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Colonial Military Conscription in French West Africa

Zhexun Fred Mo

JEL Codes: N37, O12, P48

Keywords: Economic History; Colonial Institutions; Military Conscription; Volunteers; Informal Insurance; French West Africa; Direct Rule.



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December 9, 2019

Abstract

Among a set of extractive institutions particularly set up by colonial powers themselves, military conscription has been understudied to this day. In this paper, I attempt to delve deeper into this important historical institution in French West Africa (FWA) during the interwar era (1920-1939). First of all, I find that when the conscription target stipulated by higher colonial officials increased, strikingly the lower district-level authorities were not complying with this figure faithfully, even when they complied, the target increase was only met by a dubious increase in “deemed fit” soldiers in regions where labor constraints were already running high. Such findings point to a more complex French colonial rule in West Africa where authorities were “fighting over” the scarce resource of labor. Secondly, I find that in times of negative income shocks, potential flooding events in tropical regions of FWA made individuals more likely to volunteering into the army and correspondingly, an increase in drought risk in arid Sahel regions of FWA also made the indigenous more likely to present themselves to the military. Both effects point to the fact that the conscription system was being exploited as an informal insurance device by the locals at a time when insurance institutions were lacking and weather-induced negative agricultural income shocks were frequent. ¹

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1 Introduction

"The Black Troops represent African civilization reborn, and constitute our crowning achievement."

Charles Mangin (1910)

On November 8th, 2019, as part of the centenary commemoration for the end of the First World War, French president Emmanuel Macron and his Malian counterpart Ibrahim Boubacar Keïta inaugurated the re-launching of the monument dedicated to the heroes of the "Black Army" (le Monument aux héros de l'Armée noire) who served for the French military during the World Wars, in Reims, France. While on the other hand, during the same month, the Senegalese ambassador to Moscow, Abdou Salam Diallo, expressed his dissatisfaction with the disparity in terms of treatment between the French and African war veterans, both of who served as integral parts for the French Army during the two World Wars. He further accused the French government of the still-existent inequities endured by the African French army veterans in terms of pension allowances.

Such contrasting events delineate the relevance as well as significance on the rather controversial, and often emotion-ridden issue of such a black African army who served diligently for France even till this day. Specifically, this black army, often referred to in French as "*Tirailleurs Sénégalais*" (in English "Senegalese Riflemen") were indigenous African young males conscripted into the French army throughout the entire French colonial rule across continental Africa.

Rather self-evidently, the colonial military conscription system is an extremely important extractive institution for colonial French authorities. As first of all, in sheer numbers, for the First World War alone, it levied over 170,000 soldiers across the entire French West Africa and over 30,000 of them were sacrificed during this Great War (M. J. Echenberg, 1991), let alone the more consistent drainage of local prime-age male labor for more than two decades during the inter-war period and the same extreme war-time levy that ensued during the Second World War.

However, in the historical political economy literature on Africa, especially the literature that centers around colonial institutions, the military conscription system in Africa has been substantially understudied. The past literature has mainly focused on other types of "short-term" and more drastically "extractive" institutions "at first glance", such as colonial territories concessioned by the colonizers to

private companies (Lowe & Montero, 2016), specific institutional set-up due to the particularities of British indirect “native rule” (Acemoglu et al., 2014), or the more general “arbitrary border division” initiated by colonizers towards the entire continent (Michalopoulos & Papaioannou, 2016). Therefore, the first-order motivation of research for this paper is to tap into the black box of a both historically and contemporarily relevant colonial institution: the military conscription system in the context of French West Africa (FWA).

In this paper, instead of trying to answer the grand question on what the long-run historical effects of military conscription are in FWA, I will take the first step to evaluate the colonial-time functioning of this intricate system, on the one hand on how it informs the ruling patterns inside the top-down French administrative system, and on the other hand about how it might have significantly affected the living conditions of the indigenous, especially in times of historical economic difficulties.

By employing the district-level conscription data during the interwar period (1920-1938) in FWA, firstly, in terms of administrative layouts, I find that when the local districts were required to supply more military conscripts in a given year by higher-ranked colonial officials, the district administrators would only comply with this increased recruitment quota 30% of the time and even when they complied, the increase in ultimate recruits mainly stemmed from an increase in the individuals “deemed fit” in regions with high existing labor constraints, hence potentially soldiers with worse health conditions were supplied to the French military, which was contrary to the initial objective of the colony officials who had intended to uncompromisingly increase the size of the army. Such results inform the rather drastic competing interests among French officials of varying ranks over one of the most important resources in colonial Africa: the ubiquitous “scarcity” of labor across the entire continent.

Second of all, even more strikingly, when extreme positive rainfall deviations and negative temperature shocks struck, hence the risks of flooding were running high in the tropical regions of FWA, the indigenous would subjectively volunteer more to the military. Correspondingly, when the risks of droughts were running high in arid Sahel regions of FWA with negative rainfall deviations, the individuals would present themselves more frequently to the conscription centers. Such results can be most adequately explained with a negative agricultural income channel at play between weather shocks and the subjective initiative for military participation, where the indigenous opted for the seemingly “extractive” institution out of “informal insurance” objectives.

The main findings in this paper pave the way for future research on French military conscription systems in Africa. Given that the conscription system played a rather “fortuitous”, yet historically relevant role of “informal insurance” for the indigenous in times of economic difficulties, as well as serving as an important predictor for the intricate administrative structures of direct French colonial rule, it would be all the more interesting to understand how the military conscription system, henceforth, affected the post-colonial administrative structures in independent French West African states and if there’s any further historically persistent developmental repercussions of the conscription system till this day.

The remainder of the paper would be organized as the following. Section 2 would give a broad overview of the literature concerning this paper’s research; Section 3 describes the historical background of military conscription; Section 4 presents the theoretical hypotheses of the research questions; Section 5 describes the data and main empirical strategies; Section 6 provides the summary statistics; Section 7 presents the main results; Section 8 performs a few robustness checks; Section 9 gives a discussion of the results and future research orientations; And section 10 concludes.

2 Literature Review and Contributions to the Literature

The contributions to the literature from this paper could be multi-fold. First of all, this paper contributes to better understanding the functional intricacies of extractive colonial institutions, and in this particular case, the French colonial military conscription system in West Africa.

The general literature on colonial institutions has started with an exclusive focus on the long-term developmental impacts of various institutions put in place during colonial times, often at a rather grand and macro cross-country level (Engerman & Sokoloff, 1997; Acemoglu et al., 2001, 2002, 2005), where the proclaimed causal inference might be a bit strenuous to grab given other deep underlying factors at play. The more recent literature has attempted to identify causal developmental impacts of institutions at the more refined local level within a specific geographical region where the deep cultural, geographical or other long-lasting determinants seem to be more or less held constant, such as the focus on French West Africa (Huillery, 2009), the British Raj of India (Banerjee & Iyer, 2005), Spanish exploitative mining regimes in current-day Peru (Dell, 2010) or simply a specific type of “local institution” of very extractive nature and put in place for a rather short period of time during

colonial years, such as colonial concessions (Lowe & Montero, 2016), the native chief rule instituted by the British in Sierra Leone (Acemoglu et al., 2014) and colonial oppression episodes in Madagascar (Garcia Ponce & Wantchekon, 2011).

Indeed, the historical and contemporary relevance on the inquiry for long-term developmental outcomes is undoubtedly valid, but such long-run repercussion analyses, nonetheless require very careful close-up scrutiny at the potential diverging or reversing historical impacts of the institutional layout under study in different important historical junctures throughout space and time.

