)	-0.454* (0.239)	-0.517** (0.261)	0.063 (0.078)
Year FE Pair FE Controls × Year FE Pair × Year FE Obs	Yes Yes Yes Yes 1380	Yes Yes Yes Yes 1380	Yes Yes Yes Yes 1380		Yes Yes Yes Yes 1380	Yes Yes Yes Yes 1150	Yes Yes Yes Yes 1150	

Notes: The table reports coefficients from pairwise DiD regressions of voter turnout and pan-German vote share on a measure of wartime fatality at the court district level. Fatality is defined as the ratio of soldiers reported dead or missing to the total number of World War I casualties (including deaths, missing, prisoners of war, and wounded) during the 1914–1919 period. Each column corresponds to a separate regression on the pool of national elections in 1907 and 1911 (pre-treatment period) and 1920 (post-treatment period). Regressions in Columns (1) to (3) and (5) to (7) include controls interacted with year fixed effects, pair fixed effects, and pair-by-year fixed effects. Controls include 1910 Census characteristics (log population, population per household, female population share, religious composition, and share of foreigners) and geographic factors (railway access indicator and log elevation). Standard errors are clustered at the pair level. Columns (4) and (8) show the difference between the separate coefficients of women and men with standard errors that are obtained through Wald test. Significance levels are: $^*p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.





Notes: The figure displays treatment heterogeneity and sample split analysis. Each block in Graph (a) is a separate pairwise OLS regression for voter turnout and pan-German vote share in 1920 that includes pair fixed effects and a set of pre-WWI control variables as in Figure 2.3. Fatality is disaggregated by location of war event, year of war event, soldier rank, status, and age. Each coefficient of Graph (b) shows the difference between the fatality coefficient for the above-median subsample and that for the below-median subsample in 1920, according to the sample split in cultural, economic, demographic, and geographic categories. All variables are Z-standardized. The horizontal lines represent the 90% (in bold) and 95% (thin) confidence intervals with standard errors clustered at the pair level.

2.A Appendix: Data Sources, Coding and Access Modality

This section lists the data sources of this study, provides coding details, and shows the access modality.

2.A.1 WWI Casualty Rates

Our casualty data stem from the "Lost Lists" of the Habsburg Empire. The dataset contains records of soldiers who died, were wounded, went missing, or were taken as prisoners of war during WWI is available at https://www.familia-austria.at/index.php/manibus-unitis/verlustlisten-1-weltkrieg/1320-erfassung-der-oesterreichisch-ungarischen-verlustlisten-i-weltkrieg.

The data was scraped using a self-written Python script. Subsequently, soldiers' addresses were geolocated via the Google API using another self-written Python script. If automatic geocoding failed to identify a soldier's municipality (e.g., due to an incomplete or non-unique address), additional manual corrections were applied. These included minor spelling adjustments and, in cases where the exact address was missing but the municipality could be determined within a district, assigning the soldier to the geographical center of the municipality.

The net number of casualties was then calculated based on all geolocated soldiers. If the same soldier—identified by name, surname, date of birth, and municipality—appeared multiple times in the dataset (e.g., due to multiple injury records or sequential records of being wounded and later killed), only the last recorded instance was retained. Figure 2.A.1 provides statistical details on the total number of entries, geolocated cases, and the final net number of casualties. Our matching rate to a unique municipality for entries for Upper Austria reaches 94% of all entries.

The "Lost Lists" contains various characteristics of soldiers that are extracted and coded as follows:

Age: In this dataset, we determine a soldier's age at the time of casualty by calculating the difference between the date of the incident and the date of birth.

Habsburg name: We classify soldier names as either Habsburg or non-Habsburg. A name is categorized as Habsburg if it corresponds to the names of Habsburg rulers during World War I (e.g., Franz, Josef), preceding it (e.g., Rudolf) or the names of well-known Habsburg

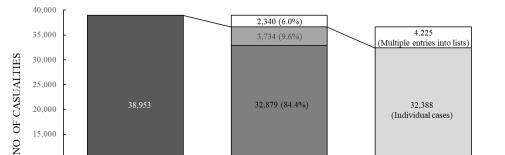
family members throughout the time.

Eastern versus Southern Front: The scraped dataset primarily provides location information mainly for cases where soldiers were taken as prisoners of war (POW). All POWs in Italy are assigned to the Southern Front, while all others are assigned to the Eastern Front. For soldiers who are not PoWs, we determine their front allocation based on their regiment and the months of the incident of any PoW event. Specifically, we calculate the proportion of POWs assigned to the Eastern and Western fronts within each regiment-year and allocate the remaining soldiers to the front with the highest share in that regiment-year.

Soldiers' rank and status: We classify soldiers based on their rank (ordinary or high rank) and status (volunteer, reserve, or draftee) within the army.

The original dataset contains brief textual descriptions of soldiers' positions. Soldiers' status is explicitly indicated if they were volunteers (e.g., Einjährig-Freiwilliger Korporal) or part of the reserve (e.g., Kadett in der Reserve). Soldiers who do not fall into these categories are classified as draftees.

Rank classification is also derived from the original dataset. Soldiers with an explicit indication of a higher rank (e.g., Reserve-Korporal, Leutnant), regardless of their status, are classified as high rank. Those without any indication of rank are classified as ordinary soldiers.



Geolocalized

■ Matched by hand

Net number

□ Cases not used

5,000

Total entries with

"Oberösterreich"

■ Matched automatically

Figure 2.A.1: Casualty scraping, geo-localization, and cleaning

Notes: The figure displays numbers of scraped casualty cases, their geo-localization and entry-cleaning for Upper Austria. Total entries stem from https://www.familia-austria.at and include all casualty cases that contain the respective federal state. Casualty cases are then geo-localized (automatically and by hand) to the municipality in Upper Austria) based on the territorial status of the 1920s. Casualty cases without a unique locality assignment within the borders of post-WWI Upper Austria are deleted. The remaining casualty cases are corrected for multiple entries, i.e., if a certain soldier appears several times in the "Lost Lists", he/she is counted only once and by the most severe entry (Death or PoW).

2.A.2 Election Data (by Gender)

Election data at the level of the municipality for the years 1919, 1920, 1925, 1927, 1930, and 1931 were obtained from the State Archive of Upper Austria, as published by the State Government, and subsequently digitized by us. The archival records include election results disaggregated by gender for the years 1920, 1927, 1930, and 1931, while voter turnout by gender is available for all years. Additionally, election data for Austria as a whole at the level of court district for the years 1907, 1911, 1919, 1920, 1927, and 1930 were digitized from published sources retrieved from various archives. We digitized the following sources (scanned copies):

- Ergebnisse der Wahlen zur konstituierenden Nationalversammlung am 16. Februar 1919 in Oberösterreich. Herausgegeben von der provisorischen Landesregierung für Oberösterreich.
- Ergebnisse der Wahlen für den oberösterreichischen Landtag am 18. Mai 1919. Herausgegeben von der Landesregierung für Oberösterreich.
- Ergebnisse der Wahlen zur Nationalversammlung am 17. Oktober 1920 in Oberösterreich.
 Herausgegeben von der Landesregierung für Oberösterreich. Verlag des oberösterreichischen Landesrates.
- Ergebnisse der Wahlen für den oberösterreichischen Landtag am 17. Mai 1925. Herausgegeben von der Landesregierung für Oberösterreich. Verlag der oberösterreichischen Landesregierung.
- Statistische Nachrichten. Sonderheft: Wahlstatistik Nationalratswahlen vom 24.
 April 1927. Einzeldarstellung nach Gemeinden und Geschlecht. Wien, September 1927.
- Ergebnisse der Wahlen für den Oberösterreichischen Landtag am 19. April 1931. Herausgegeben von der oberösterreichischen Landesregierung in Linz. Verlag des Amtes der oberösterreichischen Landesregierung.
- Österreichische Statistik. LXXXIV. Band, 2. Heft. Herausgegeben von der k.k. Statistischen Zentralkommission. Die Ergebnisse der Reichsratswahlen in den im Reichsrate vertretenen Königreichen und Ländern im Jahre 1907. Bearbeitet vom Bureau der k.k. Statistischen Zentralkommission. Wien: Kaiserlich-Königliche Hof- und Staatsdruckerei, 1908. In Kommission bei Karl Gerold's Sohn.
- Österreichische Statistik. Neue Folge, 1. Heft. Herausgegeben von der K.K. Statis-

tischen Zentralkommission. Die Ergebnisse der Reichsratswahlen in den im Reichsrate vertretenen Königreichen und Ländern im Jahre 1911. Bearbeitet vom Bureau der K.K. Statistischen Zentralkommission. Wien: Kaiserlich-Königliche Hof- und Staatsdruckerei, 1912. In Kommission bei Karl Gerold's Sohn.

- Endgültiges Ergebnis der Nationalratswahl in den 24 Wahlkreisen, Land Carinthia. 19.
 Juni 1921.
- Ergebnisse der Nationalratswahlen vom 24. April 1927. Einzeldarstellung nach Gemeinden und Geschlecht.
- Statistische Nachrichten: Nationalratswahlen vom November 1930.

Berteilung ber gultigen Stimmen auf bie Barteien Abgegeb. Stimmen Bahlberechtigte Gemeinde Chriftlichfoglale Cogialbemotraten Großb. Boltspartel Rommun. Partei mrild. B. Bolitifder Begirt Ried im Juntreis. Untiefenhofen 32 4 19 15 8 9 15 47 4 32 17 12 36 19 52 22 90 55 56 40 107 56 26 67 32 131 221 307 212 372 20 7 15 10 41 25 56 25 33 94 63 31 74 49 25 11 Geinberg St. Georgen b.O. 304 241 381 240 130 131 158 550 297 258 541 281 477 457 611 453 753 491 194 160 111 174 142 154 159 413 319 545 Gurten Rirchdorf a. 3. Lambrechten 104 82 46 135 165 88 42 254 St. Martin i. 3. Mörichwang Rühlheim 211 170 687 144 142 422 204 5 62 24 38 33 20 Obernberg a. 3. 14 18 13 70 217 497 260 1069 610 143 500 Add Ort i. 3nutreis 454 241 599 176 248 184 64 89 454 200 164 172 428 931 Reichersberg 111 171 160 78 Senftenbad) 145 38 51 12 5 21 Wippenham Gerichtebezirt Obernberg a. 3

Figure 2.A.2: Voting data counts by gender in 1920

Notes: The figure shows a page of the voting results at the level of municipalities in Upper Austria. It contains the number of men voters and their votes, the number of women voters and their votes, and the total numbers.

2.A.3 Further Data

Socio-economic and socio-demographic variables of municipalities for the years 1910 and 1934 are based on the following archival sources (hard copies):

- Spezialortsrepertorium der österreichischen Länder. Bearbeitet auf Grund der Ergebnisse der Volkszählung vom 31. Dezember 1910. Herausgegeben von der K.K. Statistischen Zentralkommission. II. Oberösterreich. Wien, 1916. Verlag der K.K. Hof- und Staatsdruckerei.
- Österreichische Statistik. Neue Folge, 1. Heft. Herausgegeben von der K.K. Statistischen Zentralkommission. Die Ergebnisse der Volkszählung vom 31. Dezember 1910 in den im Reichsrate vertretenen Königreichen und Ländern. 1. Heft: Die summarischen Ergebnisse der Volkszählung mit 6 Kartogrammen. Bearbeitet vom Bureau der K.K. Statistischen Zentralkommission.
- Die Ergebnisse der österreichischen Volkszählung vom 22. März 1934. Issue 5. Vienna: Österreichisches Bundesamt für Statistik. 1935.

Other Variables

Court statistics: The data on the court district level is digitized from Zivilrechtspflege, 1910 archival book.

Social capital: The social capital variable is proxied by the number of associations per capita (1910 population). The information about associations in Upper Austria is retrieved from https://www2.land-oberoesterreich.gv.at/internetgeschichte/Start.jsp?SessionID=SID-785EF419-8D96BF6B

Train access: The data on train access is sourced from Enzyklopädie des Eisenbahnwesens, edited by Dr. Freiherr von Röll, 7th volume (Kronenbreite - Personentarife), published in Berlin and Vienna in 1915. This historical source provides detailed information on the railway network during that period. For geolocation and spatial analysis, we utilize QGIS solutions to accurately map and integrate the historical railroad data into our research.

Elevation: The elevation of the terrain in a grid of 10m × 10m is downloaded from https://www.data.gv.at/katalog/dataset/land-ktn_digitales-gelandemodell-dgm-osterreich and geolocated using QGIS solutions.

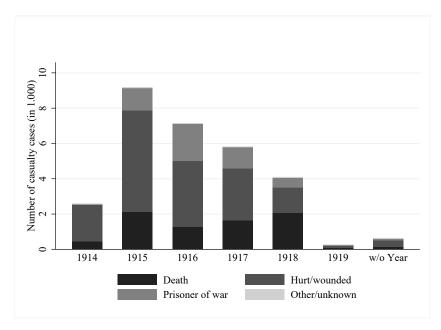
Soil caloric suitability index: The index is provided by (Galor and Özak, 2016). The index captures the variation in potential crop yield across the globe, as measured in calories

per hectare per year. The index we use in this research is based on the average potential yields within each cell, attainable given the set of crops that are suitable for cultivation in the post-1500 period. Source: https://github.com/ozak/Caloric-Suitability-Index.

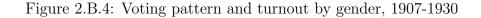
2.B Appendix: Additional Figures and Tables

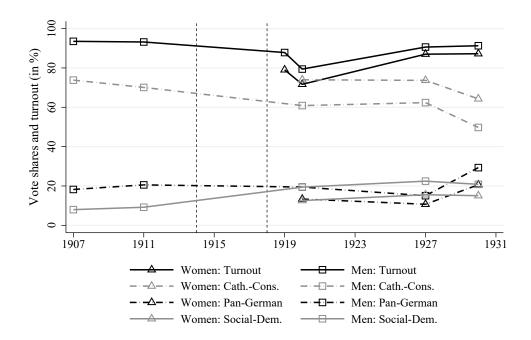
2.B.1 Additional Figures

Figure 2.B.3: Casualties according to the cause of entry into "loss lists"



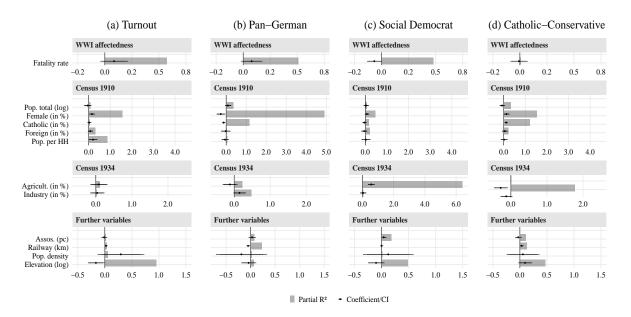
Notes: Figure shows the number of casualties in Upper Austria by type (death, hurt, prisoner of war and other—mainly missing) over the years. Last bar with "no year" indication includes entries without information on casualty year. Net casualties include only one casualty per soldier. If multiple casualties are assigned to the same soldier, only the latest entry is counted.





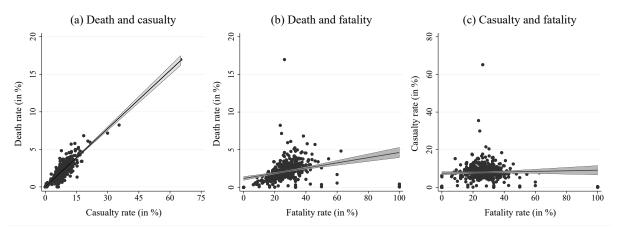
Notes: The figure displays vote shares for the main political camps in Austria and turnout in national elections. Data for the elections in 1907 and 1911 are based on election district data and include only men. Data from 1919 onward show voting patterns and turnout by gender at the municipality level in Upper Austria. For the national constituent assembly election in 1919, only data on turnout by gender are available. Election results at the election district and municipality level for 1923 are entirely missing. The dashed vertical lines indicate the start and end of World War II.

Figure 2.B.5: Correlation between the voting gap and municipality characteristics



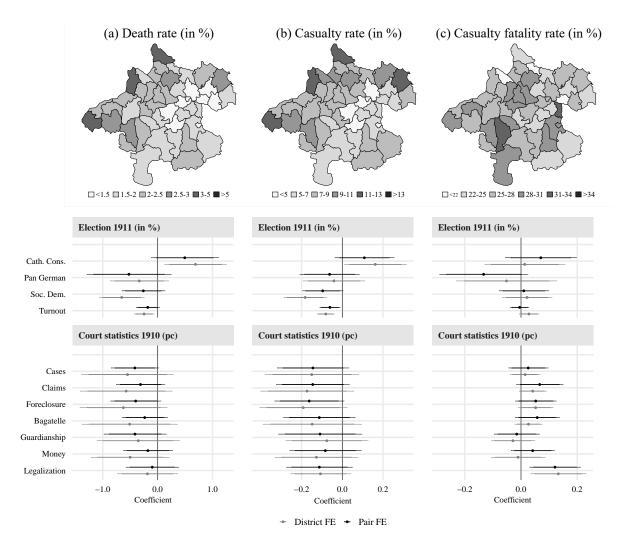
Notes: Graphs (a) to (d) show the regression coefficients from separate non-pair OLS regressions of gender gap (w-m) in turnout and voting for the pan-German camp, Catholic-Conservative, and Social Democrats in 1920 jointly on the fatality rate, variables from the 1910 and 1934 censuses, and further variables. Each regression controls for district fixed effects. Shaded gray bars show partial R^2 s of respective variables. All variables are Z-standardized. The horizontal lines represent the 90% (in bold) and 95% (thin) confidence intervals with standard errors clustered at the municipality level.