As such, before jumping towards a grand conclusion on how colonial institutions significantly affected the living conditions of the indigenous in contemporary times, rather first and foremost, it might be equally important to comprehend how these institutions most effectively affected the organization of daily lives back during the colonial years and if such impacts during the colonial years served as stimulants or hindrance for further development bifurcations for the regions mostly affected by such ruling. Such inquiries have largely escaped the attention of most economic historians of development until very recently, in further trying to understand the role played by forced labor institutions during colonial times on colonial expenditure capacities, Van Waijenburg (2018) found an enormous contribution of the forced labor "corvée" system to colonial fiscal capacities in French African colonies. Similarly, by exploiting colonial data on the extensive extraction of convict labor for public works projects in British Nigeria, Archibong and Obikili (2019) identified that the share of convict labor made up of a substantial share of the total public works expenditures at the time.

In this sense, this paper also tries to evaluate, in the first place, the historical relevance of the military conscription system in French West Africa, on how it might have served to influence the living patterns of the indigenous Africans or the administrative structures of the French colonial authorities back then, and such research can be further seen as an important building block for the subsequent and more extensive analysis of the medium- or long-term repercussions of colonial military conscription in Africa.

Additionally, this paper also speaks to the vast literature on exploring the administrative complexities of the French direct colonial rule. The current literature started with a focus on the differential long-term developmental impacts between the direct French colonial rule and the indirect British colonial rule, starting with the seminal research from La Porta et al. (1997) and Porta et al. (1998) where the

authors evaluated the long-term investment repercussions of French-civil-law versus British-common-law systems, to the more recent focus on ethnicity identification (Ali et al., 2018) or ethnic conflict consequences (Wucherpfennig et al., 2016) due to the differential inclusion versus exclusion ethnic politics during colonial times. However, starting from very early on, the literature has already emphasized the great within-heterogeneities in colonial rule in French and British colonies respectively (Crowder, 1964; Berry, 1992). More recently, Frankema and Van Waijenburg (2014) explored how the colonial authorities in Africa adopted varying ruling strategies to cope with heterogeneous local ruling difficulties due to local factors such as geography, population density, etc. For instance, they explored how the German adopted both direct and indirect rules in Namibia and how the Portuguese colonizers applied both direct rules and concession policies to private companies depending on various geographical regions in Mozambique in the 19th century. The same has been observed by Cogneau et al. (2018) where they emphasized the second French colonial empire's adaptive ruling capacities towards differing socioeconomic and historical contexts.

For colonial rule in French West Africa, a lot of the past research in the economics literature has focused on the rather "omnipotent" role played by the local district-level administrators in influencing investments in public goods such as education and health expenditures that displayed striking long-term persistence (Huillery, 2009; Cai, 2015; Dray, 2016). For the analyses conducted in this paper, instead of excessively focusing on the seemingly decisive role of district administrators, which may be subject to debate, I tried to look more into how the interaction between French colonial officials of different ranks took place via the military conscription system. Such research contributes to a potential better understanding of certain mal-functioning and inefficiencies associated with the stringent top-down French colonial rules in FWA.

Furthermore, this paper also contributes to the rather scarce literature on various informal insurance mechanisms exploited by indigenous people in historical or colonial settings. Blouin (2016) explored how the arrival of the Belgian colonizers destroyed the precolonial insurance institution existent between the Hutus and Tutsis in Rwanda and the newly institutionalized forced labor system during the colonial times might have ultimately undermined the inter-ethnic trust cemented over the years via the informal insurance device. In the same vein, it could be equally conceived that similar ancient insurance structures might have been wiped away along the conquest of West Africa by the

French Army. While on the other hand, extreme economic adversity and the lack of guarantee for subsistence survival might have further propelled the indigenous people to exploit seemingly “extractive colonial institutions” to their own advantage as a potential shelter and insurance of last resort. Such an exploration is particularly interesting because there’s rather scant research on how historically colonial or other oppressed subjects “subjectively” opted for such extractive institutions for the benefits of themselves.

3 Background

3.1 Historical background

The term *Tirailleurs Sénégalais* (in English “Senegalese Riflemen”) was first coined by the then-General Governor of French West Africa Louis Faidherbe in 1857, to refer to the first permanent unit of black Senegalese soldiers recruited by him into the French Army. Ever since then, this term has been generalized and adopted as an all-encompassing appellation for the section of the colonial French Army composed of indigenous black African recruits, either they were conscripted from French West Africa or French Equatorial Africa.

In actuality, the history of recruiting indigenous Africans into the French Army preceded this first creation of a permanent unit by Governor Faidherbe. As early as the 1820s, a small Bataillon d’Afrique of a few hundred recruits had already been formed in Senegal during the initial years of the post-Napoleonic era (de Boisboissel, 1931). Throughout the 19th century, the recruitment of African soldiers more or less followed a “Slaves into Soldiers” principle, sustained by the scandalous Rachat system, where the French Army repurchased slaves from the slave-owning masters at discounted rates (Zuccarelli, 1962), or its variants in the post-slavery era, such as payment of enlistment bonuses to the previous slave masters (Renault, 1972) or incorporation of prisoners-of-war and porters, etc.

Such a slave-mercenary-based conquest army was partially transformed into a more regular institution with incorporation of soldiers from all walks of life after the institutionalization of the civilian rule of French West Africa in 1905. It was also the time when this entire system of *Tirailleurs Sénégalais* witnessed its largest spike in terms of recruits ever since its creation. At the time, the French colonial authorities quickly realized that they needed more military men to guard the newly-conquered

territory than to conquer them in the first place (M. J. Echenberg, 1991, p. 25). As such, a partial conscription law was put in place in 1912 and subsequently this law successfully incorporated an astounding figure of 170,000 black indigenous Africans to have served in the French Army during the First World War.

The First World War fundamentally changed the entire institution of *Tirailleurs Sénégalais* forever. Although there was a lot of post-war debate on how the recruitment system should be sustained or reformed, ultimately the French colonial authorities decided to formerly institute the wartime recruitment system by introducing a universal peacetime conscription system in French West Africa in 1919. Henceforth, such conscription patterns as stipulated by the universal law sustained until the breakout of Second World War, when the war-time special conscription scheme predominated again. After the Second World War, the purpose of the conscription system was fundamentally altered as it was professionalized, with a significant increase in fitness standards and incorporation of soldiers from local military schools.

The ultimate decision to maintain a conscription army during the peacetime years was one that was going to most profoundly influence the living patterns of the indigenous as well as military colonial rule in the region. Although the two World Wars seemingly levied an enormous number of indigenous Africans in sheer numbers, it needs to be taken into account that the peacetime conscription system continuously lasted for a period of more than two decades and its ultimate total levy on the most-able local young males far exceeded the toll exacted by the two World Wars. This would also be the sample period of interest for the key analyses conducted in this paper, during the period of which the functional complexities inside the French colonial administrative hierarchy with regard to military conscription, and the indigenous people's behavioral responses towards this seemingly "extractive system" would be duly explored.

3.2 The administrative organization of French West Africa (FWA)

Before moving forward to the detailed depiction of the peacetime conscription system, it's important to bear in mind the overall administrative structure of the entire FWA, which is the focus for the empirical analysis of this paper.

As can be seen from Figure 1, French West Africa (FWA) was a federation of eight former French

colonies, namely Senegal, Cote d'Ivoire, Guinea, Niger, French Sudan (current-day Mali), Dahomey (current-day Benin) and Upper Volta (current-day Burkina Faso). It straddles across a vast and diverse territory with more than 4,800,000 square kilometers in size (roughly twice the size of modern-day Algeria, or eight times the size of metropolitan France) with extremely low population densities, as it's been estimated that in 1910 the region was inhabited by only around 12 million people.

Colonial French West Africa (*Afrique Occidentale Française*) as a federation was officially created in 1895 and the civilian government was established in 1904. Although the major military conquests were over by this time, civilian administration only gradually became effective across the entire FWA from the early 1900s till 1920s, with it taking the longest for geographically remote districts such as those of Mauritania, etc (Huillery, 2009). This also mirrored the period of time when the *Tirailleurs Sénégalais* witnessed its first major rise in recruitment, mainly for consolidating the colonial rule over the conquered regions and for soldier supply of the upcoming First World War. Hence on the whole, the period between 1904 and 1920 could be more or less regarded as an "adjustment period" of FWA where the colonial ruling both in terms of military prestige and civilian administration gradually established a firm basis for the forthcoming peacetime era (1920-1938).

The structure of the colonial administration of FWA was argued to be stringently pyramidal: At the head of the federation we have the general governor (*gouverneur général*), who is followed by the lieutenant governors at the colony level (*lieutenant-gouverneur*) and ultimately, the administrators (*administrateur or commandant de cercle*) were the rulers of the respective districts within each given colony.

Hence, on the paper, FWA seemed to be an officially and strictly centralized regime. Yet there has been ample anecdotal historical evidence suggesting that the district administrators possessed the real powers in deciding the arrangements of the major daily activities at the local level. Some historians even went so far as to claim that the administrators were the "real rulers of the French Empire" (Delavignette, 1939) by being "omnipotent and omnipresent" (El Mechat, 2009). Indeed, the district administrators were in charge of a series important tasks such as taking charge of tax collection, assisting in military conscription work, overseeing local public investment projects in terms of infrastructure construction, health and education expenditures, etc. It's been argued that it was potentially the large geographical distance in the immense FWA region as well as the lack of communication means at the

time that contributed to the rather omnipotent local power capacities of the administrators (Cohen et al., 1973).

3.3 The stringent “top-down” approach of peacetime conscription

Hence, it is against this backdrop of the colonial FWA administrative system that the peacetime conscription system was carried out. Unsurprisingly, on the surface, the peacetime military conscription system was reputed to be a strictly “top-down” operational process. To start with, every autumn, the minister of defense in Paris would indicate the number of *Tirailleurs Sénégalais* required to be recruited for the entirety of French West Africa. Subsequently, this number was sent to the cabinet of French government for approval. Once this annual quota was accepted, it purportedly became “immutable” and was sent to the General Governor (head of all French West African colonies) in Dakar, Senegal for actual execution of the conscription. The General Governor would then distribute the quotas to the eight colonies following a fixed formula developed over the years with some regard to the population distribution across the colonies. Henceforth, the Lieutenant-Governor (head of a particular colony) would further divide the received colony-level quota into district-specific conscription targets and sent them to district administrators for the ultimate and actual fulfilment of military conscription at this most dis-aggregate administrative level, which is also the level of analysis for this paper.

Around the month of December or January in the following year, after having received the fixed recruitment quota, the district administrators would start to make an enumeration list of indigenous young males, who were regarded as potential recruits for the district in that given year. This process was usually carried out with the assistance of the local chiefs (who might have more knowledge of the distribution of population at the local level) or with available population census lists.

Subsequently, the actual military conscription took place in the form of a mobile drafting commission board (committee) that moved from one district to another to carry out the recruitment procedures. Such a drafting commission board was usually composed of one French army officer (the chairman of the committee), the district administrator (second to the army officer), two clerks (one from the military and the other from the civilian administration) and one military physician (in charge of medical examination for the potential recruits). The enumerated soldiers would then be called upon in their residential villages or towns to travel to the drafting centers in their own district for medical

examination. It was at this point in time that a certain proportion of the enumerated individuals would choose to escape from the conscription calls and some even went so far as to flee away from their residential districts to evade the search from the military authorities.

The individuals who were “present” would then receive medical examinations to be determined whether they were fit for the military or not. The standards of such medical examinations could be left to much speculation, but what needs to be emphasized is that at the end of the day, the number of “fit” out of all the present individuals is at best a “deemed fit” measure, not necessarily reflecting the true health conditions of the potential recruits. As such, the “deemed fit” measure could be largely subject to endogenous manipulation of the drafting board officers given potential changes in the recruitment process that might require them to do so. Subsequently, among the soldiers who were deemed fit, the drafting committee first asked who would “volunteer” to join the army and these volunteers were then directly recruited as “first portion” of the army. Among the rest, according to the official target (quota) for this year’s recruits, the committee would perform a lottery to recruit a portion of the remaining soldiers, who would join the previous volunteered soldiers and the two together would constitute the overall “first-portion” soldiers. Ultimately, the remaining fit soldiers who were left out of the lottery would form the “second portion”, also known as “military reservists”, who might be activated in times of urgent needs, such as the two World Wars, etc.

4 Theoretical Hypotheses

In this paper, I do not attempt to answer the overarching question on what fundamentally motivated the indigenous Africans to join the French military, or to dissect the intricate interplay of various factions of power inside the colonial administration to further determine the observed conscription patterns. Instead, I will try to answer a few relevant questions along similar research agenda and within the available data structure at hand as described below.

4.1 Maneuver of conscription from the colonial authorities

The maneuver of military conscription from the colonial authorities’ perspective could be regarded as a simple three-dimension (non-) cooperative game among three principal agents: the local African chiefs, the French military officers and the French civilian district administrators.

As previously mentioned, the civilian district administrators often required (crucial) assistance from the local chiefs in drafting up the enumeration list with “recruitable” and “identifiable” indigenous Africans. The chiefs hence purportedly faced a dilemma between serving for the French authorities (in the case of which they would usually be provided with financial incentives, such as salaries for being hired to perform certain tasks) or playing favorites for their own people at the local level, where they might also want to keep the most-able young males as labor force for themselves.

On the other hand, even within the French colonial authorities themselves, there could be competing interests between the civilian administrators and the military officers regarding the conscription procedures. The district administrators might themselves have preferred to keep the best prime-age labor for local exploitation either in large-scale local cash crop plantations or other construction of public infrastructure projects, in the objective of principally contributing to local welfare. In the same vein, they could also have preferred to keep the best labor locally in order to appease potential tension with the local chiefs.

Such competing interests are made more likely to result in a strategic maneuver of the recruitment procedure, further given the fact that on the one hand, the “mobile” nature of the drafting board required the military officers to travel across several districts to conduct the recruitment procedures at a rather high frequency. This renders it rather impractical for them to obtain thorough knowledge of the recruitment landscape at the local level. Such a reality concerning the actual conscription procedure was vividly documented by [M. J. Echenberg](#) (1991, p. 251):

“The army officer, the physician and one clerk would have to visit perhaps ten to fifteen cercles in the colony when recruitment took place. Only the civilian component of the drafting board had some continuity and knowledge of the local demography, etc.”

While on the other hand, nonetheless, the district administrators and the local chiefs possessed more specific knowledge of the recruitment capacities of their own regions and hence had more room for manipulating, if not the “quantity”, the “quality” of the potential recruits at the local level than an officer who came in only for the week to conduct the draft board hearings.

Therefore, although the conscription procedure was on paper supposed to be a strictly “top-down” procedure, as the most conventional kind of direct-ruling French colonial institution was purported to be, there are ample rationales to believe that there are more administrative and functional intricacies

within these seemingly pyramidal colonial institutions.

Although the data available wouldn't allow me to capture the exact magnitude of the respective roles played by either the military or civilian officials (or local chiefs) on influencing the conscription outcomes such as volunteering or present rates, or how the competition for prime-age male labor exactly played out between the three parties, one plausible arena where such functional intricacies could be explored is how the lower-ranked colonial officials were adjusting or reacting towards a change in the recruitment target as stipulated by the colony-level administrative officers.