Figure 2.B.6: Correlation plots of different local affectedness measures



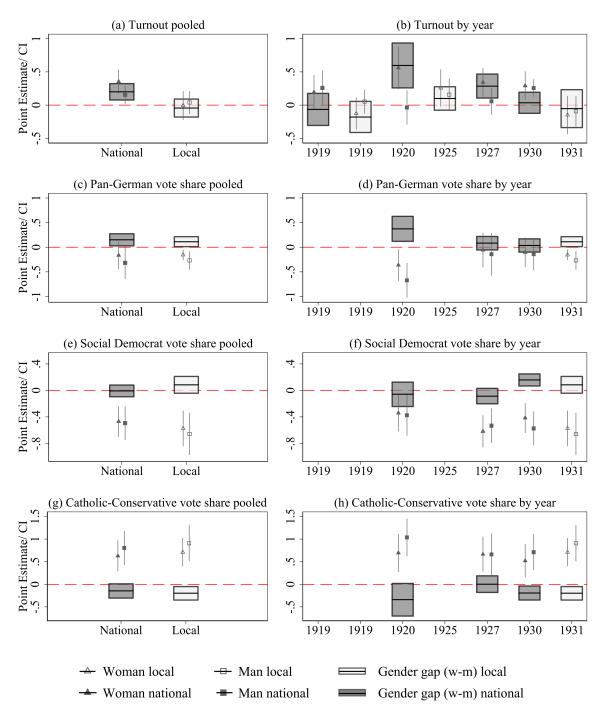
Notes: Figure presents the bivariate correlations between three measures of war-affectedness across municipalities. Panel (a) plots the death rate against the casualty rate, panel (b) shows the death rate versus the fatality rate, and panel (c) illustrates the relationship between the casualty and fatality rates. Casualty and death rates are expressed as percentages of the male population in 1910. Each panel includes a linear fit line to visualize the strength and direction of the association.

Figure 2.B.7: Balance of war-affectedness and court district measures in Upper Austria



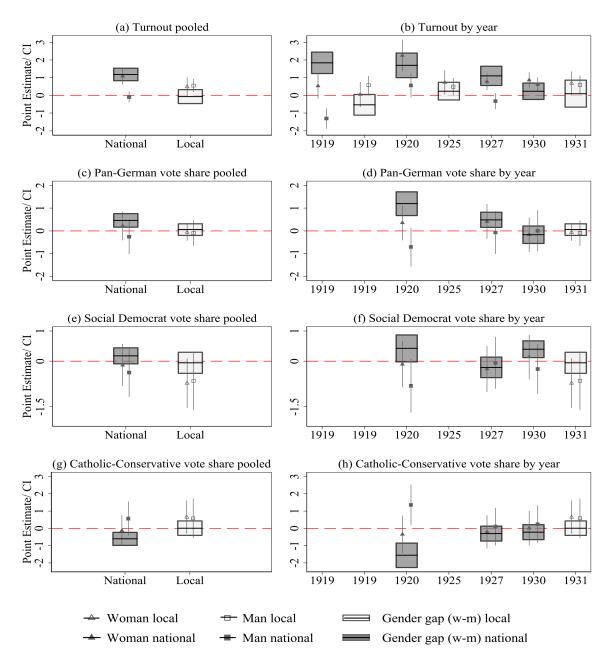
Notes: The figure displays local war-affectedness during WWI and a balance test with various local characteristics at the level of 48 court districts in Upper Austria. The maps display the distribution of death rate (Graph (a)), causality rate (Graph (b)), and fatality rate (Graph (c)). The death rate is defined as the ratio of dead soldiers to the 1910 male population, causality is defined as the ratio of the total number of World War I casualties (including deaths, missing, prisoners of war, and wounded) to the 1910 male population, fatality is defined as the ratio of soldiers reported dead or missing to the total number of World War I casualties during the 1914–1919 period. Bottom panels represent the coefficients from pairwise and non-pairwise OLS regressions of different court district characteristics on the death rate, causality rate, and fatality rate. All variables are Z-standardized. Pairwise regressions include the pairs with the longest border and control for pair fixed effects. Non-pairwise regressions control for district fixed effects. The horizontal lines represent the 90% (in bold) and 95% (thin) confidence intervals with standard errors clustered at the pair/district level.

Figure 2.B.8: Results with death rates on the gender gap in turnout and voting



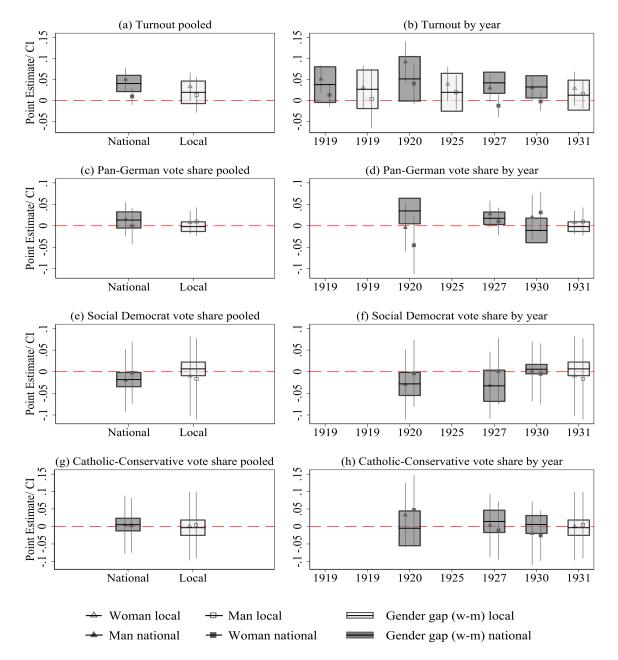
Notes: The figure displays coefficients from pairwise OLS regressions of voter turnout and party vote shares on a measure of wartime death rate. Death rate is defined as the ratio of dead soldiers over the 1910 male population during the 1914–1919 period. The graphs illustrate the effects of the death rate on voter turnout and on the vote shares of the pan-German, Social Democratic, and Catholic-Conservative parties. Results are shown pooled across national and local elections (Graphs (a), (c), (e), and (g)) and across election years (Graphs (b), (d), (f), and (h)). All regressions control for pair fixed effects, 1910 Census characteristics (log population, population per household, female population share, religious composition, and share of foreigners), as well as geographic factors (railway access indicator and log elevation). Vertical lines and boxes represent 95% confidence intervals, with standard errors clustered at the pair level.

Figure 2.B.9: Results based on dummy specification on the gender gap in turnout and voting



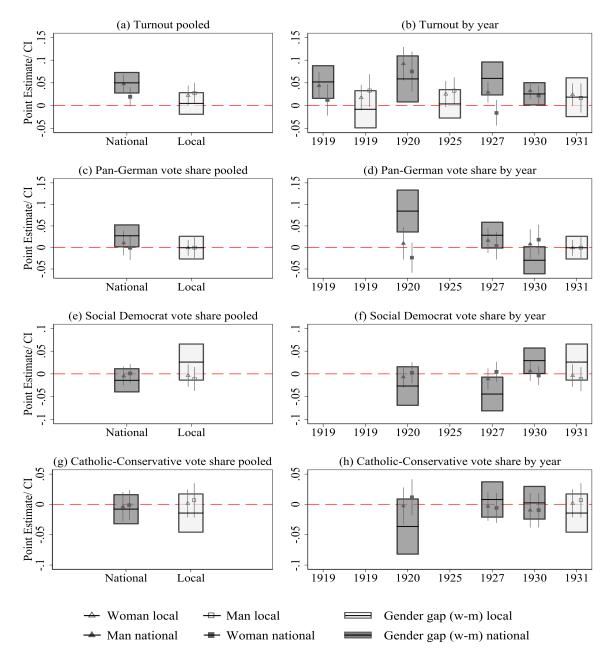
Notes: The figure displays coefficients from pairwise OLS regressions of voter turnout and party vote shares on a measure of wartime fatality dummy indicator. Fatality is defined as the ratio of soldiers reported dead or missing to the total number of World War I casualties (including deaths, missing, prisoners of war, and wounded) during the 1914–1919 period. The fatality dummy indicates a fatality rate above the median. The graphs illustrate the effects of above-median fatality on turnout and on the vote shares of the pan-German, Social Democratic, and Catholic-Conservative parties. Results are shown pooled across national and local elections (Graphs (a), (c), (e), and (g)) and across election years (Graphs (b), (d), (f), and (h)). All regressions control for pair fixed effects, 1910 Census characteristics (log population, population per household, female population share, religious composition, and share of foreigners), as well as geographic factors (railway access indicator and log elevation). Vertical lines and boxes represent 95% confidence intervals, with standard errors clustered at the pair level.

Figure 2.B.10: Results on the gender gap in turnout and voting (with district fixed effects)



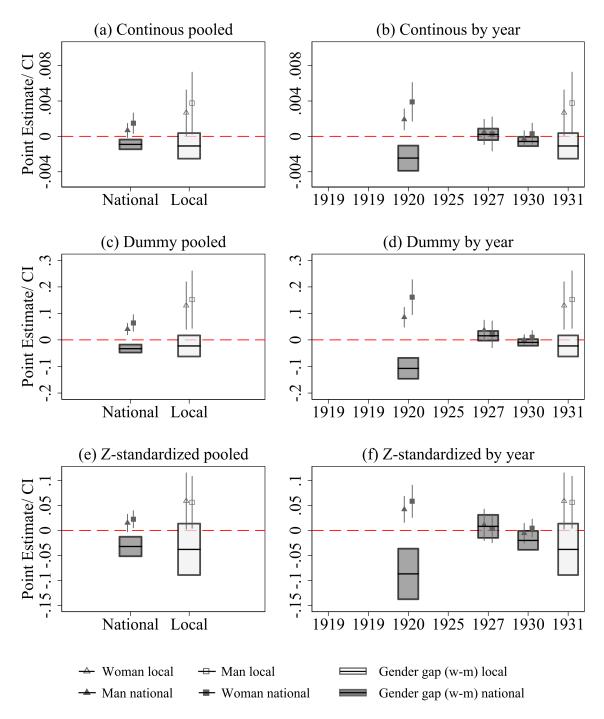
Notes: The figure displays coefficients from OLS regressions of voter turnout and party vote shares on a measure of wartime fatality. Fatality is defined as the ratio of soldiers reported dead or missing to the total number of World War I casualties (including deaths, missing, prisoners of war, and wounded) during the 1914–1919 period. The graphs illustrate the effects of fatality on voter turnout and on the vote shares of the pan-German, Social Democratic, and Catholic-Conservative parties. Results are shown pooled across national and local elections (Graphs (a), (c), (e), and (g)) and across election years (Graphs (b), (d), (f), and (h)). All regressions control for district fixed effects, 1910 Census characteristics (log population, population per household, female population share, religious composition, and share of foreigners), as well as geographic factors (railway access indicator and log elevation). Vertical lines and boxes represent 95% confidence intervals, with standard errors clustered at the pair level.

Figure 2.B.11: Results on the gender gap in turnout and voting (Z-Standardized measures)



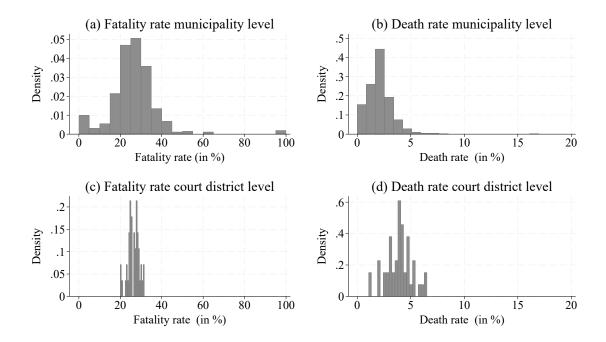
Notes: The figure displays coefficients from Z-standardized pairwise OLS regressions of voter turnout and party vote shares on a measure of wartime fatality. Fatality is defined as the ratio of soldiers reported dead or missing to the total number of World War I casualties (including deaths, missing, prisoners of war, and wounded) during the 1914–1919 period. The graphs illustrate the effects of fatality on voter turnout and on the vote shares of the pan-German, Social Democratic, and Catholic-Conservative parties. Results are shown pooled across national and local elections (Graphs (a), (c), (e), and (g)) and across election years (Graphs (b), (d), (f), and (h)). All regressions control for pair fixed effects, 1910 Census characteristics (log population, population per household, female population share, religious composition, and share of foreigners), as well as geographic factors (railway access indicator and log elevation). Vertical lines and boxes represent 95% confidence intervals, with standard errors clustered at the pair level.

Figure 2.B.12: Results on the gender gap in Communist voting



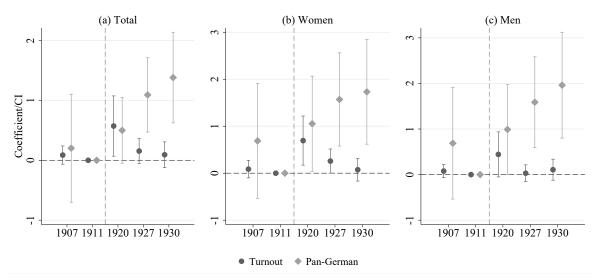
Notes: The figure displays coefficients from pairwise OLS regressions of Communist party vote share on a measure of wartime fatality (Graphs (a), (b)), above-median fatality dummy indicator (Graphs (c), (d)), and Z-standardized fatality (Graphs (e), f)). Fatality is defined as the ratio of soldiers reported dead or missing to the total number of World War I casualties (including deaths, missing, prisoners of war, and wounded) during the 1914–1919 period. Results are shown pooled across national and local elections (Graphs (a), (c), and (e)) and across election years (Graphs (b), (d), and (f)). All regressions control for pair fixed effects, 1910 Census characteristics (log population, population per household, female population share, religious composition, and share of foreigners), as well as geographic factors (railway access indicator and log elevation). Vertical lines and boxes represent 95% confidence intervals, with standard errors clustered at the pair level.

Figure 2.B.13: Distribution of WWI casualties on municipality and court district levels



Notes: The figure presents four histograms showing the fatality and death rates frequencies during the 1914-1919 period in Upper Austria. Graphs (a) and (c) display the frequency of the fatality rates across 502 municipalities and 48 court districts, respectively. The fatality rate (in %) is defined as the ratio of soldiers reported dead or missing to the total number of World War I casualties (including deaths, missing, prisoners of war, and wounded). Graphs (b) and (d) display the frequency of the date rates across 502 municipalities and 48 court districts, respectively. The death rate (in %) is defined as the ratio of soldiers reported dead to the total number of the 1910 male population.

Figure 2.B.14: Event study results of fatality on turnout and pan-German voting



Notes: The figures display coefficients from event-study regressions of total, women, and men turnout and pan-German vote share on the fatality rate across pairs of 502 municipalities in Upper Austria. Coefficients are standardized to zero for the last pre-WWI period (1911). The fatality rate is defined as the ratio of soldiers reported dead or missing to the total number of World War I casualties (including deaths, missing, prisoners of war, and wounded). All regressions include pair fixed effects, pair fixed effects interacted with year fixed effects, and pair fixed effects interacted with the 1910 Census variables (analogous to regressions in Figure 2.3). Gray dashed vertical lines represent the period of WWI (1914-1919). Vertical lines represent the 95% confidence intervals clustered at the pair level.

2.B.2 Additional Tables

Table 2.B.2: Summary Statistics

	Period	Obs.	Mean	Std. Dev.	Min.	Max.
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: WWI casualties						
Fatality	1914-1919	502	26.29	12.19	0.00	100.00
Net casualties	1914-1919	502	7.96	4.64	0.00	65.16
Death	1914-1919	502	2.10	1.34	0.00	16.97
Missing	1914-1919	502	0.02	0.07	0.00	0.69
Prisoners of war	1914-1919	502	1.42	0.99	0.00	12.44
Hurt	1914-1919	502	4.42	2.66	0.00	34.97
Panel B: Election Habsburg						
Turnout	1907-1911	1004	93.36	1.80	86.99	96.57
Pan-German	1907-1911	1004	19.39	11.89	0.00	54.95
Catholic-Conservative	1907-1911	1004	71.95	15.91	19.44	100.00
Social Democrat	1907-1911	1004	8.58	8.70	0.00	46.50
Communist	1907-1911	1004	0.00	0.00	0.00	0.00
Panel C: Election post-WWI						
Turnout	1919-1931	3514	82.90	8.35	43.72	119.54
Pan-German	1919-1931	3514	15.89	14.84	0.00	73.98
Catholic-Conservative	1919-1931	3514	66.10	21.23	0.00	100.00
Social Democrat	1919-1931	3514	17.89	15.06	0.00	91.18
Communist	1919-1931	3514	0.12	0.64	0.00	14.67
Panel D: Court statistics						
Cases	1910	46	34.79	14.60	24.90	127.46
Claims	1910	46	0.72	0.90	0.33	6.47
Foreclosure	1910	46	4.39	3.22	1.54	23.36
Bagatelle	1910	46	0.66	1.95	0.14	13.40
Guardianship	1910	46	11.86	4.26	5.40	35.00
Money	1910	46	1.07	0.68	0.40	4.63
Legalization	1910	46	1.25	1.01	0.18	4.80
Panel E: Census						
Total population	1910	502	1652.17	3296.46	148.00	67817.00
Female	1910	502	50.25	2.11	36.60	73.68
Catholic	1910	502	98.10	6.86	15.30	100.00
Protestant	1910	502	26.14	62.31	0.04	637.55
Foreign	1910	502	0.78	1.27	0.00	14.42
Population per HH	1910	502	6.28	1.69	3.57	24.15
Panel F: Census						
Agriculture	1934	502	52.12	19.94	0.81	93.33
Industry	1934	502	24.71	10.52	2.67	64.64
Service	1934	502	6.58	5.25	0.00	40.65
Panel G: Further Controls						
Assosiations (pc)	1918	502	0.75	2.28	0.00	34.28
Railway (km)	1914	502	5.66	42.69	0.00	942.48
Soil idx (log)	_	502	8.33	0.38	0.00	8.50
Elevation (log)	_	502	6.17	0.32	5.44	7.37

Notes: The table presents summary statistics for the main variables. Column (1) indicates during which period each variable was generated. Column (2) reports the number of observations at the level of 502 municipalities (48 court districts) in Upper Austria. Columns (3) to (6) display the mean, standard deviation, minimum, and maximum for each variables. Panel A reports self-compiled measures of WWI affectedness. Panels B and C report self-compiled data on voting during the Habsburg and after-WWI periods, respectively. Panels D to G present time-invariant and time-varying covariates. Detailed data sources and definitions are provided in Online Appendix 2.A.