Specifically, the annual recruitment to be fulfilled at the district level is detailed in equation (1), where it could be seen that the target number to be fulfilled in district i , colony c in a given year t could be influenced at various stages of the district-level conscription procedure, specifically when the enumeration list was being drawn, when the enlisted indigenous Africans showed up to the conscription centers (where present rate could be calculated), then at the moment when the medical examinations took place (fitness rate hence determined) and ultimately while a lottery was proceeded to determine who among the "judged fit" would be recruited as first portion into the conscription army.

$$TargetFulfilled_{ict} = Enumeration_{ict} * Presentrate_{ict} * Fitnessrate_{ict} * Lotteryrate_{ict} \quad (1)$$

If we believe that at least in terms of the "quantity" of the targets, it is rather hard for the district administrators to not comply with the stipulated figure as prescribed by his colony-level superiors ² then rather intuitively, a given change in the recruitment target could henceforth be fulfilled via adjustment at any of the four stages of district-level conscription procedure so as previously described.

To a certain extent, it seems rather self-evident that if the district administrators were simply following the rules from their colonial superiors, they could either enumerate more soldiers or negotiate with the military personnel to adjust the lottery rate upward in order to fulfil a simple increase in the recruitment quota. On the other hand, however, if competing interests for local labor were already "salient", or the constraint for supplying prime-age local male labor to the military was already running high in a given district (such that labor scarcity was a real concern for local district development), then a further increase in the recruitment target might propel the district administrators to

²This is in itself an assumption and needs to be empirically tested in the following.

make recruiting adjustments against the initial intentions of the military recruiters, such as negotiating to endogenously relax the medical examination standards to ensure that there's a larger base of "deemed fit" Africans to recruit the "first portion" from. Empirically, we would observe an endogenous rise in the fitness rate, or the absolute number of people "deemed fit" for such an increase in such recruitment quota. If the above underlying channel was indeed at play, although the expected increase in the number of soldiers ultimately recruited would still be realised, there's a higher probability that this new group of soldiers might ultimately display lower average health conditions than the cohort of soldiers conscripted in normal years without such an increase in the recruitment target.

From a historical point of view, there's already certain anecdotal historical evidence suggesting that the fitness rate was a rather constant target to be strategically manipulated with, as the suspicion echoed by [M. J. Echenberg \(1991\)](#) p. 58) goes:

"... Such astonishingly low fitness numbers invite some speculation. Did civilian authorities insist upon totally unrealistic medical standards in order to keep the number of soldiers down? ..."

All being said, an increase in the "deemed fitness rate" following a recruitment quota rise may not necessarily indicate that the lower-ranked officials were more likely to hide the best local labor for themselves (or for the chiefs), as in the end this measure only conveys "deemed fitness". It's also imaginable that an increase in the target might exert enormous recruiting constraint on the district administrators that they might ultimately surrender the best-quality labor (which were hidden beforehand) to the military, hence an increase in the fitness rate might signify a real increase in the "quality" of the soldiers eventually recruited. The empirical analysis in the following parts would intend to shed more light on these seemingly competing underlying mechanisms at play.

4.2 Attitudes towards military conscription from the indigenous

Besides the potential maneuvering from the colonial authorities on influencing the conscription patterns, the more interesting inquiry is on how the local indigenous people were responding towards the calls of conscription. To start with, it's important to keep in mind that a large majority of the potential target for military recruitment consists of poor indigenous agricultural male labor ([M. J. Echenberg, 1991](#), p. 62) of particularly young ages (from around 18 to 21), also known as the "social underclass" in the entire French West Africa.

In normal times without extreme weather shocks or wars, significant mobilizing factors propelling the indigenous to join the French conscription army seemed to be rather rare, especially given the fact that the recruited soldiers had to be away from their families for a duration of three years (without the possibility of returning back home in between), the pay was minimal and they further faced significant risks of physical health or even death if assigned to overseas outposts. Although military recruits as well as the affiliated members of their original households would be exempted from the burden of head taxation, in normal times it might not be too much an appeal for the indigenous, especially given certain historical accounts that at the time, other forms of waged labor or even agricultural labor on cash plantations were financially more attractive compared to the benefits after being conscripted (Echenberg, 1991, p.28).

However, during times of large and extreme weather shocks, such as chronic droughts in the Sahel regions or sustained excessive rainfalls in the tropical rainforest regions of Guinea or Cote d'Ivoire, we might expect that the military would appear more appealing than in normal days for a few different reasons.

First and foremost, it could be envisaged that the basic livelihood of these agricultural smallholder households could be threatened due to the negative impacts exerted by such extreme weather upon agriculture-based sources of income. As such, the "extractive" nature of the military institution might appear less salient. What's more, it has also been qualitatively argued that in years of agricultural economic difficulties, military conscription more or less became the sole means of "employment" for these indigenous Africans (M. J. Echenberg, 1991, p. 63).

In addition, it's important to emphasize that in times of economic difficulties, the exemption of the compulsory head taxation upon serving for the French military became ever more appealing than before, as the rather "tolerable" levy of head taxation in normal years might now appear to be a huge "financial burden" for the indigenous households. As such, when the economic conditions turned harsh, we could expect the indigenous to escape less upon calls of enumeration than during normal times. Furthermore, they could also volunteer more eagerly after they were deemed fit, in order to ensure a spot in the military and not to be left out in the second portion (who could still face the risk of being activated as forced labor for large-scale public infrastructure projects) in the lottery process.

Another potentially minor yet equally plausible channel via which weather shocks could influence

the present rate is that, given the fact the indigenous people were required to “travel” oftentimes long distances from their residences to the conscription center where the drafting committee was located, the fixed costs associated with such long-distance travelling would be much greater in times of extreme conditions such as flooding or scorching temperatures, hence this might also explain why present rates could, contrary to the prediction from the previous mechanism, remain rather low when such severe weather perturbation strikes.

All being said, the validity of the aforementioned “income channel” story hinges on the fact that the first of all, the weather shocks indeed translate into real income shocks for the indigenous people. Secondly, in times of negative income shocks, the “targeted military recruits” would be more willing to join the military as a form of “self-insurance” than to fend for their family in such times of dire needs. The latter story might be plausible as first of all, it’s also important to note that the target for military recruitment is confined to young African males aging on average around 20 years old (up till 28 if the the enumerated individual was deemed too young upon his first conscription call and re-drafted later) and these targeted individuals represented more or less the core prime-age agricultural labor forces for the indigenous households. Given the rather unclear nature as to how the “decision to join the military” exactly occurred (either at the household or the individual level), in times of negative agriculture income shocks, the indigenous households might, contrary to the channels discussed above, be more prone to hold onto the sole scarce labor (the targeted young males for recruitment) who potentially acted as the main source of income for the entire household in times of severe shocks. On the other hand, during normal times or even periods with positive income shocks, the households might be more at ease with sending one young son away for the military, as there was no such dire need of maintaining a minimum standard of living. Therefore, these competing potential channels at play need to be further confirmed with empirical analysis conducted below.

More interestingly, the effects of weather shock may not be solely confined to the local indigenous people (targets of recruits), as weather shocks could equally induce policy adjustments from the side of the colonial authorities. One aspect of district-level colonial authority policies, as previously argued, is the annual collection of head taxation, the responsibility of which mainly falls under the realm of the district administrators. Given that more than one fifth of the total colonial fiscal revenues stemmed from head taxation, it’s reasonable to expect that the district administrator would pay special attention

to the varying “taxing capacity” of his district-level subjects in a given year. And such “taxing capacity” could be very much subject to the influence of weather shocks. If a particular chronic drought or severe flooding event strikes a given district, out of fear that his subjects may no longer be able to pay the due tax rates as prescribed from the years before, the administrator could very well be in the intention of adjusting the head tax rate per capita downward for that particular year, in order to ensure that at least a minimum levy of taxation could still be conducted or that the tax system appear less draconian and hence more sustainable in the long run. On the other hand, if a positive shock, such as a positive rainfall shock, strikes in regions with conventionally arid and hot climate, the administrator could interpret this as a potential boost in agricultural income and would subsequently adjust the head tax rates upward given such an “increase” in the “extractive capacity” of the indigenous subjects.

Such potential policy adjustments in response to weather shocks could be a potential threat to the interpretation of the “reduced-form” relationship between extreme weather conditions and the individual initiative to participate in the military, because if the policy adjustment was in favor of the indigenous (such that it alleviated the financial burden of the locals in times of economic difficulties), they would be less concerned about their own survival and hence potentially be less likely to opt for the military as a potential insurance device of “last resort”. Therefore, a simple association between weather shocks and military participation outcomes might not reveal the full or true extent of the impact of weather shocks on the indigenous’ initiative to join the military.

That being said, however, the presence of such head taxation adjustments interfering the interpretation of the results of weather shocks on military participation outcomes crucially depends on the timing when such taxation was “adjusted” and hence accordingly levied on the local Africans. It’s reasonable to assume that the annual district-level taxation decisions were usually taken at the beginning of a calendar year, given that the head tax collection involved particularly time-consuming tasks that needed to be gradually rolled out throughout the entire year. As such, the weather shock factors (if there were any) that would be taken into account while making the taxation adjustment decision for the current year could most likely be shocks burdened by the indigenous Africans from last year, and for such head taxation adjustment to affect the interpretation of the impact of weather shocks on military participation in the current year, it must be that these weather shocks from the previous year were exerting a significant influence on volunteering or presence in the current year, or that there’s

general high inter-year persistence of weather shocks in FWA across the sample period under study.

With these potentially competing mechanism in mind, in the subsequent sections of empirical analysis, I would both explore the head taxation itself directly as an outcome of the weather shocks and a potential control to account for part of the effect of weather shocks on military participation outcomes.

5 Data and Empirical Strategies

5.1 Conscription data

For my conscription data, I would be using two independently recorded datasets collected by Denis Cogneau and Alexander Moradi, one compiled from district-level historical drafting commission files and the other one sampled from more dis-aggregate individual conscript files. All the data concerning *Tirailleurs Sénégalais* were digitized from the section “Série 4D” (where all military files are kept) in colonial archives stored in Dakar, Senegal.

There are two main district-level datasets that could be exploited for subsequent analysis, one with balanced districts and the other with districts delineated at the 1925 administrative level. The two datasets differ in the geographic region of the administrative unit under study, principally due to the fact that the geographical boundaries of the FWA districts were significantly altered over the colonial years, such that some districts were merged with others, or split into smaller districts in an other year³. Given that the only available district-level administrative map for the entire FWA is delineated at the 1925 administrative level (Figure 1) and this is the only map with most dis-aggregate administrative information available onto which the gridded weather data (see below) would be mapped in order to create district-specific weather measures, I would mainly use the 1925-district dataset for subsequent empirical analyses, as the merging of this dataset with the weather shock data would more faithfully reflect a true matching of the conscription activities with the weather shocks experienced in the same geographical region in reality.

Because the drafting commission board was effectively in place from the 1920 till the end of the Second World War, and further due to the fact that during wartimes conscription methods took very

³Such constant altering of district boundaries was more faithfully manifested in the balanced-district dataset, while the 1925-district dataset attempted to trace all the variables under analysis back to the district defined under 1925 administrative delineations.

distinctive manners owing to the huge increase in demand for soldiers⁴. I excluded the years after 1940 as well as the years preceding to the effective implementation of the conscription system (pre-1920s). Ultimately, the years of interest for my subsequent analysis range from 1920 to 1938, mainly the interwar period where the mobile drafting commission board was most effectively active and the guidelines of peacetime conscription law were also rather strictly followed.

After extensive data cleaning, ultimately the 1925-district conscription dataset gives me around 1,460 observations straddling across 105 districts in FWA from 1920 to 1938. The panel structure of the dataset is not completely or strongly balanced. On average in each year, around 77 districts' data points are available, with 1934 enjoying the highest number of districts (99) and the initial two years 1920, 1921 enjoying the lowest number of districts available (30 and 50 respectively). On the other hand, for the 105 districts under analysis, the average number of years in which a single district appears in the dataset is around 14 (out of 18 years, the time length of the panel data structure at hand), with the lowest having districts straddle across four years of data points and the highest with districts straddling across the full sample period.

5.2 Major outcome variables of interest

As previously documented in the historical background of the military conscription regime, there are a few military participation measures that can particularly be the outcomes of interest for the investigation purpose of this paper. Specifically, these variables include the present rate, the fitness rate and the volunteering rate.

Present rate: Present rate is measured as the proportion of the individuals who ultimately showed up (the raw present number) for medical examinations out of the total number of individuals appeared on the enumeration list.

Fitness rate: Fitness rate refers to the share of the individuals who were “deemed fit” out of all the individuals present at the district-specific drafting committee in a given year.

Volunteering rate: Volunteering rate is calculated as the proportion of individuals who voluntarily offered themselves to join the military out of all the individuals who were “judged fit” after the medical exams.

⁴For example, World War One witnessed one of the largest increases in colonial military recruits, with an astounding number of 170,000 soldiers recruited during the war time (Michel, 1982).

From the construction of the aforementioned variables, it's apparent to observe that present rate and volunteering rate are similar to a certain extent, yet they also differ along a few important dimensions.

Firstly, both measures capture to varying degrees the "subjective willingness" of the indigenous people to join the military, given that individuals who disliked the military in the first place could have chosen to escape from the military conscription calls by being "absent", or simply "not volunteered" on the site of the conscription centers.

However, on the other hand, the measures differ along other dimensions. Firstly, present rate is an outcome upon which the colonial authorities were able to exert more influence than volunteering rate, as they held information about the residence of the enumerated individuals and hence if the individuals didn't show up for the medical examinations, depending on the stringency attached to fully recovering all the people on the enumeration list, the colonial authorities were, in principle, capable of thoroughly hunting down the absentees or adopting more punitive measures against absenteeism in order to ensure the maximum rate of presence. On the other hand, although purportedly colonial authorities were also able to further specify the potential benefits of joining the military before the volunteering calls were proceeded, the influence of such gestures could have upon the ultimate outcome of volunteering wouldn't be as high as that stemming from the subjective behavioral responses of the potential recruits. Hence, the present rate observed for a district in a given year should be more interpreted as an outcome of concerted efforts from both the colonial authorities and the indigenous people while the volunteering rate could be interpreted as a an outcome mainly tinged with subjective behavioral response.

5.3 Specifications for the impact of recruitment targets

Given the panel nature of my datasets, most of my analyses would be conducted in a fixed effect panel setting.

First of all, in terms of the analysis on the impact of recruitment targets on presence and fitness, the following main regression specification in equation (2) would be explored, where $Target_{ict}$ is the main explanatory variable, namely the "pre-determined" recruitment target (in its original number) assigned by the lieutenant governor in colony c to an administratively affiliated district i in a given year

t . The value of target is measured at its original number (in levels) due to the fact that I'd like to capture the differential impacts of target increase between districts with conventionally small target sizes and the ones that were generally being recruited more heavily⁵. Y_{ict} is the outcome of interest, it being present or fitness outcomes. Contrary to the explanatory variable specification, there's no preferred measurement of fitness or presence at this stage of exploration, hence both fitness and presence would on the one hand, be measured in "rates", which are essentially fractional outcomes ranging between zero and one; and on the other hand, they would also be measured as the "raw number" of people who would be present at the conscription center, and the "raw measure" of people who would be "deemed fit" after medical examinations were performed. One reason why the "rates" variables could be preferred to be "raw-number" variables is that such population measures in raw numbers could be subject to potential omitted variable bias. In this particular setting, although the recruitment target was arguably exogenous to both fitness and presence outcomes, it's conceivable that the colony-level lieutenant governor could have taken the population dynamics of the affiliated districts into account while deciding the share of annual target to be assigned locally. If fitness and presence are measured in "raw numbers", it's equally likely that the number of people who would ultimately show up (then later "judged fit") in a district in a given year could be influenced by the population dynamics in that year.