Table 2.B.3: Probit Estimates of Eastern Front Exposure

	1914-1919		Post-1916	
	(1)	(2)	(3)	(4)
Panel A: Census 1910				
Total population	-0.017	-0.010	-0.033*	-0.031*
	(0.016)	(0.017)	(0.018)	(0.019)
Female	-0.002	0.005	0.009	0.015
	(0.010)	(0.011)	(0.012)	(0.013)
Catholic	0.004	0.003	0.009	0.006
	(0.011)	(0.012)	(0.013)	(0.014)
Foreign	0.000	0.000	-0.012	-0.011
_	(0.011)	(0.012)	(0.013)	(0.014)
Population per HH	0.026	$0.028^{'}$	0.039	$\stackrel{}{0}.045^{'}$
•	(0.030)	(0.031)	(0.035)	(0.036)
Panel B: Census 1934	,	,	,	,
Agriculture	0.057	0.074	0.018	0.031
	(0.045)	(0.048)	(0.053)	(0.055)
Industry	-0.002	$0.004^{'}$	-0.017	-0.009
	(0.030)	(0.031)	(0.035)	(0.036)
Service	$0.003^{'}$	$0.013^{'}$	-0.008	-0.000
	(0.025)	(0.026)	(0.029)	(0.030)
Panel C: Geography	,	,	,	,
Railway	0.007	-0.005	-0.008	-0.019
	(0.023)	(0.023)	(0.026)	(0.027)
Elevation	$0.007^{'}$	$0.014^{'}$	$0.020^{'}$	$0.030^{'}$
	(0.016)	(0.017)	(0.019)	(0.019)
Soil idx	$0.011^{'}$	$0.011^{'}$	0.025**	0.025**
	(0.010)	(0.010)	(0.012)	(0.012)
Year FE	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes
Casualty Type FE	No	Yes	No	Yes
Individual Controls	No	Yes	No	Yes
Observations	24444	23451	15864	15373

Notes: The table presents coefficients from individual-level probit regressions of an Eastern Front indicator with the Southern Front as the reference category on a set of municipality characteristics including: the 1910 Census (log total population, female share, Catholic share, foreign share, population per household), the 1934 Census (shares employed in agriculture, industry, and services), geographic variables (log railway length (km), log elevation, and log soil caloric index)). All specifications include year and district fixed effects. Columns (2) and (4) additionally control for casualty type fixed effects (death, hurt, prisoners of war, missing) and individual-level controls (age, age squared, soldier's rank with high rank as the reference category, and military status with draftee as the reference category, and indicators for volunteer and reserve). All covariates are standardized (Z-scores). Robust standard errors are reported in parentheses. Significance levels: $^*p < 0.10$, $^{***}p < 0.05$, $^{****}p < 0.01$.

Table 2.B.4: Alternative clustering of standard errors

		1920	Pooled National					
	Turnout	Pan-German	Turnout	Pan-German				
	(1)	$\overline{(2)}$	$\overline{(3)}$	$\overline{\qquad \qquad } (4)$				
Fatality	0.059	0.085	0.050	0.027				
Panel A: Spatially clustered standard errors								
Spatial cutoff 10km	[0.046]	[0.049]	[0.017]	[0.024]				
Spatial cutoff 20km	[0.015]	[0.045]	[0.015]	[0.023]				
Spatial cutoff 40km	[0.004]	[0.025]	[0.011]	[0.024]				
Spatial cutoff 60km	[0.019]	[0.028]	[0.012]	[0.026]				
Panel B: Conventionally clustered standard errors								
Clustered at pair level	(0.031)	(0.030)	(0.014)	(0.016)				
Clustered at district level	(0.038)	(0.059)	(0.019)	(0.025)				
Clustered at municipality level	(0.042)	(0.043)	(0.015)	(0.017)				
Controls Census 1910	Yes	Yes	Yes	Yes				
Geography	Yes	Yes	Yes	Yes				
Pair FE	Yes	Yes	Yes	Yes				
Obs.	2532	2532	11068	8266				

Notes: The table shows robustness exercises using alternative clustering approaches for standard errors, applied to the main outcome. All regressions are analogous to regressions in Figure 2.3. Panel A reports clustered standard errors with varying spatial cutoffs (from 10 kilometers up to 60 kilometers). Panel B presents "conventional" clustered standard errors at the level of municipalities (n=502), districts (n=17), and pairs (our main specification).

Chapter 3

Geographic Mortality Differentials and the Quality-Quantity Trade-Off

3.1 Introduction

Investing in education and human capital is a long-term commitment, with returns that unfold over an individual's lifetime. Based on the Ben-Porath hypothesis² and motivated by the unified growth model of Cervellati and Sunde (2011, 2015), in which mortality is a key factor for human capital investment and the timing of economic take-off, this research investigates how mortality shapes family decisions about education and fertility.³

In this research, we provide evidence that, in a pre-industrial setting, lower mortality risk, driven by geographic factors, incentivized families to shift from quantity to quality in child-rearing, leading to lower fertility rates and higher investments in education. Central to our argument is the idea that higher altitudes, typical of mountainous regions, are associated with lower population density and reduced spread of airborne diseases, which in turn boosts the average lifespan (Diamond, 1999; Franck et al., 2022).⁴ In these healthier environments, fewer births are needed to achieve a desired family size, freeing up resources and encouraging

¹Coauthored with David Gomtsyan and Èric Roca Fernández

²It posits that a longer expected lifespan increases the returns to human capital investment.

³In Cervellati and Sunde (2011, 2015), variations in country-level mortality rates explain differences in the timing of economic take-off and broader patterns of global development. This chapter provides empirical evidence supporting the pivotal link between longevity and human capital investment, central to their framework.

⁴See also Woods (2003) on the relationship between density and mortality, and Table 3.21 in Dobson (1997, p. 147) classifying land over 400 feet and places distant from trading centers as characteristic of "very healthy places" in England.

a shift from child quantity to quality,⁵ despite the inherent disadvantages of difficult-to-reach mountainous areas.⁶ Finding better human capital outcomes in such areas indicates that mortality-driven incentives are strong enough to overcome these geographic disadvantages.

To test this, we examine mid-19th-century Armenia, a region operating under Malthusian conditions at the time. Its relatively homogeneous population, combined with significant variations in altitude and other geographic and climatic factors over short distances, provides an ideal setting for our study. Furthermore, limited urbanization and lack of modern medical interventions influencing mortality and fertility create a near "natural experiment" environment. We constructed our dataset by digitizing archival census and parish records, which include information on over 22,000 individuals. The data comprises a compact area, not larger than 85 kilometers across, including villages with dramatically varying elevations ranging from 823 to 2,126 meters. Agroclimatic conditions also vary significantly, influenced by distinct precipitation patterns that range from 300 mm to 1,000 mm annually. We show that higher altitude locations display lower population density and mortality rates, that annual births per woman are also lower, and that residents in such areas have greater numeracy skills (approximated by age heaping), all indicative of a shift towards child quality over quantity. Lacking a clear identification strategy to overcome endogeneity concerns, we show that results are not driven by increased gender equality or income levels.

This work contributes to the literature on the unified growth theory and the closely related quality-quantity trade-off. In Galor (2011), parental investment decisions are determined by technological progress, wealth, and returns to human capital accumulation, with the first accounting for most of the transition (Madsen and Strulik, 2023).⁹ Our focus on a preindustrial society, with very limited technological change and stable income levels, allows us to isolate the role of mortality from increasing technological progress.¹⁰ Other studies have

 $^{^5}$ As Cinnirella et al. (2017) demonstrate, increased birth spacing served as a key strategy for reducing fertility in England between 1540 and 1850.

⁶High mountain ranges and rugged terrain increase trading costs (Fernández-Villaverde et al., 2023; Frensch et al., 2023; Giuliano et al., 2013), limit openness, and can worsen political and ethnic divisions (Michalopoulos, 2012; Jimenez-Ayora and Ulubaşoğlu, 2015).

⁷For instance, studies of contemporary African economies might be confounded by the presence of local missions and health posts, while rural-urban migration and modern communication can expose populations to external cultural influences.

⁸For context, 300 mm of precipitation is typical of Europe's arid Mediterranean regions (e.g., Almería, Piraeus, Cagliari). In comparison, cities like Cologne, Oslo, and Liverpool receive approximately 800 mm of annual precipitation. See https://en.wikipedia.org/wiki/List_of_cities_by_average_precipitation.

⁹Mortality has a limited role in explaining the demographic transition in Madsen and Strulik (2023), echoing Hazan and Zoabi (2006).

¹⁰In Galor (2011), more rapidly increasing technological progress requires greater investments in human capital. Consequently, increasing longevity means individuals experience more technological change over their lifetime, which incentivizes human capital investment, making it difficult to disentangle mortality

also examined the relationship between mortality and fertility decisions, but often in the context of modern economies and leveraging sudden health shocks (Siuda and Sunde, 2021; Jayachandran and Lleras Muney, 2009) or breakthroughs in healthcare (Hansen, 2013; Oster et al., 2013; Hansen and Strulik, 2017; Ager et al., 2017; Klasing and Milionis, 2020). Our approach, in contrast, emphasizes a gradual, co-evolutionary perspective, in which mortality influences demographic transitions over time, aligning better with the slow pace of unified growth.

Furthermore, studies on the quality-quantity trade-off during pre-industrial times often only show negative correlations between fertility and education and do not investigate the mechanisms involved. For example, Fernihough (2016) finds that school-going children often came from smaller families in Ireland, Becker et al. (2010) shows a similar relationship in mid-19th-century Prussia, and Murphy (2015) finds an earlier onset of this trade-off in French regions with higher female education. Hu (2025) documents a comparative advantage for medium-fertility families in Imperial China whose descendants enjoyed greater reproduction success and higher educational attainment in the long run. Diverging from these approaches that focus on formal schooling or literacy, we assess a more fundamental aspect of human capital: basic numeracy, proxied by age heaping. 12

Lastly, the previous literature has often overlooked the role of gender equality in the context of the quality-quantity trade-off, despite the seminal work of Galor and Weil (1993). Departing from that canonical model, and based on Doepke and Tertilt (2018), we fully consider it and contrast two competing hypotheses. The first, which we term the *life expectancy* hypothesis, posits a direct epidemiological link: higher altitudes are associated with lower population density and a different disease environment, which reduces the mortality burden, particularly from airborne diseases (Diamond, 1999; Anderson and May, 1992). A longer expected lifespan, in turn, incentivizes investing in human capital. The second, *female agency* hypothesis, proposes a socio-economic channel. Altitude correlates with animal husbandry and dairy production, activities in which women hold a comparative advantage, which can increase female bargaining power (Boserup, 1970; Alesina et al., 2013b). This enhanced agency can lead to a quality-quantity shift in family preferences towards fewer, healthier, and

effects from technological progress. By studying a setting with minimal technological change, as we do in this research, we can isolate the role of mortality in human capital investment decisions.

¹¹de la Croix et al. (2019) finds a similar result for England. Other studies, including Black et al. (2005) and Angrist et al. (2010) find no evidence of the trade-off. However, the instrumental variable used (twin births) has been recently criticized by Bhalotra and Clarke (2019).

¹²Age heaping refers to the tendency of individuals to report their age in rounded numbers, particularly multiples of five or ten, rather than their exact age. We use its inverse so that higher values indicate better numeracy skills.

better-educated children, boosting human capital and reducing mortality (Becker, 1960).¹³ Throughout the chapter, we analyze the implications of each theory, and test them using data. We ultimately dismiss the female agency hypothesis, finding that it is not a primary driver of our results.¹⁴ To the best of our knowledge, only de la Croix and Perrin (2018), who use structural estimation, identifies the role of both child mortality and women's wages in determining children's education levels. Our approach is also conceptually similar to Andersen et al. (2016), who link shorter investment horizons to lower human capital investment. However, their focus is on post-industrial economies where jobs increasingly demand human capital.

3.2 Setting

This study focuses on the Erivan Governorate (also known as Erivan Province) of the Russian Empire, a region encompassing modern-day Yerevan and the agriculturally vital Ararat Valley. It became part of the Russian Empire after the Fifth Russo-Persian War (1826-1828). Prior to Russian rule, the area had been under Persian control for centuries, resulting in a distinct cultural and demographic landscape. This predominantly agrarian economy, with limited technological advancement, operated under conditions characteristic of a Malthusian regime, where population growth was closely tied to resource availability, particularly land and water.

Despite its relatively small geographic size, this region exhibits dramatic variations in altitude, and consequently, in agroclimatic conditions. Figure 3.1 illustrates the locations and elevations (in meters above sea level) of the villages included in our analysis. Within this compact area, village elevations range from approximately 830 meters to over 2,000 meters. This altitudinal variation corresponds to significant differences in precipitation, with annual rainfall ranging from a desert-like 300mm to a much wetter 1,000mm. The lower end of this precipitation range is comparable to arid regions of the Southern Mediterranian, making it challenging for many crops to survive without supplemental irrigation. Historically, however, an extensive network of canals and rivers, cultivated and maintained by the local population, supported a surprisingly fertile agricultural environment, see Chopin (1852) and Greenwood (1965). The higher end of the precipitation spectrum is more typical of Northern European

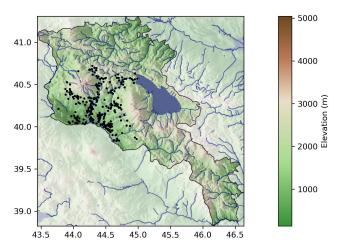
¹³See Voigtlander and Voth (2013); Baten and de Pleijt (2022); Ager et al. (2023) on the comparative advantage of women in animal husbandry and the related dairy industry. Greater female autonomy increases gender equality, see Frigo and Roca Fernández (2021).

¹⁴Given Baten and Blum (2014) and the correlation in our setting between higher altitude and dairy production, it is conceivable that this type of agricultural specialization also contributed to longer lifespans by providing a more protein-rich diet.

climates, such as that found in Gothenburg, Sweden. These higher-altitude areas within the Erivan Governorate are characterized by extensive pastures, favoring a specialization in dairy farming. Lake Sevan, a large, high-altitude lake, is the source of the Hrazdan River, which flows through the study area and likely contributes to agricultural patterns. Critically, these variations in altitude and climate are associated with differences in the disease environment. Our data on causes of death, as recorded by priests, reveal a lower prevalence of deaths attributed to airborne and contagious diseases at higher altitudes.

Our analysis concentrates on the area surrounding present-day Yerevan, including the Ararat Valley and villages along the Hrazdan River. This geographic focus is deliberate: it maximizes within-sample variation in altitude while maintaining a relatively homogenous population in terms of its primary economic activity. While the region included both Christian and Muslim communities, we have data on the percentage of Muslims in each village, allowing us to account for potential religious differences. Other regions of Armenia, such as the north-eastern areas, often exhibit less internal variation in altitude (being predominantly high-elevation) and had different historical experiences, including prolonged Ottoman influence and distinct linguistic dialects. These inter-regional differences introduce potential confounding factors that are minimized by focusing on the Yerevan-Ararat-Hrazdan area. Furthermore, data coverage for several key variables is more complete for this focal region. As mentioned, the economy of the Erivan Governorate during the mid-19th century was overwhelmingly agrarian. Yerevan, the regional capital, primarily served as a military outpost, with limited development of trade or industry during this period (Chopin, 1852). The 1907-1909 manufacturing census of the Russian Empire records only one firm from our study region—a winery (Vasilii, 1912). Our microdata, reflecting individual occupations, corroborates this agricultural dominance: only 2,190 of 54,768 individuals (including all ages) report non-agricultural occupations.

Figure 3.1: Ararat Valley and Surrounding Area



Notes: The map displays the current borders of Armenia, highlighting the study region in the Ararat Valley and surrounding areas. Black dots indicate the locations of villages included in our analysis. Elevation is represented by the color gradient, with lighter shades denoting higher altitudes. Major rivers, including the Hrazdan, and Lake Sevan are also shown.

3.3 Data

This study draws on three primary data sources: the 1831 Russian Imperial Census, parish records from the Armenian Apostolic Church, and supplementary data on geographic and climatic variables. The census provides a broad snapshot of the population, including measures of numeracy, while the parish records offer detailed longitudinal information on births, deaths, marriages, and causes of death. While each source has its limitations, in combination, they provide a rich and unusually detailed picture of demographic and socioeconomic conditions in mid-19th century Armenia.

Census data. The 1831 Census of the Erivan Governorate provides a rich source of information on individual, household, and village-level characteristics. We digitized micro-records from the National Archives of Armenia, covering 235 villages within our focus area, encompassing over 22,000 individuals (see a sample in Appendix Figure 3.E.3a). To construct population density variables, we also collected data from an additional 120 villages outside our focus area, allowing us to compute population density within a 5 km buffer around each

¹⁵Censuses in the Russian Empire were population registers compiled for administrative purposes, primarily to track taxable individuals and those eligible for conscription. Unlike modern censuses focused on broad demographic data, revisions were designed to serve the state's needs for military recruitment, taxation, and resource allocation. These censuses were essential for the Russian authorities in managing newly incorporated territories, such as Armenia, after the Russo-Persian War, providing detailed data on the social and economic structure of local populations.

village.

At the individual level, the Census records the age of each male household member. Women's ages are recorded only when they are household heads, typically due to widowhood. We use this age information to construct measures of human capital, specifically focusing on numeracy, as detailed below.

At the village level, the Census provides information on various characteristics, including the number of domestic animals. We use the number of husbandry animals (cows, calves and sheep), controlling for the total number of draft animals (buffaloes, horses and oxen), as a proxy for the village's agricultural specialization. This allows us to consider gendered specialization patterns and account for ensuing potential differences in female empowerment. Previous research has shown that societies with a greater emphasis on husbandry and dairy production tend to exhibit higher levels of female autonomy (Voigtlander and Voth, 2013; Baten and de Pleijt, 2022; Ager et al., 2023), while societies focused on crop production, which often relies more on upper-body strength due to plow usage, may have lower female autonomy (Alesina et al., 2013a).