Such omitted variable bias could be partially alleviated via the inclusion of district fixed effects η_i , colonial-specific linear trends β_{ct} and ultimately district-specific linear trends γ_{it} ⁶. Furthermore, among the district-specific and time-varying control variables X_{ict} , an estimate of district-level annual population during the colonial years would be included (explored more in the following), notwithstanding the inevitable measurement errors associated with such estimates. The "rates" measures, however, are relatively safer than the "raw number" outcomes, given that they are rather "standardized" measures which could have potentially purged out such population dynamics, except extremely larger population swings at the local level in bad years of famine, etc.

$$Y_{ict} = \alpha_0 + \alpha_1 Target_{ict} + X_{ict}\alpha_3 + \eta_i + \delta_t + \beta_{ct} + \gamma_{it} + u_{ict} \quad (2)$$

⁵Such a specification would also be conducive for the following analysis on the heterogeneous impact of target increase, which takes into account the labor recruitment constraint and initial targeting pressure (which could be partially captured by the "raw number" of targets) in a given district.

⁶Such conventional fixed effects are specified in the same way for all the regressions equations below, hence the exposition of which would not be repeated.

Secondly, following the previous hypothesis that the impact of target on presence and, especially fitness outcomes would differ given the varying district-specific labor recruitment constraints, one candidate proxy for such local-level conscription labor constraint would be the lottery rate decided from the year before. As previously discussed, a lottery rate was decided to determine how many of the fit soldiers (identified in a given year) would be ultimately recruited as “first portion”, the real constitutive branch of the French Army. Rather naturally, given existing medical examination criteria, if the labor constraint was running rather low, the number of fit soldiers could easily exceed the target recruit for that year, and the drafting board would not need to set a high lottery rate among these fit soldiers to be recruited as “first portion”. As such, a very high lottery rate from the previous year might indicate that labor recruitment constraint was running high in that district. Subsequently, in the current year, a further increase in the target recruitment could exhibit itself as extreme additional pressure on the side of the district administrators to recruit more people than before.

Ultimately, a lagged lottery rate is preferred to other measures of lottery rate from the past given that it bears the most immediate and relevant pressure on the impact of a recruitment target change in the current year.

Analytically, in equation (3), the coefficient β_2 on the interaction term between $Target_{ict}$ and $LaggedLottery_{ict}$ would capture such heterogeneous impact of targeting on fitness and presence outcomes. Given that the target value is mechanically positive, if the aforementioned mechanism is at play, we would expect that at a higher given value of lagged lottery rate, which means districts with more existing recruitment constraints, an increase in target size would actually increase the fitness and presence outcomes more than the effect of the same increase in target size in districts with a lower given value of lagged lottery rates⁷. As such, the sign of β_2 would hypothetically be positive.

In terms of the outcome of interest Y_{ict} , contrary to the previous case, only fractional outcomes measured in “rates” would be exploited, given that now lagged lottery is measured in “rates” and its impact would be more readily interpretable with “rate outcomes”.

There might be a concern that a lagged lottery rate could be mechanically correlated with lagged present or fitness rates. Because firstly, if present or fitness rates were already very high last year (a lot

⁷Because a higher lagged lottery rate indicates more labor constraint pressure, hence in order for the target to be still met, the district administrator would try all possible ways to ensure that he would get the right “number” of soldiers. Such additional efforts could manifest in an increase in ensuring more soldiers would show up (present rate), or judging more soldiers to be fit in a given cohort (fitness rate).

of enlisted individuals showed up or a lot of people then "deemed fit"), such high rates could indicate that there was no need to set a high lottery rate to meet the recruitment target, hence there might be a negative association between lagged presence/fitness rate and lagged lottery rate. If we believe that there is certain inter-year auto-correlation of fitness and present rates at the district level, then mechanically we might detect a significant relationship between lagged lottery rate and current-year presence or fitness rates. Such association would interfere our interpretation of the interaction term, hence it's imperative to include the lagged outcome of interest Y_{it-1} in the regression specification to purge out a pure pseudo effect of labor constraint on fitness or present rates, which is rather due to the auto-correlation in the outcome of interest itself.

$$Y_{ict} = \beta_0 + \beta_1 Target_{ict} + \beta_2 Target_{ict} * LaggedLottery_{ict} + \beta_3 LaggedLottery_{it-1} + \beta_4 Y_{it-1} + X_{ict}\beta_5 + \eta_i + \delta_t + \lambda_{ct} + \gamma_it + u_{ict} \quad (3)$$

The previous discussion reveals that the variable lagged lottery rate itself alone is apparently endogenous to the outcomes of interest explored. However, given that target itself is arguably exogenous to the outcomes of interest, the interaction term at the end of the day should be an exogenous influencer on present and fitness rates, further given the fact that all the potential endogenous variations in the "lagged lottery rate" variable are properly controlled for via the inclusion of the lagged outcome of interest and all kinds of fixed effects specifications.

5.4 Specifications for the impact of weather shocks

In this sub-section, the main regression specifications exploring the impacts of weather shocks on military participation outcomes would be duly analyzed.

$$Y_{ict} = \alpha_0 + \alpha_1 PositiveRainfall_{ict} + \alpha_2 NegativeRainfall_{ict} + X_{ict}\alpha_3 + \eta_i + \delta_t + \lambda_{ct} + \gamma_it + u_{ict} \quad (4)$$

In the main equation (4) above, Y_{ict} indicates the outcome of interest, it being volunteering or present rates (depending on the regression of interest) in district i located in colony c , year t . Because

the income effect of weather shock is non-monotonic, such that both extreme positive and negative weather shocks could exert negative income repercussions and further given that the entire territory of French West Africa straddles across a wide variety of climatic conditions, it's natural to expect that positive and negative weather shocks to exert distinctive impacts on military participation outcomes via their respective influences on varying agricultural activities. As such, I would divide the weather shock variables into a positive and a negative weather shock measure constructed with linear-spline-splitting methods. As such, α_1 and α_2 respectively identify the effect of positive or negative weather shocks on military participation.

Given the panel structure of the dataset and the fact that weather shocks could be correlated with district-specific characteristics (given the wide differences in climatic condition across the region), which might alone explain military participation outcomes, in all regression specifications I always include district fixed effect η_i and further due to the fact that weather shocks might influence other macro time trends inside French West Africa, time fixed effects δ_t are also rather invariably included in all specifications.

In more stringent regression specifications, I further gradually included colony-specific and district-specific linear time trends, in order to control for any other colony or district-specific channels (other than the agricultural income mechanisms) that could be determined by weather shocks and also simultaneously influence military participation outcomes. Additionally, X_{ict} refer to district-specific and time-varying observable controls, such as the essential head tax rate as previously mentioned or other district-specific public investment and taxation measures.

Indeed, there are still a few limitations associated with the specification in equation (4). Firstly, the rather "reduced-form" relationship between pure weather shocks and military participation as constructed above could potentially mask the heterogeneous responses given the varying intensity of shocks received by different sub-regions of FWA. For example, we might expect that extreme positive temperature shocks would exert a more salient impact in regions that on average exhibit higher temperatures to start with, as in these regions a higher temperature spike might more easily expose the indigenous to a potential drought than in areas that enjoy cooler climates on average.

As such, we could interact the weather shock variables with dummy indicators that divide FWA into various regions of distinctive climatic conditions, for example the most apparent division of FWA

is to divide it into a region of more desert-like and arid Sahel-climate region and coastal tropic-like climate region. The exact regression specification is the following in equation (5), where $Tropic_i$ is a dummy variable taking on value one if the district enjoys tropical climate⁸. As such, α_1 refers to the effect of positive rainfall shock in regions with non-tropical climate compared to normal times (when the weather shock measure is zero). In addition, the sum of the coefficients α_1 and α_2 would indicate the total average effect of positive rainfall shocks in regions with historical palm cultivation compared to normal times (when the rainfall shock is zero) and we can further interpret the difference, α_2 , as the differential effect of positive rainfall shocks in tropical areas, compared to the effect of rainfall shocks in regions that enjoy a more desert-like arid climate.

$$Y_{ict} = \alpha_0 + \alpha_1 PositiveRainfall_{ict} + \alpha_2 Tropic_i * PositiveRainfall_{ict} + \alpha_3 NegativeRainfall_{ict} + \alpha_4 Tropic_i * NegativeRainfall_{ict} + X_{ict}\alpha_5 + \eta_i + \delta_t + \lambda_c t + \gamma_i t + u_{ict} \quad (5)$$

Secondly, Equation (4) essentially assumes that the effect of weather shocks on military participation would be linear. However, it's also rather intuitive to assume that more severe weather shocks could exert a larger impact on military participation via a potentially more adverse income effect. Hence, I would further split the positive and negative weather deviation measures into finer linear splines. For instance, hypothetically, I could divide the positive and negative rainfall deviations into two separate linear splines each, hence four linear splines in total⁹. This specification is ultimately preferred to a quadratic specification of weather shocks in the current setting, because a quadratic specification essentially assumes that the impacts of either positive or negative weather deviations would remain symmetric, and there's no concrete rationale to believe that such symmetry would be the case in the current diverse climate setting of FWA.

In terms of mathematical construction, the regression specification for the four-linear-spline analysis would be very similar to the one in equation (4). Specifically, in the following equation (6), α_1 would identify the impact of negative rainfall shocks on either presence or volunteering rates in the most negative range of rainfall shock distribution¹⁰ and α_4 would identify the impact of positive rainfall shocks

⁸This is just raised an example of climate indicator, exactly how such indicator dummies are empirically constructed would be explored in the following sub-section on variable construction

⁹The exact details on how these finer linear-spline variables are constructed would be introduced in the following sub-section on weather data

¹⁰The range of which would be contingent on the distributional values of the shock variables under study and further explored

on either presence or volunteering rates in the most positive range of rainfall shock distribution. And the same reasoning could be applied to the interpretations of α_2 and α_3 . As such, the same analysis and regression specification would apply for temperature shocks as well. And ultimately, I would jointly include both temperature and rainfall shocks in the regression specification, in order to take into account plausible interaction impacts between rainfall and temperature shocks exerting income effects on the indigenous farmers.

$$\begin{aligned}
Y_{ict} = & \alpha_0 + \alpha_1 \text{NegativeRainfall2}_{ict} + \alpha_2 \text{NegativeRainfall1}_{ict} + \alpha_3 \text{PositiveRainfall1}_{ict} \\
& + \alpha_4 \text{PositiveRainfall2}_{ict} + X_{ict} \alpha_5 + \eta_i + \delta_t + \lambda_{ct} + \gamma_{it} + u_{ict}
\end{aligned} \tag{6}$$

Across all specifications from equation (2) to equation (6), the standard errors are always clustered at the district level. Although there might be the potential concern that there could be spatial correlation of the military participation outcomes given the mobile nature of the drafting board, it's important to bear in mind that the district-level indigenous Africans would only report to the conscription center located within the confines of their residential districts and further given the fact that the mobile drafting board operated in a rather chronological order across different districts, it's not likely that there would be several drafting boards operating at the same time across a few geographically adjacent districts. Hence overall it's rather unlikely that conscription outcomes across these districts would be contaminated by spatial stickiness.

Ultimately, given that there are only 8 colonies under study in the entire FWA, clustering at the colony level in order to account for potential intra-correlation across districts within a given colony might be too stringent an empirical test for this exercise. Furthermore, such clustering might not be empirically relevant either, as for instance the colony of Upper Volta (current-day Burkina Faso) was dissolved in 1932, then divided among French Sudan (Mali), Cote d'Ivoire and Niger) and was only reinstated in 1947.

in variable construction section as well.

5.5 Weather data

Weather data are obtained from two main sources, one constructed by [Matsuura and Willmott \(2018\)](#) from the University of Delaware (subsequently referred to as Delaware data), and the other constructed by [Harris et al. \(2018\)](#) from the University of East Anglia (subsequently referred to as UEA data), based upon the climate data collected and calibrated by [Harris et al. \(2014\)](#). These two independently constructed climate data are more or less the conventional sources in the literature of climate research and have recently started to be exploited in the field of economics ([Christian et al., 2015](#); [Dell et al., 2009, 2012, 2014](#); [Harari & Ferrara, 2018](#)).

Both weather datasets contain global terrestrial monthly average rainfall (in millimeters) and near-surface average temperature (in Celsius) measures at the disaggregate grid level (0.5 degree * 0.5 degree¹¹) from 1901 to 2017. Given that my dataset is at the district-year level and the overwhelming majority of the gridded weather data points are measured at smaller geographical points than the average size of a district in colonial French West Africa, I averaged all the gridded data points that would fall inside the administrative region of a district at its 1925 boundary to compute the district-level monthly rainfall and temperature averages.

Given the year-district structure of my conscription panel dataset, I need to exploit the monthly weather data points to construct annual district-level weather measures. Such a task, nonetheless, requires a bit more caution and further investigation. First of all, it's important to bear in mind that although all activities of military conscription took place all year around across the entire FWA, the effective functioning of the mobile drafting commission was mostly constrained to the months from January till April, where the main outcomes of interest, such as fitness rates, volunteering rates and present rates were effectively produced. The aim of such a constraint to the initial few months of the year is mostly to sidestep the time period (from May till October) where the majority of the migrant agricultural laborers (navétanes) would be away from their residential villages or districts ([David, 1980](#)). That being said, the constraint was mostly applicable to the interior colonies (French Sudan, Niger and Upper Volta), while for Senegal, due to its special administrative status in French West Africa, the peacetime conscription there only took place after all the conscription activities had been finalized in all other FWA colonies, in order to fill in or constrain recruit numbers if there was any

¹¹One grid corresponds to a squared area with side length of around 55 kilometers.

deficiency or even situations of over-recruiting. Hence, the recruitment committee was not held in Senegal usually until late April or May (M. J. Echenberg, 1991, p. 58). We could rather safely assume that by the end of the month of June, all conscription activities, especially the activities that pertained to the outcomes of interest in this paper would have already been finalized. As such, there's little reason to believe that the weather conditions from July till December in a given year for a specific district would in any way influence the corresponding military participation outcome for that district in that given year in a rational manner. That being said, such a recruitment procedure was only said to be followed "in principle". We couldn't conclude with confidence that there was no administrative recruitment delay for some districts in a few years of interest. Therefore, the main weather shock variable henceforth constructed would be the first-half-year-average-based (from January till June) weather shock deviations, while the second-half-year-average-based (from July till December) weather shock deviations would be exploited for robustness checks later in the paper.

In order to construct comparable weather shock measures across all the districts under study and given the fact that the territory of French West Africa straddles across a wide variety of climatic conditions (ranging from the rainforest tropical climate in Cote d'Ivoire to the more continental and arid desert climate in Niger and Mauritania), in the same spirit with Hidalgo et al. (2010), my main explanatory variable was defined as the standardized annual (first-six-month-based) average precipitation or temperature at the district level. Very similar standardized weather shock measures are also adopted by Papaioannou (2016), where he explored the impact of climatic shocks on conflicts in colonial Nigeria also in a panel setting.