The Census also includes information on the share of Muslims residing in each village, an important consideration given the region's history. While the territory of modern Armenia has historically been populated primarily by Armenians, the forced relocation implemented by Shah Abbas in 1605 led to the settlement of some vacant villages by nomadic Muslim groups, who are collectively referred as Tatars in the Russian official documents. While this demographic shift may have affected the region, we control for potential ethnic and religious differences in our analysis using both village-level and, when available, individual-level information from the Census.

Furthermore, the Census provides data on the presence of various occupations at the village level, including blacksmiths, carpenters, weavers, and millers. The presence of these non-agricultural occupations can serve as an indicator of village-level economic development and diversification, potentially influencing human capital outcomes. Critically, a more developed market for artisans could increase the returns to basic skills like numeracy, making this an important factor to consider in relation to our human capital measure.

Numeracy: A key outcome variable in our analysis is basic numerical awareness, which serves as our primary proxy for human capital accumulation in this setting. Due to the limited availability of formal education in mid-19th century rural Armenia, and the nature of the data available in the 1831 Census, we focus on a very fundamental indicator of numerical literacy: age heaping. Age heaping occurs when individuals, often due to limited numeracy

skills, tend to report their ages rounded to the nearest multiple of five or ten. ¹⁶ Therefore, we construct a binary indicator for each individual:

$$Numeracy_i = \begin{cases} 0, & \text{if} \mod(age_i, 5) = 0, \\ 1, & \text{otherwise.} \end{cases}$$
(3.1)

This measure, while simple, captures a fundamental distinction: whether an individual reported an age consistent with rounding to the nearest five or ten (coded as 0), or an age that suggests a more precise awareness of their age (coded as 1). In the context of a largely agrarian society with limited formal schooling, we argue that this distinction provides a meaningful, albeit coarse, proxy for basic numerical literacy. Because our measure only captures a very basic level of numerical awareness, we complement the analysis with a key prediction of the quality-quantity trade-off in fertility: an increase in human capital (proxied here by basic numerical awareness) should be associated with a decline in fertility.

Parish records. The Armenian Apostolic Church maintained meticulous records of births, marriages, and deaths throughout the 19th and early 20th centuries. For this project, we digitized and linked data from 116 villages in the Erivan Governorate, covering the period from 1838 to 1878, to the 1831 Census records (see a sample in Appendix Figure 3.E.3b). Because these records were maintained by the Armenian Apostolic Church, they do not contain information on the Muslim population. While the parish records are not complete for all villages and all years, Figure 3.A.1 in the Appendix demonstrates that there are no systematic differences in record-keeping related to altitude or over time.

From these parish records, we derive several key indicators to test our hypotheses relating agro-climatic conditions to human capital formation and to rule out alternative explanations. Our analysis focuses on three primary demographic outcomes: age at marriage, fertility, and mortality. Unlike the Census, parish records provide information for both men and women.

Age at Marriage. Parish records provide valuable insights into marriage patterns, allowing us to investigate the relationship between altitude and age at marriage. We extract data on the age at marriage for both women and men, as well as the spousal age gap, where larger values indicate that men are older than women. These variables allow us to examine the impact of altitude on marriage timing and to test two competing hypotheses regarding the underlying mechanisms.

¹⁶While standard measures of age heaping, such as Whipple's Index and the ABCC Index, are typically calculated at the population level, our focus is on capturing individual-level variation in basic numerical skills. Appendix 3.B presents the results when using the ABCC index (A'Hearn et al., 2009).

The first hypothesis centers on *increased female agency*. If higher altitude, through its influence on agricultural specialization (e.g., dairy farming), leads to greater female economic participation and autonomy, we would expect to observe: 1) an *increase* in women's age at marriage, and 2) a *decrease* in the spousal age gap.¹⁷ This is because greater female autonomy is often associated with delayed marriage and a more equal power dynamic within marriage, reflected in a smaller age gap.

The second hypothesis focuses on *increased life expectancy* due to a lower disease burden at higher altitudes. Under this hypothesis, we would expect to see an increase in the age at marriage for *both* men and women, as a deliberate strategy to control fertility. In a Malthusian context with increased life expectancy, delaying marriage would be a way to reduce completed family size. Crucially, this mechanism would *not* necessarily predict a change in the spousal age gap.

Fertility. Second, we analyze fertility rates, calculated as the ratio of births recorded in the parish records to the female population.¹⁸ Estimating the denominator—the number of women—presents a significant challenge, as our census data provides only a single snapshot of the total population in the 1831 Census.

Using this static 1831 population figure as the denominator would lead to an overestimation of fertility rates over time, as the female population would have naturally increased due to births exceeding deaths. This overestimation would be a problem for any analysis of fertility trends over time. More critically for our study, if fertility rates differ systematically with altitude (as predicted by both the female agency and life expectancy hypotheses), this overestimation could introduce a bias into our estimated relationship between altitude and fertility. Specifically, if fertility is higher at lower altitudes (due to lower human capital or shorter lifespans), then the overestimation of fertility rates due to population growth would be greater in those lower-altitude areas. This could artificially strengthen any observed negative relationship between altitude and fertility, making it difficult to disentangle the true effect of altitude from the bias caused by the changing denominator.

To mitigate this potential bias, we restrict our analysis of fertility to a relatively short period following the 1831 Census. This minimizes the impact of population growth on our denominator and reduces the potential for spurious correlations. We expect fertility rates to be *negatively* correlated with altitude under both the female agency and life expectancy

 $^{^{17}}$ See Carmichael (2011) for the relationship between women's age at marriage, spousal age gap, and female agency, and Voigtlander and Voth (2013) for the link between agricultural specialization and female autonomy.

 $^{^{18}\}mathrm{We}$ lack information on the number of women of child bearing age.

hypotheses.

Mortality. Constructing reliable mortality measures from the parish records presents a significant challenge because we cannot directly link individual birth and death records. While both include information on village, year of birth (or age at death), and gender, there is no unique identifier to connect a specific death to a specific birth.¹⁹ To overcome this limitation, we construct village-year-gender-specific survival rates.

For every village, year, and gender group, we determine the number of individuals born in a particular year (e.g., 1820) based on the birth records. We then examine the death records in subsequent years (e.g., 1821, 1822, ...) to count the number of deaths reported for individuals born in that same village and year, and of the same gender.²⁰

This approach has limitations. It does not account for migration between villages, which could lead to either over- or underestimation of survival, depending on the direction of migration flows. While large-scale migration was likely limited during this period, we acknowledge this as a potential source of bias.²¹ Furthermore, our method implicitly assumes that all births and deaths within a village-year-gender group are recorded in the parish registers. Underreporting of deaths, particularly infant deaths, would lead to an overestimation of survival rates.

Death causes. Finally, we analyze reported causes of death in the parish records to further distinguish between the competing hypotheses. We classify the recorded causes of death into three broad categories: airborne contagious diseases, other contagious diseases, and other causes. We focus specifically on infant and child mortality rates within these categories.²²

The two hypotheses—increased female agency and increased life expectancy due to lower disease burden—yield different predictions regarding the *pattern* of mortality reduction across these cause-of-death categories.

Under the *increased female agency* hypothesis, driven by a shift in family preferences towards greater investment in child quality (as predicted by evolutionary biology), we would expect

¹⁹The Parish records include names, but we did not digitize them due to time constraints and the limited feasibility of matching the names.

²⁰Implicitly, we assume that, for a given village, year of birth, and gender, individuals whose births were recorded, but whose deaths were not recorded in subsequent years survived until the end of our observation period. For instance, if two males are recorded as being born in 1820 in a particular village, and one death is registered in 1830 for a male born in the same year and village, we assume the other male survived at least until 1830.

²¹Appendix 3.D provides crude estimates of migration.

²²We employ advanced AI models to categorize the causes of death, minimizing potential bias from manual classification.

to see a *general* reduction in infant and child mortality across *all* cause-of-death categories. Greater investment in children's health and well-being should, in principle, reduce mortality from all causes, not just a specific subset.

In contrast, the *increased life expectancy* hypothesis, stemming from lower population density and reduced exposure to airborne pathogens at higher altitudes, predicts a more *selective* pattern of mortality reduction. We would expect to see a significant decrease in mortality from *contagious diseases*, particularly those transmitted through the air, but *not necessarily* a corresponding decrease in mortality from other contagious diseases (necessitating bodily contact or fluid exchanges) or other causes that are less directly linked to population density and airborne transmission.

Other variables. To control for potential confounding factors and isolate the effect of altitude and related agro-climatic conditions on human capital, we incorporate a range of additional geographic, demographic, and socioeconomic variables.

Using GIS software, we obtain precise measurements for each village of: altitude, latitude, longitude, distance to the nearest river, potential caloric yield (Galor and Özak, 2016), maximum and minimum temperature, precipitation, evapotranspiration, and distance to Yerevan (the regional capital).²³ These geographic factors have been shown in previous research to influence human capital outcomes and are, therefore, important controls.

We also collect contemporaneous data on female representation in local village councils from the Central Electoral Commission of Armenia, and on the share of the population that is Yazidi (the main ethnic minority in present-day Armenia) from Arbatli and Gomtsyan (2019). These variables allow us to further address the potential confounding influence of female agency and ethnic diversity. If higher altitude were systematically associated with greater female agency, we would expect to see a corresponding increase in women's political participation, all else equal.²⁴

Table 3.A.1 in Appendix 3.A presents summary statistics for all variables used in the analysis.

²³See https://climateknowledgeportal.worldbank.org/country/armenia/era5-historical for min/max temperature, precipitation, and evapotranspiration.

²⁴We collected data on travel distance from each village to Yerevan to account for potential urban influences, and this disentangles urbanization from the effect of altitude.

3.4 Empirical Strategy and Results

The data described in Section 3.3 allow us to test several interconnected hypotheses that support a positive relationship between life expectancy and investments in child quality. However, as discussed in Section 3.1, using altitude differences to explain mortality patterns could potentially confound the effects of mortality with those of increased female agency, as altitude may also influence agricultural specialization and, consequently, gender roles. Therefore, our empirical approach must carefully disentangle these potential confounding factors.

The following subsections outline our primary hypotheses, describe our empirical strategies for testing them, and present the corresponding findings.²⁵

3.4.1 Altitude and Agricultural Specialization

Before examining our central hypotheses, we first establish the empirical relationship between altitude and agricultural specialization within our study region. As discussed earlier, societies with a greater reliance on animal husbandry and dairy farming often exhibit higher levels of female agency, due to women's comparative advantage in this sector.²⁶

To test the relationship between altitude and agricultural specialization, we estimate models with two alternative dependent variables designed to capture different aspects of a village's specialization in husbandry: The first, I_j^M , is a binary indicator equal to 1 if the number of husbandry animals—on which women have a comparative advantage—in the village is above the average for all villages in our sample, and 0 otherwise.²⁷ The second, N_j^M , counts the number of husbandry animals in the village.²⁸

We estimate the following regression models:

$$\Pr(I_j^M = 1) = \Phi(\beta \log(Altitude_j) + \mathbf{Z}_j' \kappa + \gamma \log(1 + other \, animals_j) + \alpha_{m(j)} + \epsilon_j) \quad (3.2)$$

$$E[N_j^M | \mathbf{X}] = \beta \log(Altitude_j) + \mathbf{Z}_j' \kappa + \gamma \log(1 + other\,animals_j) + \alpha_{m(j)} + \epsilon_j$$
 (3.3)

where: I_j^M and N_j^M are defined above. Altitude_j is the altitude of village j (in meters above

²⁵Tables 3.A.2–3.A.8 in Appendix 3.A reproduce the main results under OLS models.

²⁶See, for instance, Ager et al. (2023).

²⁷Using the median instead of the average provides the same conclusions.

²⁸Husbandry animals include cows, calves, and sheep.

sea level), \mathbf{Z}_j is a vector of village-level control variables, including the logarithm of the distance to the closest river, potential caloric yield, precipitation, evapotranspiration, maximum and minimum temperature, the proportion of the village population that is Muslim (in some specifications), and the logarithm of the total village population (in some specifications). $\alpha_{m(j)}$ represents mahal (region) fixed effects and $other\ animals_j$ is the number of draft animals (buffaloes, horses, donkeys and oxen) in village j. This is a key control variable, included to account for the overall scale of animal ownership and potential non-homothetic preferences. Equation 3.2 is estimated using a probit model, whereas Equation 3.3 is estimated using negative binomial regression.²⁹

Table 3.1 presents the results of these regressions. Columns 1 and 2 report probit estimates for the I_j^M indicator, while Columns 3 and 4 focus on the count variable, with basic and full control variables in odd and even columns. All regressions include robust and Conley standard errors with a 20 km bandwidth.³⁰ All regressions include *mahal* fixed effects.

²⁹In this study, we employ the statistical models that best suit our data structure—probit for binary outcomes and negative binomial regression for count data. We provide the corresponding OLS estimates in Appendix 3.A.3 for robustness.

³⁰Basic controls include the logarithm of the distance to the closest river, potential caloric yield, precipitation, evapotranspiration, maximum and minimum temperature. Full controls include, additionally, the share of Muslims and the logarithm of population.

Table 3.1: Altitude, agricultural specialization, and population density.

	Husbandry animals above avg.		Husbandry animals		Population density (log.)	
	(1)	(2)	$\overline{(3)}$	(4)	(5)	(6)
Altitude (log.)	1.486 (1.126) [0.739]**	3.323 (1.176)*** [1.138]***	0.480 (0.429) [0.411]	0.598 (0.331)* [0.221]***	-1.204 (0.301)*** [0.282]***	$ \begin{array}{c} -1.266 \\ (0.291)^{***} \\ [0.232]^{***} \end{array} $
Geography	Yes	Yes	Yes	Yes	Yes	Yes
Muslim share	No	Yes	No	Yes	No	Yes
Population (log.)	No	Yes	No	Yes	No	No
Husbandry-producing animals (log.)	No	No	No	No	Yes	Yes
Draft animals (log.)	Yes	Yes	Yes	Yes	Yes	Yes
Mahal	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.473	0.578	0.084	0.105	0.592	0.619
Observations	234	234	234	234	234	234

Notes: This table presents the results of regressions linking village altitude (measured in logarithm) and the probability of a village having an above-average number of husbandry animals in Columns 1–2; the expected number of husbandry animals in Columns 3–4; and population density in Columns 5–6. Columns 1 and 2 are estimated with a probit model, Columns 3 and 4 use a negative binomial model, and the remaining employ OLS. Columns 1 and 3 control for the logarithm of the distance to the closest river, potential caloric yield, precipitation, evapotranspiration, maximum and minimum temperature. Columns 2 and 4 further include the share that Muslims represent and the logarithm of total population. Columns 5 and 6 are identical to Columns 3 and 4, except for the removal of the logarithm of total population. Columns 1–4 include the logarithm of the number of non-milk producing animals, and Columns 5 and 6 add the logarithm of the number of husbandry animals. All regressions include mahal (region) fixed effects. All Columns present robust standard errors in brackets, and Conley standard errors in square brackets using a cut-off distance of 20 km. * p < 0.1, ** p < 0.05, *** p < 0.01.

Across the specifications in Table 3.1, we find a generally positive association between altitude and a greater focus on husbandry animals, consistent with our hypothesis that higheraltitude areas are more specialized in that activity. In Columns 1 and 2, the coefficient on (the logarithm of) altitude is positive and statistically significant. However, upon adding the control for the share of Muslims in the village in Column 2, its value more than doubles, highlighting the importance of accounting for the different agricultural practices of the predominantly Muslim population, who, as a historically nomadic group in Armenia, tend to exhibit a greater reliance on pastoralism (Koç, 2024). The estimated coefficient in Column 2 implies that a 1% increase in altitude is associated with a 0.51 percentage point increase in the probability of a village having an above-average number of husbandry animals.

Columns 3 and 4 present the results of the negative binomial regressions. Column 3 considers basic controls, and we find a non-insignificant coefficient. Nevertheless, once the full set of controls is added in Column 4, the coefficient becomes positive and significant. In that case, a 1% increase in altitude is associated with an increase of about 225 husbandry animals, which is significant considering that, on average, villages counted 367 husbandry animals.

We next examine the relationship between altitude and population density (expressed in logarithm) within our study region. To measure population density, we calculate the number of residents living within a 5 km radius of each village.³¹ We estimate the following linear regression model using OLS:

$$\log(Pop \, Density_j) = \beta \, \log(Altitude_j) + \mathbf{X}_j' \mathbf{\lambda} + \alpha_{m(j)} + \epsilon_j, \tag{3.4}$$

where: $Pop\ Density_j$ is the population density of village j. $\log(Altitude_j)$ is the natural logarithm of the altitude of village j (in meters above sea level), \mathbf{X}_j is a vector of village-level control variables, including the logarithm of the distance to the closest river, potential caloric yield, precipitation, evapotranspiration, maximum and minimum temperature, the logarithm of husbandry and draft animals, and the proportion of the village population that is Muslim (in some specifications). α_m represents mahal (region) fixed effects.³²

We estimate Equation 3.4 with two specifications: one with basic controls and one with the full set of controls (adding the proportion of Muslims). We report robust standard errors

³¹To avoid edge effects and potential bias for villages located near the boundary of our study area, we collected additional data on 120 neighboring villages, ensuring that the 5 km radius for all villages in our main sample was fully populated with data.

³²Note that we exclude the logarithm of total village population from the control variables in this regression, as it is directly related to the dependent variable (population density).

and Conley standard errors with a 20 km cutoff distance in Columns 5 and 6 of Table 3.1. We find a statistically significant negative association between altitude and population density, consistent with our expectation that higher-altitude areas are less densely populated. Across both specifications (with basic and full controls), the coefficient on log altitude is approximately -1.2, indicating that a 1% increase in altitude reduces population density by about 1.2 percentage points. Given that the mean of the logarithm of population density in our sample is 5.22, this represents a substantial effect and supports the premise that altitude can serve as a proxy for exposure to certain types of diseases, particularly those transmitted through airborne pathogens, which are sensitive to population density.

3.4.2 Altitude and Life Expectancy

We now turn to a crucial intermediate step in our analysis: examining the relationship between altitude and mortality. This analysis is essential for testing the mechanism proposed by Cervellati and Sunde (2011, 2015), who argue that variations in extrinsic mortality drive differences in the timing of the demographic transition and subsequent investments in human capital.³³ Armenia's diverse topography, mirroring environmental variations observed across countries, provides an ideal setting to test this mechanism. A positive association between altitude and life expectancy would provide support for this crucial link in our hypothesized causal chain.

We begin by analyzing two fundamental indicators of mortality: first, the probability of dying before age five, which takes the form of an indicator variable equal to 1 if the individual died before reaching the age of five, and 0 otherwise; and second, the age at death, which we model as a count variable.

We estimate the following regression models:

$$\Pr(Dying Before Five_i = 1) = \Phi(\beta \log(\text{Altitude}_{j(i)}) + \gamma \operatorname{Male}_i + \mathbf{Z}'_{j(i)}\kappa + \alpha_{m(i)} + \theta_{t(i)} + \epsilon_i)$$
(3.5)

$$E[Age\ At\ Death_i|\mathbf{X}] = \beta\ \log(\text{Altitude}_{j(i)}) + \gamma\ \text{Male}_i + \mathbf{Z}'_{j(i)}\boldsymbol{\kappa} + \alpha_{m(i)} + \theta_{t(i)} + \epsilon_i, \quad (3.6)$$

³³While their model focuses on cross-country comparisons, the underlying mechanism—that longer life expectancy incentivizes human capital investment—should also operate at smaller geographic scales.

where: $Dying Before Five_i$ and $Age At Death_i$ are the binary indicators for death before age five and the age at death, respectively, for individual i in village j(i). $log(Altitude_{j(i)})$ is the natural logarithm of the altitude of village j. $Male_i$ is an indicator variable equal to 1 if individual i is male, and 0 if female. $\mathbf{Z}_{j(i)}$ is a vector of village-level control variables, including: the logarithm of the distance to the closest river, potential caloric yield, precipitation, evapotranspiration, maximum and minimum temperature, the logarithm of the number of husbandry and draft animals, the proportion of the village population that is Muslim, and the logarithm of total population in the village, the latter two only in some specifications. $\theta_{t(i)}$ and $\alpha_{m(i)}$ represents a set of death-year fixed effects and mahal fixed effects.

Equation 3.5 is estimated using a probit model, whereas Equation 3.6 is estimated using a negative binomial regression, to account for the non-negative, integer-valued nature of the age-at-death variable.³⁴

Table 3.2 presents the results of these regressions. Columns 1 and 3 include death-year and mahal fixed effects, the logarithm of the distance to the closest river, potential caloric yield, precipitation, evapotranspiration, maximum and minimum temperature and the logarithm of the number of husbandry and draft animals.³⁵ Columns 2 and 4 further add the share that the Muslims represent in a village and the village population, although we recognize the latter may be a problematic control as it varies with altitude. Columns 1-2 focus on the probability of dying before age five, while Columns 3-4 examine the age at death. All specifications report robust and Conley standard errors with a 20 km bandwidth.

The results consistently support a significant association between higher altitude and lower mortality. Focusing first on the probability of dying before age five, Column 1 indicates a decrease in the probability of dying as an infant of 0.31 percentage for each 1% increase in altitude.³⁶ Turning to age at death, Columns 3 and 4, which use negative binomial regression, reveal a statistically significant and positive association with altitude, implying increased longevity at higher elevations of about 18.15 years for each 1% in elevation (using the estimates in Column 3). A large fraction of that increase comes from decreased mortality during childhood.³⁷

³⁴Unfortunately, parish records have limited individual-level control variables, which restricts our ability to control for other potential confounders at the individual level.

³⁵ Although more intense contact with farm animals provides a long-term evolutionary advantage against airborne diseases (Diamond (1999)), the time frame under which it operates far exceeds the scope of our project. However, Klous et al. (2016) reviews the medical literature on the topic, finding increased pathogen transmission. We account for the number of animals to factor in this transmission vector.

³⁶The value in Column 2 essentially yields the same conclusion—a 0.28 percentage point decrease.

³⁷Re-estimating the impact of altitude on age at death for the sub-sample of individuals that died after age 10 yields a coefficient equal to 0.14, significant at the 5% level. This corresponds to an increase in life

Table 3.2: Mortality regression results.

	Infant deat	h, (0/1)	Death a	age	
	(1)	(2)	(3)	(4)	
Altitude (log.)	-0.857 $(0.183)^{***}$ $[0.274]^{***}$	-0.782 (0.187)*** [0.300]***	0.715 (0.135)*** [0.196]***	0.691 (0.140)** [0.196]***	
Geography	Yes	Yes	Yes	Yes	
Demography	No	Yes	No	Yes	
Animals	Yes	Yes	Yes	Yes	
Ind. controls	Yes	Yes	Yes	Yes	
Year	Yes	Yes	Yes	Yes	
Mahal	Yes	Yes	Yes	Yes	
R^2	0.056	0.057	0.005	0.005	
Observations	8909	8909	8909	8909	

Notes: This table presents the results of regressions linking village altitude (measured in logarithm) and the probability of dying before the age of five in columns 1–2 and the age at death for the entire population in Columns 3–4. Columns 1 and 2 are estimated with a probit model, while columns 3 and 4 use a negative binomial model. Columns 1 and 3 control for the logarithm of the distance to the closest river, potential caloric yield, precipitation, evapotranspiration, maximum and minimum temperature and the logarithm of the number of husbandry and draft animals. Columns 2 and 4 further include the share that Muslims represent and the logarithm of total population. Columns 1–4 include gender and the logarithm of the number of certain types of animals. All regressions include mahal (region) fixed effects and year fixed effects. All columns present robust standard errors in brackets, and Conley standard errors in square brackets using a cut-off distance of 20 km. * p < 0.1, ** p < 0.05, *** p < 0.01.

While the preceding analysis provides initial evidence of the altitude-mortality relationship, we now employ a more refined approach to analyze mortality dynamics: a proportional hazard model. This method is better suited to model the time to death, as it estimates the probability of dying at any given age, conditional on survival up to that age. By using both birth and death records, we can include information on all individuals, even those who were still alive at the end of our observation period. This helps to reduce potential selection bias that could arise if we only analyzed individuals for whom we have death records. Specifically, our empirical strategy maximizes the following log-likelihood function:

expectancy of 6.8 years.

$$\mathcal{L} = \sum_{\tau=1}^{D} \left(\sum_{i \in D_{\tau}} \left[\beta \log(Altitude_{j(i)}) + \gamma Male_{i} + \mathbf{Z}'_{j(i)} \boldsymbol{\kappa} + \alpha_{m(i)} + \theta_{t(i)} \right] - \right)$$
(3.7)

$$- d_{\tau} \log \left(\sum_{l \notin D_{\tau}} \exp(\beta \log(Altitude_{j(l)}) + \gamma Male_{l} + \mathbf{Z}'_{j(l)} \kappa + \alpha_{m(i)} + \theta_{t(i)}) \right) \right), \quad (3.8)$$

where $\tau = 1, ..., D$ represents the years in which deaths are observed in our sample and D_{τ} denotes the set of individuals who died in year τ . For individual i, we include as controls the natural logarithm of the altitude of the village j(i) where individual i resided, an indicator variable equal to 1 for males, the vector $\mathbf{Z}_{j(i)}$ of village-level control variables for village j(i), including: the logarithm of the distance to the closest river, potential caloric yield, precipitation, evapotranspiration, maximum and minimum temperature, the logarithm of the number of husbandry and draft animals, 38 the logarithm of total village population and the proportion of the village population that is Muslim. θ_t represents death-year fixed effects and $\alpha_{m(i)}$ are mahal fixed effects.

Table 3.3 presents the results of the Cox proportional hazard model estimations. Mirroring the structure of Table 3.2, Columns 1–2 focus on infant mortality, while Columns 3–4 analyze mortality across the entire population. Columns 1 and 2 include death-year fixed effects, gender, and the logarithm of the distance to the nearest river as basic controls. Columns 3 and 4 add the logarithm of a village's total population and the proportion of Muslims in the village.³⁹

Across all specifications, we observe a consistent negative and statistically significant coefficient on the logarithm of altitude. For infant mortality, the coefficient is around -1.5, indicating a substantial reduction in the hazard of infant death at higher altitudes: moving from the lowest valley to the highest mountain increases the logarithm of altitude by about 0.95, which corresponds to almost dividing by four the probability of a child dying. For mortality across the full age range, the coefficient on the logarithm of altitude remains negative and statistically significant, with a similar magnitude, which implies a reduction in the hazard of about the same level. This reinforces our earlier findings from the linear regression models and provides further robust evidence for a positive association between altitude and life expectancy in this historical Armenian population. Moreover, as we document in Section

³⁸See footnote 35.

 $^{^{39}}$ The table presents the coefficients from the Cox model, not the implied hazard ratios. Hence, a negative coefficient indicates a lower probability of dying at a given age.

Table 3.3: Cox regression results.

	Infant ($\leq 5)$	Full sample		
	(1)	(2)	(3)	(4)	
Altitude (log)	-1.617 $(0.259)^{***}$	-1.412 $(0.272)^{***}$	-1.570 $(0.266)^{***}$	-1.314 $(0.276)^{***}$	
Geography	Yes	Yes	Yes	Yes	
Demography	No	Yes	No	Yes	
Other	Yes	Yes	Yes	Yes	
Ind. controls	Yes	Yes	Yes	Yes	
Year	Yes	Yes	Yes	Yes	
Mahal	Yes	Yes	Yes	Yes	
R^2	0.055	0.056	0.032	0.033	
Observations	7684	7684	11792	11792	

Notes: This table presents the results of Cox regressions relating village altitude (measured in logarithm) to the probability of dying. Columns 1 and 2 focus on children up to five years of age and Columns 3 and 4 consider the whole population. Columns 1 and 3 control for the logarithm of the distance to the closest river, potential caloric yield, precipitation, evapotranspiration, maximum and minimum temperature. Columns 2 and 4 further include the share that Muslims represent and the logarithm of total population. Columns 1–4 include gender and the logarithm of the number of certain types of animals. All regressions include mahal (region) fixed effects and year fixed effects. All columns present robust standard errors in brackets. * p < 0.1, *** p < 0.05, **** p < 0.01.

3.4.4, the mortality gradient cannot be explained by a positive income differential.

Having established a robust positive association between higher altitude and increased life expectancy, we now turn to investigating the mechanisms underlying this relationship. As outlined earlier, we are considering two primary, and potentially competing, explanations: increased female agency and reduced disease burden at higher altitudes.

The female agency hypothesis suggests that altitude-driven shifts in agricultural specialization, favoring dairy production, could enhance women's economic roles and autonomy. This, in turn, might lead to family preferences more aligned with women's desires for fewer, higher-quality children, resulting in broadly improved child health and survival across various causes of death. Conversely, the reduced disease burden hypothesis posits that lower population density at higher altitudes primarily reduces the transmission of airborne diseases (see Diamond, [1999] and Franck et al., [2022]). This mechanism predicts a more specific mortality reduction, concentrated particularly in deaths from respiratory illnesses.

To differentiate between these explanations, we now analyze cause-of-death data from the parish records.⁴⁰ If increased female agency is the dominant factor, we should observe a general reduction in mortality across all cause categories. However, if reduced disease burden is the key driver, we anticipate a more pronounced decrease, specifically in mortality attributed to respiratory diseases. To evaluate these competing predictions, we use probit regression to estimate Equation 3.9

Cause Of Death_i =
$$\Phi(\beta \log(Altitude_{j(i)}) + \gamma Male_i + \mathbf{Z}'_{j(i)}\kappa + \epsilon_i),$$
 (3.9)

where: $Cause\ Of\ Death_i$ is a binary indicator variable for individual i, taking the value 1 if the recorded cause of death falls into a specific category, and 0 otherwise. $Altitude_{j(i)}$ is the altitude of village j(i). Regressions control for gender $(Male_i)$ and village-level control variables, including: the logarithm of the distance to the closest river, potential caloric yield, precipitation, evapotranspiration, maximum and minimum temperature, the logarithm of the number of husbandry and draft animals, the logarithm of total village population, and the proportion of the village population that is Muslim.

Our analysis focuses on two primary cause-of-death categories, chosen to differentiate between the competing hypotheses. The first considers respiratory diseases that are directly

⁴⁰Baten and Blum (2014) indicate that a higher protein diet increases height. Insofar as height and life expectancy are correlated, this is another potential mechanism. However, we are unable to disentangle it from the main one we propose: population density.

relevant to the reduced disease burden hypothesis, as airborne transmission is expected to be lower at higher altitudes—because of lower population density. The second category is *other contagious diseases*. This broader category of contagious diseases, *excluding* respiratory illnesses, serves as a contrast. If female agency and generally improved child health are driving mortality reductions, we might expect to see reductions in both respiratory and other contagious diseases. If the effect is specific to airborne transmission, we expect to see stronger effects for respiratory diseases. Moreover, we also expect the bulk of any effect to be among children because mortality reductions at younger ages have the largest impact on overall life expectancy and because childhood is a particularly vulnerable period for infectious diseases.

Table 3.4 presents the results of our cause-specific mortality analysis, estimated using a probit model as described in Equation 3.9. Columns 1–4 focus on mortality attributed to respiratory diseases, and Columns 5–8 examine mortality from other contagious, non-respiratory diseases. We present results separately for infant mortality (deaths up to age five, Columns 1–2 and 5–6) and mortality across the full age distribution (Columns 3–4 and 7–8).

Table 3.4: Cause of death regression results.

	Resp. dis. ($age \leq 5$)	$ge \le 5$) Resp. dis. (all sample)		Cont., non-resp. (age ≤ 5)		Cont., non-resp. (all sample)	
	(1)	(2)	(3)	(4)	(5)	(6)	$\overline{(7)}$	(8)
Altitude (log.)	-0.741 $(0.331)^{**}$ $[0.248]^{***}$	-0.812 (0.334)** [0.354]**	-0.525 $(0.199)^{***}$ $[0.140]^{***}$	-0.441 $(0.207)^{**}$ $[0.158]^{***}$	-0.667 (0.300)** [0.512]	-0.694 (0.306)** [0.590]	-1.215 (0.211)*** [0.565]**	-1.231 (0.214)*** [0.590]**
Geography	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Demography	No	Yes	No	Yes	No	Yes	No	Yes
Animals	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ind. controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mahal	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.118	0.119	0.087	0.088	0.144	0.145	0.119	0.119
Observations	3082	3082	8277	8277	3151	3151	8233	8233

Notes: This table presents the results of regressions relating village altitude (measured in logarithm) to the probability of dying of certain causes. Columns 1–4 focus on respiratory diseases, and Columns 5–8 focus on contagious, non-respiratory diseases. Columns 1–2 and 3–6 are estimated on a subsample consisting of children aged five years or less, while Columns 3–4 and 7–8 consider the entire population. All columns are estimated using a probit model. Odd columns control for the logarithm of the distance to the closest river, potential caloric yield, precipitation, evapotranspiration, maximum and minimum temperature. Even columns further include the share that Muslims represent and the logarithm of total population. All regressions include mahal (region) fixed effects and year fixed effects. All columns present robust standard errors in brackets, and Conley standard errors in square brackets using a cut-off distance of 20 km. * p < 0.1, ** p < 0.05, *** p < 0.01.

Examining the results on respiratory diseases, we observe consistently negative and statistically significant coefficients on altitude across all specifications, mostly concentrated on children. For infant mortality (Columns 1 and 2), the coefficients range between -0.74 and -0.81, indicating a substantial and robust negative association between altitude and infant deaths from respiratory illnesses: higher altitude significantly reduces the probability of infants dying from respiratory diseases. For mortality across the full age range (Columns 3 and 4), the coefficients remain negative and statistically significant, although smaller in magnitude. This suggests that the protective effect of higher altitude against respiratory diseases is more important among children, who are more vulnerable.

In contrast, examining the results on mortality from other contagious, non-respiratory diseases results presents a more nuanced picture. For infant mortality (Columns 5–6), the coefficients on the logarithm of altitude, while negative, are *not* statistically significant in either specification.⁴¹ This lack of statistical significance for non-respiratory infant mortality is a key finding. Once we consider the whole population (Columns 7–8), we obtain a negative and marginally significant effect of altitude on the probability of dying from other contagious, non-respiratory illnesses.

The pattern of results in Table 3.4 provides differential support for our competing hypotheses. The consistent and statistically significant negative effect of altitude on respiratory disease mortality among children strongly supports the reduced disease burden hypothesis. This hypothesis predicts that higher altitudes, through lower population density and reduced airborne pathogen transmission, should primarily decrease mortality from respiratory illnesses—a prediction that aligns closely with our findings. Conversely, the lack of a statistically significant effect of altitude on infant mortality from non-respiratory contagious diseases weakens the increased female agency hypothesis as the primary driver of mortality reduction. If increased female agency were the dominant mechanism, leading to generally improved child care and health investments, we might expect to see a more generalized reduction in infant mortality across all contagious disease categories, not just respiratory illnesses.⁴²

To further assess the robustness of our mortality findings and address potential alternative explanations, we conduct several sensitivity checks, focusing on different mortality outcomes.

⁴¹While robust standard errors are shown for completeness, we prioritize the interpretation of results using Conley standard errors. Conley standard errors are designed to address spatial autocorrelation, which is likely present in our geographic mortality data and could bias standard errors.

⁴²While we do observe significant effects of altitude on mortality from non-respiratory contagious diseases in the full sample, the absence of such an effect for infant mortality specifically raises questions about the broad applicability of the female agency explanation in this context.

These checks are presented in Table 3.C.10 in Appendix 3.C. These show, first, that individuals in higher-altitude regions are reported more often as dying of "other causes" —a residual category encompassing deaths not attributed to contagious diseases or old age. This result is consistent with the previous reduction in the probability of dying from contagious diseases. Second, we investigate reporting "old age" as a cause of death. A potential concern with historical cause-of-death data is differential reporting bias. If, at higher altitudes, record keepers were systematically more likely to attribute deaths to "old age"—perhaps due to less precise diagnoses or different cultural norms—this could confound our cause-specific mortality analysis. Our results do not indicate this to be the case. Last, we conduct a placebo test by examining mortality recorded as occurring "at birth" or very shortly thereafter. Infant deaths in the immediate neonatal period are highly unlikely to be caused by contagious diseases transmitted through airborne or other environmental pathways, as newborns would not yet have been exposed to these pathogens. Deaths at birth are more likely due to congenital conditions, birth complications, or maternal health issues, factors that are not directly linked to population density or airborne disease transmission. Therefore, we should not expect altitude to have a significant effect on mortality "at birth" if our primary mechanism is indeed related to reduced contagious disease burden at higher altitudes. The results align with these predictions.

3.4.3 Altitude and the Quality-Quantity Trade-Off

Having established a robust positive association between higher altitude and increased life expectancy, driven primarily by reduced mortality from respiratory diseases among children, we now address our central hypothesis: that increased life expectancy incentivizes investments in child quality, specifically human capital. This brings us to the core of our quantity-quality trade-off analysis.

Numeracy

As mentioned earlier, we proxy for human capital using numeracy, measured by the (inverse of the) prevalence of age heaping in the 1831 Census records. ⁴³ We employ a probit regression framework to estimate the relationship between altitude and numeracy, using individual-level data:

$$Numeracy_i = \Phi(\beta \log(Altitude_{j(i)}) + \mathbf{X}_i' \boldsymbol{\gamma} + \mathbf{Z}_{j(i)}' \boldsymbol{\kappa} + \alpha_{m(i)} + \epsilon_i), \tag{3.10}$$

⁴³Age heaping, the tendency to report ages rounded to the nearest zero or five, is inversely related to numeracy skills. Higher age heaping indicates lower numeracy, and vice versa.

where: $Numeracy_i$ is our measure of human capital for individual i residing in village j(i), $log(Altitude_{j(i)})$ is the natural logarithm of the altitude of village j and \mathbf{X}_i is a vector of individual-level control variables for individual i, including its age and its square, household religion, size and sex ratio. These variables control for potential resource dilution effects or economies of scale in household size and potential gender biases in parental investment in human capital (e.g., son preference). Lastly, $\mathbf{Z}_{j(i)}$ is a vector of village-level control variables including: the logarithm of the distance to the closest river, potential caloric yield, precipitation, evapotranspiration, maximum and minimum temperature, the logarithm of village population and the proportion of the Muslim community in the village. Regressions include mahal fixed effects. Consistent with the theoretical foundations on age heaping, the sample only includes individuals aged 23–62.⁴⁴

In line with Cervellati and Sunde (2015, 2011) and our prior empirical findings, we hypothesize a positive coefficient on the logarithm of altitude. This would indicate that individuals residing in higher-altitude villages, characterized by higher life expectancy, exhibit higher levels of numeracy (i.e., lower age heaping), consistent with increased investment in human capital. Furthermore, considering the theoretical implications of the quality-quantity tradeoff, we expect that this increase in human capital at higher altitudes should be accompanied by a shift towards lower fertility rates, reflecting a demographic transition. We explore this prediction regarding fertility in the subsequent section.

Table 3.5 presents the results of our probit regressions, estimating Equation 3.10. Even columns present the results considering individual-level control variables to account for idiosyncratic differences that might be correlated with both numeracy and altitude, while odd columns augment the previous specification with village-level controls. For each specification, we present results for the entire population (Columns 1 and 2), men only (Columns 3 and 4), and women only (Columns 5 and 6). All regressions report both robust standard errors and Conley standard errors (with a 20 km cutoff distance) to ensure inference is robust to spatial autocorrelation.⁴⁵

Table 3.5 presents compelling evidence of a link between altitude and human capital, as measured by numeracy. Looking at the whole sample results and the male subsample, a

⁴⁴Age heaping is very common in our data, with only about 5% of adults reporting an age not ending in 5 or 0. This characteristic of the data renders estimating the effect of altitude more challenging, given the large proportion of zeroes in the sample.

⁴⁵While religious affiliation is recorded at the individual level in the census records, inter-religious marriages were exceedingly rare during this period. Consequently, most of the variation in religious affiliation occurs across households rather than within them, making household-level controls for religious composition less critical.

Table 3.5: Human capital regression results.

	Entire sample		Male sample		Female sample	
	(1)	(2)	(3)	(4)	(5)	(6)
Altitude (log.)	0.712 (0.166)*** [0.349]**	0.836 (0.172)*** [0.384]**	0.652 (0.169)*** [0.340]*	0.761 (0.175)*** [0.378]**	0.745 (1.810) [1.517]	4.023 (2.121)* [2.198]*
Geography	Yes	Yes	Yes	Yes	Yes	Yes
Demography	No	Yes	No	Yes	No	Yes
Ind. controls	Yes	Yes	Yes	Yes	Yes	Yes
Mahal	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.040	0.044	0.034	0.037	0.034	0.045
Observations	8988	8988	8236	8236	751	751

Notes: This table presents the results of regressions linking village altitude (measured in logarithm) and numeracy skills, measured by the (inverse) probability of age-heaping. Columns 1 and 2 focus on the whole sample, Columns 3 and 4 on men, and Columns 5 and 6 on women. All columns are estimated using a probit model. Odd columns control for the logarithm of the distance to the closest river, potential caloric yield, precipitation, evapotranspiration, maximum and minimum temperature. Even columns further include the share that Muslims represent and the logarithm of total population. All columns include individual-level controls: age, its square, household size and the share women represent in each household. All regressions include mahal (region) fixed effects. All columns present robust standard errors in brackets, and Conley standard errors in square brackets using a cut-off distance of 20 km. p < 0.1, p < 0.05, p < 0.01.

consistent pattern emerges: higher altitude is associated with higher levels of numeracy. Conservative estimates reveal that our numeracy measure increases, for the whole and male sample, by 0.087 or 0.071 percentage points when altitude increases by 1%, respectively. This effect is large given that only 4.6% of male adults in the sample report an age not ending in 0 or 5.

We also obtain a positive figure for women, although it is only significant at the 10% level, probably reflecting a smaller and selected sample. Appendix 3.B uses the ABCC index (A'Hearn et al., 2009) at the village level, instead of our binary variable, showing a positive coefficient on altitude.

Furthermore, we have considered the possibility that responses to enumerators' questions were provided by the household head and thus did not reflect each individual's numeracy but that of the head.⁴⁷ Running a regression equivalent to Equation 3.10 but excluding indi-

 $^{^{46}}$ Only widows appear as female household heads.

⁴⁷If this was the case, because of the fertility differentials implied by the quality-quantity trade-off, households with a numerically illiterate head would have more children who would be qualified as practicing

viduals below certain age thresholds provides qualitatively equivalent results. Alternatively, considering the same specification but focusing only on the household heads again yields results that are in line with the baseline displayed in Table 3.5.⁴⁸

Fertility

Finally, to provide a comprehensive test of the quality-quantity trade-off, we examine the relationship between altitude and fertility. According to the demographic transition theory, increased investment in child quality (human capital) should be accompanied by a compensatory *decrease* in child quantity (fertility). Thus, if higher altitude truly incentivizes human capital investment, as our numeracy results suggest, we should also observe a corresponding reduction in fertility rates at higher altitudes.

Due to the limitations of our historical data, measuring fertility directly presents several challenges. Individual-level data on mothers' fertility histories are unavailable in the 1831 Census. Therefore, we rely on aggregate birth records from the parish registers to calculate average annual fertility rates at the village level. Specifically, we calculate the yearly ratio of total births recorded in parish registers for each village to the female population in that village, as recorded in the 1831 Census. Using a constant denominator to calculate fertility rates over a long period introduces potential bias, as the population would have grown naturally over time. To minimize this bias, we restrict our analysis to this relatively short period (1831-1850) immediately following the census year. Furthermore, because birth data from parish registers only includes Christian births, we adjust the denominator to represent only the Christian female population, ensuring consistency in the numerator and denominator.

Given the historical context of limited or absent birth control methods in 19th-century Armenia, we include the village-level number of marriages as a control variable in our fertility regressions. As documented by Cinnirella et al. (2017) for historical England, marriage patterns are a key determinant of fertility in pre-demographic transition societies.

Table 3.6 presents the results of our village-level fertility regressions, examining the relationship between altitude and average annual fertility rates. We provide estimates using OLS with robust and Conley standard errors with a cut-off distance of 20 km. Moreover, we run separate regressions considering the total female population and only the Christian population.⁴⁹

age-heaping, artificially favoring our hypothesis. In this case, the sample size is futher reduced to 5637 observations, and the coefficient is still positive but not significant with Conley standard errors.

⁴⁸We placed age restrictions on ages 23–45. See Figure 3.A.2 in the Appendix.

⁴⁹We reiterate that births are only available for Christians.

Table 3.6: Fertility regression results.

	Fertili	ty	Fertility (Arm	enian sample)
	(1)	(2)	(3)	(4)
Altitude (log.)	-0.029 (0.008)*** [0.011]**	-0.035 (0.009)*** [0.015]**	-0.066 (0.032)** [0.004]***	-0.073 $(0.032)^{**}$ $[0.027]^{***}$
Geography	Yes	Yes	Yes	Yes
Demography	No	Yes	No	Yes
Animals	Yes	Yes	Yes	Yes
Lagged marriages	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Mahal	Yes	Yes	Yes	Yes
R^2	0.138	0.149	0.064	0.066
Observations	1164	1164	1164	1164

Notes: This table presents the results of regressions linking village altitude (measured in logarithm) and fertility, measured as the number of (Christian) yearly births relative to the female population. Columns 1 and 2 consider the entire female population in the denominator, while Columns 3 and 4 use only the Armenian female population. All columns are estimated using an OLS model. Odd columns control for the logarithm of the distance to the closest river, potential caloric yield, precipitation, evapotranspiration, maximum and minimum temperature, and the logarithm of the number of husbandry and draft animals. Even columns further include the share that Muslims represent and the logarithm of total population. All columns include the number of marriages in the previous year as control. All regressions include mahal (region) fixed effects and year fixed effects. All columns present robust standard errors in brackets, and Conley standard errors in square brackets using a cut-off distance of 20 km. * p < 0.1, ** p < 0.05, *** p < 0.01.

The results show a consistent and statistically significant negative association between altitude and fertility across different population denominators and estimation methods. In the more comprehensive specification (Column 2), the coefficient of -0.035 indicates that a 1% increase in altitude is associated with a 0.035 unit decrease in the average annual fertility rate. Given the average fertility rate in our sample (0.018), this coefficient suggests a non-negligible and economically meaningful reduction in fertility associated with higher altitude.

Columns 3 and 4 replicate the analysis but use the Armenian female population in 1831 as the denominator to better match the numerator (Christian births). Again, both estimations show negative and statistically significant coefficients on the logarithm of altitude at the 1% level. In particular, the estimate in Column 4, with the full set of controls, yields a coefficient of -0.073. This larger magnitude, compared to Columns 1 and 2, suggests that focusing on the Armenian female population—and thus more closely aligning the numerator and denominator—strengthens the estimated negative relationship between altitude and fertility. In this case a 1% increase in altitude is now associated with a 0.073 unit decrease in the average annual fertility rate, a quantitatively more substantial effect size when compared to the average fertility (0.025). Coupled with our earlier findings of increased human capital (numeracy) and increased life expectancy at higher altitudes, these fertility results complete the circle, lending further credence to the proposed mechanism linking environmental factors, longevity, human capital investment, and fertility transitions in historical populations.

3.4.4 Robustness

While our primary analyses provide evidence supporting the life expectancy mechanism linking altitude to human capital and fertility, we further address the alternative hypothesis that increased gender equality at higher altitudes might be a confounding factor. As discussed in Section 3.1, if higher altitude historically fostered greater female economic autonomy due to agricultural specialization patterns, this could have independently influenced demographic outcomes, potentially biasing our results.

To further examine and mitigate this concern, we conduct a robustness check using contemporary data on female political representation in village councils. While gender roles and societal structures evolve over time, if altitude-driven differences in gender equality were a persistent feature of this region, we might expect to observe some lingering effects on contemporary gender dynamics, particularly in areas like political participation. Consistent with this idea, Frigo and Roca Fernández (2021) demonstrate the persistence of gender roles over

long periods.

Therefore, we collected data on village council elections for our sample villages, focusing on elections held in 2016 or the nearest available year. Our measures of female political representation include the number of female candidates on the ballot in village council elections, the share they represent among the total candidates, and the percentage of women successfully elected to village councils.

This data, while contemporary, provides an indirect test for persistent differences in gender equality that could be linked to historical altitude variations. In our regression specifications, we include these measures of female political representation as dependent variables, regressing them on the logarithm of altitude and a range of control variables. These control variables mirror those used in our agricultural specialization regressions (Equation 3.2) and include the logarithm of the distance to the closest river, potential caloric yield, precipitation, evapotranspiration, maximum and minimum temperature. We also incorporate additional controls specifically relevant to contemporary Armenia: the logarithm of the distance to Yerevan (the capital city), to account for potential urban-rural gradients in political participation, and the proportion of the Yazidi ethnic minority, as ethnicity can also influence political dynamics in the region. Even columns are augmented with the share that Muslims represent and the logarithm of total population. Table 3.7 presents the results.

Table 3.7: Election regression results.

	Number fem. candidates		Share fem. candidates		% elected women	
	(1)	(2)	(3)	(4)	(5)	(6)
Altitude (log.)	-2.916 (0.970)*** [1.218]**	-3.143 (0.994)*** [1.260]**	-0.254 (0.101)** [0.145]*	-0.319 (0.105)*** [0.140]**	-0.251 (0.108)** [0.129]*	-0.316 (0.115)*** [0.132]**
Geography	Yes	Yes	Yes	Yes	Yes	Yes
Demography	No	Yes	No	Yes	No	Yes
Ind. controls	No	No	No	No	No	No
Modern day	Yes	Yes	Yes	Yes	Yes	Yes
Election Year	Yes	Yes	Yes	Yes	Yes	Yes
Mahal	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.088	0.089	0.182	0.206	0.197	0.215
Observations	199	197	206	204	206	204

Notes: This table presents the results of regressions linking village altitude (measured in logarithm) and female agency, proxied by electoral outcomes. Columns 1 and 2 focus on the number of female candidates, Columns 3 and 4 on the share they represent, and Columns 5 and 6 on the share of elected candidates that are women. Columns 1 and 2 follow a negative binomial model, whereas Columns 3–6 use an OLS model. Odd columns control for the logarithm of the distance to the closest river, potential caloric yield, precipitation, evapotranspiration, maximum and minimum temperature. Even columns further include the share that Muslims represent and the logarithm of total population. All columns control for the (logarithm) of the distance to Yerevan and the share the Yazidi ethnic minority represents. All regressions include mahal (region) fixed effects, and election-year fixed effects. All columns present robust standard errors in brackets, and Conley standard errors in square brackets using a cut-off distance of 20 km. * p < 0.1, ** p < 0.05, *** p < 0.01.

Contrary to the hypothesis that higher altitude fosters greater gender equality, the results from contemporary village council elections indicate a potential negative association between altitude and female political representation, suggesting lower, rather than higher, levels of gender equality in higher altitude locations. Thus, even taking the most conservative stance—that altitude has no impact at all on female political representation—the results still fail to support the idea of *more* favorable gender roles for women at higher altitudes.

As a further robustness check against the female agency hypothesis, we examine spousal age gaps at marriage. Theoretical models of female agency and demographic transitions suggest that increased female autonomy tends to *reduce* the spousal age gap (de Moor and Van Zanden, 2009). This is often attributed to women gaining greater control over marriage timing and family formation decisions, leading to a narrowing of the age difference between spouses.

To test this in our historical Armenian context, we analyze marriage data from the parish records, focusing specifically on first-time marriages to ensure that we are capturing couples' initial choices rather than remarriages due to widowhood.⁵⁰ Using these parish records, we estimate the spousal age gap, as well as the age at marriage for men and women separately, as functions of village altitude. We employ the following OLS regression equation:

$$Age\ At\ Marriage_i = \beta\ \log(Altitude_{j(i)}) + \mathbf{Z}'_{j(i)}\kappa + \eta_{t(i)} + \epsilon_i, \tag{3.11}$$

where: $Age\ At\ Marriage_i$ represents either the spousal age gap (groom's age - bride's age) for marriage i, the bride's age at first marriage or the groom's age at first marriage. $\log(Altitude_{j(i)})$ is the natural logarithm of the altitude of village j(i) and $\mathbf{Z}_{j(i)}$ is a vector of village-level control variables for village j(i), including the logarithm of the distance to the closest river, potential caloric yield, precipitation, evapotranspiration, maximum and minimum temperature, the logarithm of total village population, and the proportion of the Muslim community in village j. The regressions include mahal and year fixed effects.

Table 3.8 presents the results of these regressions, examining whether altitude systematically influences spousal age gaps or the ages at first marriage for men and women in 19th-century Armenia. Columns 1 and 2 present the results of our analysis examining the spousal age gap at first marriage. Across both specifications (with basic and full village-level controls), we find a positive and statistically significant relationship between altitude and the spousal

⁵⁰Parish registers include notations indicating widow or widower status for second and higher-order marriages. Divorce was exceptionally rare during the period of our study.

Table 3.8: Marriage regression results.

	Spousal age gap		Wife's age		Groom's age	
	(1)	(2)	(3)	(4)	(5)	(6)
Altitude (log.)	0.051 (0.012)*** [0.008]***	0.055 (0.012)*** [0.006]***	$-0.077 \\ (0.015)^{***} \\ [0.023]^{***}$	-0.074 (0.015)*** [0.020]***	-0.026 $(0.014)^*$ $[0.029]$	-0.019 (0.015) [0.034]
Geography	Yes	Yes	Yes	Yes	Yes	Yes
Demography	No	Yes	No	Yes	No	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes
Mahal	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.248	0.250	0.004	0.004	0.007	0.007
Observations	6965	6926	6970	6931	7057	7018

Notes: This table presents the results of regressions linking village altitude (measured in logarithm) and marriage age outcomes. Columns 1 and 2 focus on the spousal age gap, Columns 3 and 4 on the wife's age at marriage and Columns 5 and 6 on the groom's age at marriage. Columns 1 and 2 are estimated by OLS and Columns 3–6 follow a negative binomial model. Odd columns control for the logarithm of the distance to the closest river, potential caloric yield, precipitation, evapotranspiration, maximum and minimum temperature. Even columns further include the share that Muslims represent and the logarithm of total population. All regressions include mahal (region) fixed effects and year fixed effects. All columns present robust standard errors in brackets, and Conley standard errors in square brackets using a cut-off distance of 20 km. * p < 0.1, ** p < 0.05, *** p < 0.01.

age gap. This positive association directly contradicts the female agency hypothesis. Higher altitude therefore appears to be associated with larger, rather than smaller, spousal age gaps, suggesting potentially lower female agency in marriage decisions in these locations, at least as captured by this specific indicator.

Moreover, the widening spousal age gap is mostly driven by a lowering of women's age at marriage, while men's presents no variation. This divergence adds further evidence that, instead of empowering women, higher altitudes tend to be associated with a decrease in their agency.⁵¹ Coupled with the previously discussed results from contemporary village council elections, which indicated no evidence of greater female political representation at higher altitudes, these marriage market findings reinforce the conclusion that increased female agency is unlikely to be the dominant factor explaining the observed relationship between altitude, mortality, and human capital investment in our study setting.

As a final robustness check, we consider and aim to rule out the possibility that our previous findings—particularly the positive association between altitude and numeracy—simply reflect underlying differences in wealth or economic development across villages. If higher-altitude areas were systematically wealthier, this could independently explain both increased life expectancy (through better nutrition, sanitation, etc.) and increased numeracy (due to greater demand for or returns to education in wealthier economies), potentially confounding our proposed life expectancy mechanism.

To address this wealth confounder, we use data from the 1831 Russian Imperial Census on the presence of craftsmen (artisans) in each village. We argue that the presence of craftsmen serves as a reasonable proxy for village-level economic development in this context for several reasons: First, Engel's law indicates that as income rises, the relative demand for non-food goods (like those produced by artisans) increases. Thus, villages with a larger artisan sector are likely to be wealthier, reflecting higher overall demand and economic activity beyond basic subsistence agriculture. Second, artisanal occupations typically require a higher level of basic human capital, including numeracy, compared to purely agricultural labor. Therefore, a thriving artisan sector suggests a higher return to numeracy and potentially a greater demand for it within the local economy.⁵² To examine the relationship between altitude

⁵¹We previously documented lower fertility at higher altitudes (see Table 3.6). Considering that women marry younger at lower altitude, thereby increasing potential fertility, this earlier finding suggests families overcompensate the natural tendency to bear more children.

⁵²Throughout this study, we do not consider differences in population density as reflecting a more economically developed society, as is common in comparative development for a Malthusian setting. The reason is that, in our specific context, population density may be a suboptimal measure. This is because, if higher-altitude regions experienced an earlier demographic transition (driven by increased life expectancy and human capital investment, as we hypothesize), they might exhibit *lower* population density not because

and artisan presence, we estimate the following parsimonious OLS regression model using village-level data:

$$Outcome_{i} = f(\beta \log(\text{Altitude}_{i}) + \mathbf{Z}_{i}' \boldsymbol{\kappa} + \epsilon_{i}), \tag{3.12}$$

where: $Outcome_j$ represents different measures of artisan presence in village j, specifically: the total number of craftsmen in the village j or the number of craftsmen as a percentage of the total population of the village. $f(\cdot)$ represents the functional form, with estimations conducted using both negative binomial regression and OLS methods. $log(Altitude_j)$ is the natural logarithm of the altitude of village j and \mathbf{Z}_j is a vector of village-level control variables, including: the logarithm of the distance to the closest river, potential caloric yield, precipitation, evapotranspiration, maximum and minimum temperature and the logarithm of the number of husbandry and draft animals, the logarithm of total village population, and the proportion of the Muslim population in the village.

Table 3.9 presents the results of these regressions, employing progressively more comprehensive specifications. We estimate models for both the absolute number of craftsmen (Columns 1 and 2) and the share of craftsmen in the village population (Columns 3 and 4), using negative binomial and OLS estimations, respectively. For each specification, we report robust standard errors and Conley standard errors with a 20 km bandwidth to address potential spatial autocorrelation.

In general, the results do not support the hypothesis that artisans preferentially settled or thrived in higher-altitude regions. This bolsters our argument that the observed improvements in human capital at higher altitudes are not simply a byproduct of wealth differences or differential returns to education, further reinforcing the life expectancy mechanism as the more plausible explanation for the observed patterns.

3.5 Conclusion

We investigate the influence of geographic factors, specifically altitude, on life expectancy and human capital investments in 19th-century Armenia. Leveraging the substantial variation in altitude within a geographically compact region, we provide robust empirical evidence supporting the hypothesis that higher altitudes —characterized by lower population density

they are underdeveloped, but because they *transitioned earlier* to a lower-fertility regime, resulting in slower population growth. Therefore, artisan presence provides a potentially more direct and less confounded proxy for village-level economic activity in our specific setting.

Table 3.9: Occupation.

	Number of	craftsmen	% Craftsmen		
	(1)	(2)	(3)	(4)	
Altitude (log.)	-0.388	-0.000	0.021	0.008	
	(0.779)	(0.412)	(0.018)	(0.015)	
	[0.706]	[0.506]	[0.028]	[0.023]	
Geography	Yes	Yes	Yes	Yes	
Demography	No	Yes	No	Yes	
Animals	Yes	Yes	Yes	Yes	
Mahal	Yes	Yes	Yes	Yes	
R^2	0.045	0.186	0.389	0.565	
Observations	154	154	234	234	

Notes: This table presents the results of regressions linking village altitude (measured in logarithm) and the presence of craftsmen. Columns 1 and 2 consider the number of craftsmen in a village, whereas Columns 3 and 4 are their percentual representativeness. Columns 1 and 2 follow a negative binomial model and Columns 3 and 4 an OLS model. Odd columns control for the logarithm of the distance to the closest river, potential caloric yield, precipitation, evapotranspiration, maximum and minimum temperature, and the logarithm of the number of husbandry and draft animals. Even columns further include the share that Muslims represent and the logarithm of total population. All regressions include mahal (region) fixed effects. All columns present robust standard errors in brackets and Conley standard errors in square brackets using a cut-off distance of 20 km. * p < 0.1, ** p < 0.05, *** p < 0.01.

and reduced disease transmission— are associated with lower mortality rates and, consequently, longer life expectancy. Our analysis reveals that families in higher-altitude villages experienced significantly lower exposure to airborne diseases—a major determinant of early mortality—particularly among children in this historical setting.

This increase in life expectancy, in turn, reshaped human capital investments. Our findings indicate a clear positive impact of altitude-driven mortality reduction on human capital formation, as evidenced by increased numeracy levels in higher-altitude regions. Furthermore, consistent with the quality-quantity trade-off inherent in demographic transition theory, we document a corresponding decrease in fertility rates at higher altitudes. Crucially, our robustness checks provide compelling evidence that these demographic shifts are not primarily driven by increased female agency or wealth effects, factors often considered as alternative explanations for fertility transitions.

In summary, this research provides strong empirical validation for the theoretical framework proposed by Cervellati and Sunde (2011, 2015). Our findings suggest that environmentally and geographically determined variations in mortality can be a first-order determinant in

explaining the differential timing of fertility transitions and patterns of human capital accumulation across populations. In the specific context of 19th-century Armenia, the reduced child mortality experienced by families in higher-altitude regions—stemming from environmental advantages—lessened the imperative for high fertility and facilitated a greater focus on investments in the quality of their children, most notably their education and human capital.

3.A Appendix: Additional Results

3.A.1 Summary Statistics

For a comprehensive overview of the data, Appendix Table 3.A.1 presents the full set of summary statistics for all outcome variables, categorized by data source. These categories include geographic characteristics, Census-derived measures, marriage records, household-level details, birth and death statistics, electoral outcomes, and other relevant variables.

3.A.2 Differential Missing Data

The Armenian parish records are not complete for all observations, with some displaying missing information, for instance, about the month of birth. Because we compute age-specific mortality profiles by linking births and deaths, a differential prevalence of missing data by altitude could bias our results. Figure 3.A.1 analyzes this possibility by plotting the coefficient associated to year categories on regressions linking the percentage of observations with missing data over the total number of observations. In general, we do not find evidence of differential reporting over time, nor over time and by altitude.

3.A.3 Results under OLS

To complement the main analysis, where we used the estimation technique most appropriate given the nature of the data, this section presents the equivalent regressions estimated using OLS. Across all OLS specifications, we report robust and Conley standard errors.

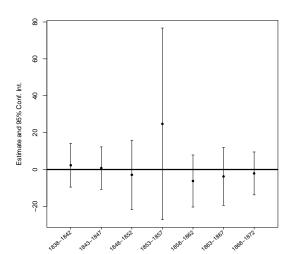
Table 3.A.1: Summary statistics

	Mean	Std. Dev.	Min	Max	N
Panel A: Geography					
Altitude (m)	1322.01	458.76	820.00	2184.00	235
Distance to river (m)	4842.77	4733.69	23.83	2124170	235
Max temp.	36.06	3.36	30.00	45.00	235
Min temp.	-33.40	2.15	-41.00	-30.00	235
Evap. (log)	6.78	0.11	6.51	7.07	235
Percip. (log)	6.21	0.22	5.74	6.67	235
Soil cal. yield (log)	8.30	0.07	8.09	8.41	235
Panel B: Census 1831					
Village level					
Milk animals	369.74	416.94	0.00	3031.00	235
Non-milk animals	149.16	134.02	0.00	771.00	235
Milk animal above avg.	0.27	0.45	0.00	1.00	235
Tot. pop.	233.06	251.04	9.00	2175.00	235
Muslim share	0.41	0.45	0.00	1.00	235
Male share	0.53	0.04	0.42	0.67	235
Individual level					
Numeracy $(1/0)$	0.35	0.48	0.00	1.00	22371
Age	22.57	18.09	0.00	120.00	22371
Female share	0.43	0.15	0.00	1.00	22371
HH size	7.48	4.28	1.00	46.00	22371
Panel C: Parish records					
First marriage 1838-1878					
Female age	17.19	1.67	9.00	35.00	7319
Male age	19.92	2.13	10.00	45.00	7406
Age gap (m-f)	2.72	1.70	-8.00	22.00	7313
Deaths 1838-1878					
Death age	25.82	27.06	0.00	115.00	10328
Death age (resp. air.)	17.54	23.30	0.01	102.00	1370
Death age (other cause exc. old age)	30.62	27.58	0.00	115.00	5522
Child mortality ($\leq 5 (1/0)$)	0.41	0.49	0.00	1.00	10328
Births 1838-1850					
Fertility	0.02	0.06	0.00	1.18	1224
Fertility (Arm.)	0.04	0.51	0.00	12.00	1224
Panel D: Modern-day variables					
Election 2016					
Female share (participated)	0.12	0.15	0.00	0.86	219
Female share (elected)	0.11	0.16	0.00	0.86	219
Other variables					
Distance to capital (km)	40.23	19.97	9.70	155.00	219
Yazidi share	0.05	0.20	0.00	1.00	219

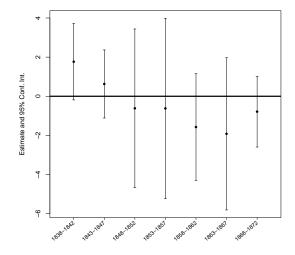
Notes: Note: The table shows the summary statistics of all variables used in the paper. Panel A represents geographic variables, Panel B represents the variables constructed based on the 1831 Census on village and individual level, Panel C shows the variables based on parish records in three sections (marriage, deaths, births), and Panel D represents modern-day variables: local election data, distance to the capital Yerevan, and Yazidi share from Arbatli and Gomtsyan (2019).

Figure 3.A.1: Missing data differentials

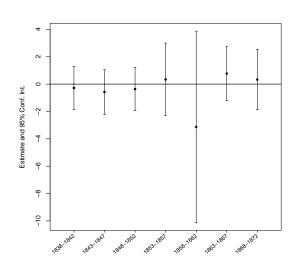
(a) Births, year fixed effects.



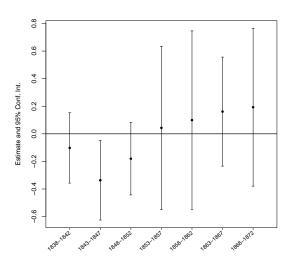
(c) Deaths, year fixed effects.



(b) Births, interactions between altitude and year fixed effects.



(d) Deaths, interactions between altitude and year fixed effects.



Notes: This Figure plots the results of regressions linking the percentage number of observations with missing data on grouped-year dummies. Regressions focus separately on birth and death records.

Table 3.A.2: Altitude, agricultural specialization, and population density, OLS.

	Husbandry animals above avg.		Population de	ensity (log.)
	(1)	(2)	(3)	(4)
Altitude (log.)	0.027 (0.197) [0.136]	0.374 (0.167)** [0.095]***	-1.204 $(0.301)^{***}$ $[0.282]^{***}$	-1.266 $(0.291)^{***}$ $[0.232]^{***}$
Geography	Yes	Yes	Yes	Yes
Muslim share	No	Yes	No	Yes
Population (log.)	No	Yes	No	No
Husbandry animals (log.)	No	No	Yes	Yes
Draft animals (log.)	Yes	Yes	Yes	Yes
Mahal	Yes	Yes	Yes	Yes
R^2	0.382	0.503	0.592	0.619
Observations	234	234	234	234

Notes: This table presents the results of regressions linking village altitude (measured in logarithm) and the probability of a village having an above-average number of husbandry animals in Columns 1–2; the expected number of husbandry animals in Columns 3–4; and population density in Columns 5–6. All columns follow an OLS model. Columns 1 and 3 control for the logarithm of the distance to the closest river, potential caloric yield, precipitation, evapotranspiration, maximum and minimum temperature. Columns 2 and 4 further include the share that Muslims represent and the logarithm of total population. Columns 5 and 6 are identical to Columns 3 and 4, except for the removal of the logarithm of total population. Columns 1–4 include the logarithm of the number of non-milk producing animals. All regressions include mahal (region) fixed effects. All columns present robust standard errors in brackets, and Conley standard errors in square brackets using a cut-off distance of 20 km. p < 0.1, ** p < 0.05, *** p < 0.01.

Table 3.A.3: Mortality regression results, OLS.

	Infant deat	Infant death, $(0/1)$		(log.)	
	(1)	(2)	(3)	(4)	
Altitude (log.)	-0.315 (0.063)*** [0.096]***	-0.289 (0.065)*** [0.105]***	1.086 (0.205)*** [0.253]***	1.111 (0.211)*** [0.267]***	
Geography	Yes	Yes	Yes	Yes	
Demography	No	Yes	No	Yes	
Animals	Yes	Yes	Yes	Yes	
Ind. controls	Yes	Yes	Yes	Yes	
Year	Yes	Yes	Yes	Yes	
Mahal	Yes	Yes	Yes	Yes	
R^2	0.072	0.072	0.069	0.069	
Observations	8909	8909	8420	8420	

Notes: This table presents the results of regressions linking village altitude (measured in logarithm) and the probability of dying before the age of five in columns 1–2 and the age at death for the entire population in Columns 3–4. All columns are estimated using an OLS model. Columns 1 and 3 control for the logarithm of the distance to the closest river, potential caloric yield, precipitation, evapotranspiration, maximum and minimum temperature. Columns 2 and 4 further include the share that Muslims represent and the logarithm of total population. Columns 1–4 include gender the logarithm of the number of certain types of animals. All regressions include mahal (region) fixed effects and year fixed effects. All columns present robust standard errors in brackets and Conley standard errors in square brackets using a cut-off distance of 20 km. * p < 0.1, ** p < 0.05, *** p < 0.01.

Table 3.A.4: Cause of death regression results, OLS.

	Resp. dis. (a	Resp. dis. (age ≤ 5) Resp. dis. (all sample)		Cont., non-res	Cont., non-resp. (age ≤ 5)		Cont., non-resp. (all sample)	
	(1)	(2)	(3)	(4)	(5)	(6)	$\overline{(7)}$	(8)
Altitude (log.)	-0.213 (0.081)*** [0.036]***	-0.216 (0.082)*** [0.066]***	-0.124 $(0.045)^{***}$ $[0.024]^{***}$	-0.096 (0.046)** [0.031]***	$ \begin{array}{c} -0.187 \\ (0.071)^{***} \\ [0.119] \end{array} $	-0.187 $(0.073)^{**}$ $[0.133]$	-0.245 (0.035)*** [0.097]**	-0.237 $(0.037)^{***}$ $[0.100]^{**}$
Geography	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Demography	No	Yes	No	Yes	No	Yes	No	Yes
Animals	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ind. controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mahal	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.125	0.127	0.072	0.073	0.164	0.165	0.110	0.110
Observations	3183	3183	8319	8319	3183	3183	8319	8319

Notes: This table presents the results of regressions relating village altitude (measured in logarithm) to the probability of dying of certain causes. Columns 1–4 focus on respiratory diseases, and Columns 5–8 focus on contagious, non-respiratory diseases. Columns 1–2 and 3–6 are estimated on a subsample consisting of children aged five years or less, while Columns 3–4 and 7–8 consider the entire population. All columns are estimated using an OLS model. Odd columns control for the logarithm of the distance to the closest river, potential caloric yield, precipitation, evapotranspiration, maximum and minimum temperature. Even columns further include the share that Muslims represent and the logarithm of total population. All columns include gender and the logarithm of the number of certain types of animals. All regressions include mahal (region) fixed effects and year fixed effects. All columns present robust standard errors in brackets and Conley standard errors in square brackets using a cut-off distance of 20 km. * p < 0.1, ** p < 0.05, *** p < 0.01.

Table 3.A.5: Human capital regression results.

	Entire sample		Male sar	nple	Female sample	
	(1)	(2)	(3)	(4)	(5)	(6)
Altitude (log.)	0.076 (0.020)*** [0.043]*	0.086 (0.020)*** [0.047]*	0.067 (0.020)*** [0.040]*	0.075 (0.020)*** [0.043]*	0.119 (0.360) [0.251]	0.384 (0.342) [0.204]*
Geography	Yes	Yes	Yes	Yes	Yes	Yes
Demography	No	Yes	No	Yes	No	Yes
Ind. controls	Yes	Yes	Yes	Yes	Yes	Yes
Mahal	Yes	Yes	Yes	Yes	Yes	Yes
R^2 Observations	0.017 8988	0.018 8988	0.012 8236	0.014 8236	0.027 754	0.034 754

Notes: This table presents the results of regressions relating village altitude (measured in logarithm) to numeracy skills, measured by the (inverse) probability of age heaping. Columns 1 and 2 focus on the whole sample, Columns 3 and 4 on men, and Columns 5 and 6 on women. All columns are estimated using an OLS model. Odd columns control for the logarithm of the distance to the closest river, potential caloric yield, precipitation, evapotranspiration, maximum and minimum temperature. Even columns further include the share that Muslims represent and the logarithm of total population. All columns include individual-level controls: age, its square, household size and the share women represent in each household. All regressions include mahal (region) fixed effects. All columns present robust standard errors in brackets and Conley standard errors in square brackets using a cut-off distance of 20 km. * p < 0.1, ** p < 0.05, *** p < 0.01.

Table 3.A.6: Election regression results, OLS.

	Number fem. candidates (log.)		Share fem. c	Share fem. candidates		% elected women	
	(1)	(2)	$\overline{\qquad (3)}$	(4)	(5)	(6)	
Altitude (log.)	-1.020 (0.359)*** [0.506]**	-1.084 (0.369)*** [0.500]**	-0.254 $(0.101)^{**}$ $[0.145]^{*}$	-0.319 $(0.105)^{***}$ $[0.140]^{**}$	-0.251 (0.108)** [0.129]*	$ \begin{array}{c} -0.316 \\ (0.115)^{**} \\ [0.132]^{**} \end{array} $	
Geography	Yes	Yes	Yes	Yes	Yes	Yes	
Demography	No	Yes	No	Yes	No	Yes	
Ind. controls	No	No	No	No	No	No	
Modern day	Yes	Yes	Yes	Yes	Yes	Yes	
Election Year	Yes	Yes	Yes	Yes	Yes	Yes	
Mahal	Yes	Yes	Yes	Yes	Yes	Yes	
R^2	0.214	0.213	0.182	0.206	0.197	0.215	
Observations	206	204	206	204	206	204	

Notes: This table presents the results of regressions relating village altitude (measured in logarithm) and female agency, proxied by electoral outcomes. Columns 1 and 2 focus on the number of female candidates, Columns 3 and 4 on the share they represent, and Columns 5 and 6 on the percentage of elected candidates that are women. All columns are estimated using an OLS model. Odd columns control for the logarithm of the distance to the closest river, potential caloric yield, precipitation, evapotranspiration, maximum and minimum temperature. Even columns further include the share that Muslims represent and the logarithm of total population. All columns control for the (logarithm) of the distance to Yerevan and the share the Yazidi ethnic minority represents. All regressions include mahal (region) fixed effects and election-year fixed effects. All columns present robust standard errors in brackets and Conley standard errors in square brackets using a cut-off distance of 20 km. * p < 0.1, ** p < 0.05, *** p < 0.01.

3.B Appendix: Using the ABCC Index as Outcome Variable

As discussed in the main text, our primary measure of basic numerical awareness relies on a binary indicator of age heaping, a fundamental proxy for human capital in the context of 19th-century Armenia. While this binary measure captures individual-level variation, and allows us to test our core hypothesis, it represents a simplification of the broader phenomenon of age heaping. To assess the robustness of our numeracy findings to an alternative, more nuanced measure of age heaping, this Appendix presents results using the ABCC index (A'Hearn et al., 2009). This index is computed at the village level and considers the share of individuals (aged 23 to 62) reporting their age as ending in either 0 or 5. Higher values of the index reveal more advanced numerical skills. To ensure consistency and comparability with our main numeracy regressions, we re-estimate Equation 3.10, replacing our binary numeracy indicator with the ABCC index as the dependent variable. These robustness checks control for the logarithm of the average age of individuals included in the ABCC index calculation, its square, the percentage of Muslims among those individuals, the townlevel sex ratio (overall), and the logarithm of the total town population (overall), where these minor adjustments reflect the different nature of the ABCC index and the population it is computed on. However, the very low number of observations prevents us from adding mahal fixed effects.⁵³

Table 3.B.9 presents the results of our robustness checks using the ABCC index as an alternative measure of individual-level numeracy. The table re-estimates the core relationship between altitude and numeracy, mirroring the specifications in our main analysis but replacing the binary numeracy indicator with the continuous ABCC age heaping index. Columns 1 and 3 include the logarithm of distance to the closest river, average individual-level controls (age and age-squared of those in ABCC calculation), and town sex ratio as controls while Columns 2 and 4 expand the controls to include village-level characteristics: the share of Muslims and the logarithm of total population. Across both columns, we observe a positive coefficient on log altitude, indicating that higher altitude is associated with a higher ABCC index. Crucially, because a higher ABCC index signifies higher numeracy, this positive coefficient on altitude for the ABCC index implies, consistently with our main results, that higher altitude is linked to improved numerical skills (less age heaping). Columns 1–2 use the whole sample. However, because the ABCC index is an average, it is inherently noisy when the sampled population is small. For this reason, Columns 3–4 exclude villages with

 $^{^{53}}$ There are roughly 20 villages within each mahal.

Table 3.A.7: Marriage regression results, OLS.

	Spousal age gap		
	(1)	(2)	
Altitude (log.)	0.051	0.055	
	$(0.012)^{***}$	$(0.012)^{**}$	
	$[0.008]^{***}$	$[0.006]^{***}$	
Geography	Yes	Yes	
Demography	No	Yes	
Year	Yes	Yes	
Mahal	Yes	Yes	
R^2	0.248	0.250	
Observations	6965	6926	

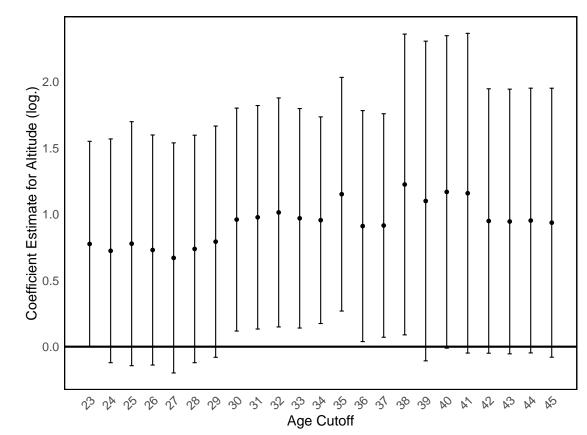
Notes: This table presents the results of regressions relating village altitude (measured in logarithm) to marriage age outcomes. Columns 1 and 2 focus on the spousal age gap, Columns 3 and 4 on the wife's age at marriage, and Columns 5 and 6 on the groom's age at marriage. All columns are estimated using an OLS model. Odd columns control for the logarithm of the distance to the closest river, potential caloric yield, precipitation, evapotranspiration, maximum and minimum temperature. Even columns further include the share that Muslims represent and the logarithm of total population. All regressions include mahal (region) fixed effects and year fixed effects. All columns present robust standard errors in brackets and Conley standard errors in square brackets using a cut-off distance of 20 km. *p < 0.1, **p < 0.05, ***p < 0.01.

Table 3.A.8: Occupation, OLS.

	% Craftsmen		
	(1)	(2)	
Altitude (log.)	0.021	0.008	
	(0.018)	(0.015)	
	[0.028]	[0.023]	
Geography	Yes	Yes	
Demography	No	Yes	
Animals	Yes	Yes	
Mahal	Yes	Yes	
R^2	0.389	0.565	
Observations	234	234	

Notes: This table presents the results of regressions relating village altitude (measured in logarithm) to the presence of craftsmen. Columns 1 and 2 consider the number of craftsmen in a village, e whereas Columns 3 and 4 their percentual representativeness. All columns follow an OLS model. Odd columns control for the logarithm of the distance to the closest river, potential caloric yield, precipitation, evapotranspiration, maximum and minimum temperature. Even columns further include the share that Muslims represent and the logarithm of total population. All regressions include mahal (region) fixed effects. All columns present robust standard errors in brackets and Conley standard errors in square brackets using a cut-off distance of 20 km. * p < 0.1, ** p < 0.05, *** p < 0.01.

Figure 3.A.2: Human capital regression results: sub-samples by age



Notes: This figure represents the coefficient on the logarithm of altitude when estimating Equation 3.10 on the sub-sample of individuals aged 23-62 while trimming the lower bound from 23 to 45. The regressions follow those in Column 2 of Table 3.5.

Table 3.B.9: Human capital regression results.

	ABCC in	ndex	ABCC index, v	illage pop. > 20
	(1)	(2)	(3)	(4)
Altitude (log.)	10.158	7.219	9.856	9.886
	$(4.500)^{**}$	$(4.017)^*$	$(3.312)^{***}$	$(3.524)^{***}$
	[2.812]***	[5.447]	$[4.255]^{**}$	[4.659]**
Geography	Yes	Yes	Yes	Yes
Demography	No	Yes	No	Yes
Avg. individual	Yes	Yes	Yes	Yes
R^2	0.089	0.108	0.186	0.195
Observations	137	137	129	129

Notes: This table presents the results of regressions relating village altitude (measured in logarithms) to the ABCC index, a proxy for village-level numeracy skills. All columns follow an OLS model. Column 1 includes controls for the logarithm of the distance to the closest river, potential caloric yield, precipitation, evapotranspiration, maximum and minimum temperatureand individual-level variables averaged at the village level: age, its square, and the sex ratio. Column 2 further includes the share that Muslims represent and the logarithm of total population. All columns present robust standard errors in brackets and Conley standard errors in square brackets using a cut-off distance of 20 km. *p < 0.1, **p < 0.05, **** p < 0.01.

less than 20 inhabitants.

The results show a positive coefficient on altitude across specifications, which is also statistically significant once we remove small villages in Columns 3 and 4. This indicates that, similar to our main findings using a binary numeracy measure, higher altitude is associated with less age heaping, suggesting improved basic numerical skills.

3.C Appendix: Robustness Checks for Mortality Analysis

To further assess the robustness of our mortality findings, we conducted several sensitivity checks analyzing alternative mortality outcomes. The results of these checks are presented in Table 3.C.10 in this Appendix.

Other death causes. First, we examine mortality from "other causes"—a residual category encompassing deaths not attributed to contagious diseases nor old age. If our finding of lower overall mortality at higher altitudes is robust, and specifically driven by reductions in contagious diseases, we would expect to see a higher proportion of deaths at higher altitudes

classified as "other causes". This is simply because if deaths from contagious diseases are reduced, then deaths from other causes, which are presumably less affected by altitude, will naturally constitute a larger share of the remaining mortality. Table 3.C.10, Columns 1 and 2, present the analysis with the probability of dying from "other causes" as the dependent variable.

Old age. Second, we investigate the reporting of "old age" as a cause of death. A potential concern with historical cause-of-death data is differential reporting bias. If, at higher altitudes, record keepers were systematically more likely to attribute deaths to "old age"—perhaps due to less precise diagnoses or different cultural norms—this could confound our cause-specific mortality analysis. If "old age" was simply a more common label for death at higher altitudes, irrespective of the actual cause, it would cast doubt on the validity of our findings for respiratory and other contagious diseases. To assess this potential bias, we analyze the relationship between altitude and the probability of death being attributed to "old age". Columns 3–4 of Table 3.C.10 present the results for this outcome. Crucially, we expect to find no statistically significant relationship between altitude and the probability of death being attributed to "old age".

Mortality at birth. Third, we conduct a placebo test by examining mortality recorded as occurring "at birth" or very shortly thereafter. Infant deaths in the immediate neonatal period are highly unlikely to be caused by contagious diseases transmitted through airborne or other environmental pathways, as newborns would not yet have been exposed to these pathogens. Deaths at birth are more likely due to congenital conditions, birth complications, or maternal health issues, factors that are not directly linked to population density or airborne disease transmission. Therefore, we should *not* expect altitude to have a significant effect on mortality "at birth" if our primary mechanism is indeed related to reduced contagious disease burden at higher altitudes. Observing a significant effect of altitude on mortality "at birth" would suggest that some other, unobserved factor correlated with altitude is driving general mortality differences rather than the specific mechanism we propose. Table 3.C.10, Columns 5–6, present the results for the probability of death "at birth".

Table 3.C.10: Robustness checks for mortality analysis.

	Other causes (Other causes (exc. old age)		Old age		Died at birth (age ≤ 5)	
	(1)	(2)	(3)	(4)	(5)	(6)	
Altitude (log.)	2.112 (0.183)*** [0.418]***	2.071 (0.187)*** [0.250]***	0.407 (0.672) [0.732]	1.002 (0.906) [1.025]	-0.028 (0.008)*** [0.033]	$ \begin{array}{c} -0.028 \\ (0.008)^{***} \\ [0.031] \end{array} $	
Geography	Yes	Yes	Yes	Yes	Yes	Yes	
Demography	No	Yes	No	Yes	No	Yes	
Animals	Yes	Yes	Yes	Yes	Yes	Yes	
Ind. controls	Yes	Yes	Yes	Yes	Yes	Yes	
Year	Yes	Yes	Yes	Yes	Yes	Yes	
Mahal	Yes	Yes	Yes	Yes	Yes	Yes	
R^2	0.068	0.070	0.331	0.336	0.059	0.059	
Observations	8316	8316	7494	7494	3183	3183	

Notes: This table presents the results of regressions relating village altitude (measured in logarithm) to the probability of dying of certain causes. Columns 1 and 2 focus on causes other than respiratory, contagious non-respiratory diseases and old age. Columns 3 and 4 focus on cases reported as dying of old age. Columns 5 and 6 use death at birth, focusing on the subsample of children died at birth. All columns are estimated using a probit model. Odd columns control for the logarithm of the distance to the closest river, potential caloric yield, precipitation, evapotranspiration, maximum and minimum temperature. Even columns further include the share that Muslims represent and the logarithm of total population. All columns include a control for gender. All regressions include mahal (region) fixed effects and year fixed effects. All columns present robust standard errors in brackets and Conley standard errors in square brackets using a cut-off distance of 20 km. * p < 0.1, ** p < 0.05, *** p < 0.01.

3.D Migration

A potential concern is that the observed patterns of child mortality and numeracy by altitude might be confounded by migration. In particular, if individuals from higher altitudes disproportionately migrated to cities (e.g., following integration into the Russian Empire) or if selective migration occurred (more capable individuals leaving or arriving), this could bias the results.

To address this concern, we constructed a measure of migration at the village level. Specifically, for each individual record of death in a given village, we checked whether their recorded place of birth was the same village. The match is based on the gender and birth year. If we did not find the corresponding birth in the given village, we classified this as an incoming migrant.

Then, for each village, we calculated the total count of such incoming migrants and the share of migrants relative to the village's population in 1831. To assess whether migration systematically differed across altitudes, we regressed this migration share on village altitude, controlling for walking time to the capital Yerevan (log).

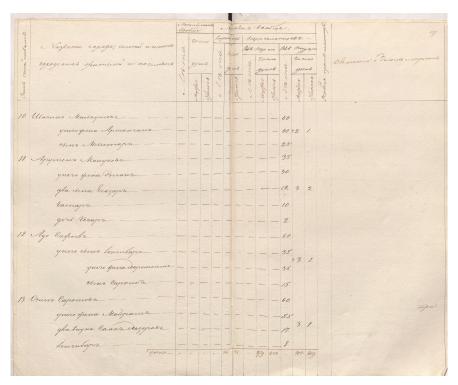
The results are presented in Table 3.D.11 below. Across specifications, there is no statistically significant relationship between altitude and the share of migrants, suggesting that migration patterns do not differ systematically across altitudes. This alleviates concerns that selective migration drives the observed relationships between altitude, child mortality, and numeracy.

Table 3.D.11: Differential migration across altitude.

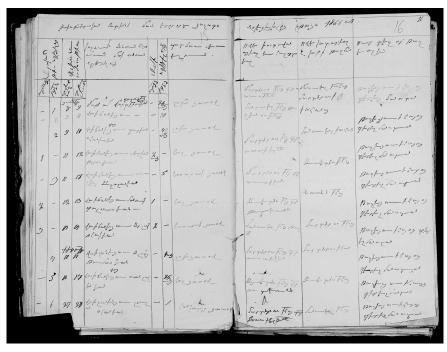
	Migration	n absolute	Migrati	on share
	(1)	(2)	$\overline{(3)}$	(4)
Altitude (log)	-0.883	0.210	0.018	0.013
	(2.323)	(2.492)	(0.021)	(0.025)
	[4.890]	[2.711]	[0.018]	[0.015]
Demography	Yes	Yes	Yes	Yes
Geography	No	Yes	No	Yes
Time to capital	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Mahal	Yes	Yes	Yes	Yes
R^2	0.387	0.398	0.410	0.417
Observations	1000	1000	1000	1000

Notes: This table presents the results of OLS regressions relating village altitude (measured in logarithm) to migration. Columns 1 and 2 consider the absolute number of immigrants in a village, whereas Columns 3 and 4 are their percentual representativeness relative to the 1831 population. All regressions include mahal (region) fixed effects, year fixed effect, traveling time to the capital Yerevan (log), demographic variables (the share that Muslims represent and the logarithm of total population). Odd columns control for the logarithm of the distance to the closest river, potential caloric yield, precipitation, evapotranspiration, maximum and minimum temperature. All columns present robust standard errors in brackets and Conley standard errors in square brackets using a cut-off distance of 20 km. * p < 0.1, ** p < 0.05, *** p < 0.01.

3.E Appendix: Data



(a) Page from 1831 Census



(b) Page from Armenian Parish records on deaths

Figure 3.E.3: Archive data samples

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