Mathematically, the weather shocks are constructed as in the following equation (6), where $Rainfall_{ict}$ indicates the annual (first-six-month average) rainfall intensity in district i for year t and $Rain\bar{fall}_i$ refers to the average annual (first-six-month-based) rainfall intensity across the entire sample period (1920-1938) in district i . In addition, $SdRainfall_i$ is the district-level rainfall standard deviation over the sample period (1920-1938).

$$StandardRainfall_{ict} = \frac{Rainfall_{ict} - Rain\bar{fall}_i}{SdRainfall_i} \quad (7)$$

Alternatively, I also constructed deviation measures from decennial, thirty-year (1900-1930, 1930-1960) or sixty-year district-level averages (1900 till 1960, covering the entire colonization period). How-

ever, in all, the sample-period-based deviation measures supposedly should best correspond to the real extreme weather conditions so as experienced by the indigenous people during this particular period of time. Hence, in my subsequent analysis, I exploit the sample-period-based deviation measures as the main explanatory weather variables.

5.6 Construction of other variables of interest

5.6.1 Construction of other weather-related variables

Climate indicator dummies

Firstly, in order to construct the climate condition dummy indicator as expressed in equation (5), one method is to sub-divide the region to identify the districts in FWA with historical palm cultivation presence, given that palm tree is a rather representative tropical plant and it requires abundant rainfall and a climate not as scorching as that in the Sahel-desert regions. Historical map with the delineation of the northern-most cultivation presence of palm trees was taken from [M'bokolo and Le Callennec \(2004\)](#) and by mapping this distribution with the 1925-district map of FWA, I identified the districts that fell within the delineated palm tree cultivation zone. The relevant districts are shaded in dark blue in Figure 2.

As a robustness check on the fact that the districts identified from the previous method are indeed the ones with the more abundant rainfall and less scorching heat, I tried a few additional methods to divide the sample at hand by the rainfall and temperature data available. First of all, with the available rainfall data (from both the Delaware and UEA sources) at hand, I identified the districts that fall within the top 50% of the distribution in terms of average rainfall over the sample period under analysis (1920-1938). In the same vein, with the temperature data I also further identified the districts falling under the bottom 50% of the average temperature distribution.

I identified the districts that fall under the top 50% of the rainfall distribution in both the Delaware and UEA maps to be the ones that are of relatively higher rainfall intensity in general. These districts are shaded in dark blue in Figure 3. In addition, districts identified within the bottom 50% of the temperature distribution are presented in Figure 4. Rather strikingly, districts with relatively abundant rainfall more or less largely correspond to the ones that enjoy a cooler climate on average as well, with Guinea and Cote d'Ivoire occupying the overlapped regions from both temperature and rainfall maps.

This is not surprising given that abundant rainfall usually brings about cooling effects, especially in regions that traditionally exhibit tropical climatic conditions.

As can be seen, the palm-cultivation region nicely constitutes a sub-sample of the districts with relatively abundant rainfall and cool temperature¹². This corresponds well with the agricultural account that the cultivation of palm oil needs abundant water and a relatively warm, yet not scorching climate and further confirms the empirical validity of the historical map exploited. As such, as the palm cultivation indicator most adequately captures both the rainfall and temperature dimensions of climatic conditions, in the subsequent heterogeneity analysis, I would mainly exploit this delineation indicator to conduct heterogeneous impact analysis of weather shocks on military outcomes.

Four-linear-spline weather shocks

Secondly, in order to construct the finer linear-spline-based weather shock measures as expressed in equation (6), and given the fact that the values of the standardized deviation measures mostly swing between (minus to plus) 2 to 3 standard deviations¹³, the shock variables are hence divided into four components at the knots of -1, 0 and 1 respectively. This method would be referred to as “standard deviation division” and it would be mainly exploited in the finer analysis on the impacts of most extreme weather shocks. In addition, as an attempt to replenish this division approach, I also adopted “quartile-based division”, which splits the deviation measures into four components based on the four quartiles of the variables’ value distribution and may be more robust to potentially more skewed distribution for a certain weather shock variable. Results using this linear-spline-splitting method would be reported in the appendix.

5.6.2 "Bartik-like" fill-in method for missing values of targets

Besides the main weather shock variables as discussed previously, another key explanatory variable of interest is that of recruitment quota (target). Rather unfortunately, there are a lot of missing values of target numbers in the original district-level data file, with the non-missing target numbers counting a sample size of around 700 observations compared to the sample size of 1460 observations for main empirical analysis. This could have been due to the fact that target number files were not as well kept as the recording of other variables such as the state of fitness, numbers of absentees, etc. Even

¹²By “abundant rainfall” I refer to districts fall within the top 50% of rainfall distribution and “cool temperature” correspondingly refers to districts fall within the bottom 50% of temperature distribution

¹³Details of the weather shock variables are reported in the following section on summary statistics.

more importantly, given the fact that most of the other military conscript information is more or less complete (with regard to the missing observations of target), in order to increase statistical power and not lose out on the information on the other key conscription variables, I intend to recover these missing values by finding a proxy measure for the target numbers.

To start with, given that the primary aim of the recruitment process is to ultimately arrive at the target recruitment number assigned for a particular district, the final number of first portion soldiers should rather accurately reflect the target specified for that district in a given year. Indeed, among the non-zero target numbers and first portion recruits, the positive correlation is rather high at a value of around 0.8267¹⁴

As such, I identified in the dataset a specific year which enjoys the highest number of district which have non-missing first-portion recruit measures. Among all the available years in the dataset, the year 1934 has the highest number of districts (99) that satisfy the previous criteria. I calculated the share of first portion recruit for each of the 99 districts out of the total first portion recruits for the particular year (1934) in FWA and take this district-level share as a proxy for the (constant) share of target recruits that district got assigned with over the entire sample period (1920 – 1938). As such, I filled in the missing values of the target numbers by calculating them as the product between this share and total number of first portion recruit for a given year across the entire territory of French West Africa, further relying on a similar assumption that the aggregate number of first portion recruits should rather faithfully reflect the total number of target recruits for that particular year. This proxied measure is henceforth referred to as “first-portion adjusted target”.

5.6.3 Construction of control variables

District-level annual population measures

Colonial population measures are scarce and more often than not, largely contaminated with measurement errors. In the subsequent analysis, district-specific demographic dynamics may need to be controlled for especially in the analysis of the effect of targeting on fitness adjustments, where the decision to increase the recruitment target for a specific district in a given year could reasonably be correlated with the population dynamics (hence the recruitment capacity) in that district, although the

¹⁴Although this value needs to be taken with a pinch of salt, given that a lot of this correlation could be just cross-sectional (between large districts and small districts), hence not really reflecting the true adherence to the target changes in a given district over years.

inclusion of district-specific linear trends in the panel fixed effects specification might have alleviated such concerns to a certain extent. In order to credibly construct district-level population figures during the sample period under study (1920-1938), colony-level annual population estimates were taken from "frankema2014writing" (n.d.). Furthermore, district-specific population data were available from (Huillery, 2009) for the year 1910 and 1925. With the Huillery data, I calculated the "share" of district population out of the colony population as the average of the real share in year 1910 and the real share in 1925, then I treated this share as a constant for all the districts in FWA throughout the sample period under study (1920-1938), with the underlying assumption that the district-specific population growth dynamic is at pace with the population growth patterns of the colony it's located in. District-level population estimate hence is obtained as the product of this assumed constant share and the colony-level population estimate from "frankema2014writing" (n.d.).

Taxation variables

Taxation data are taken from (Huillery, 2009) and specifically the years for which such taxation data were available are: all years from 1910 to 1920, and then 1923, 1925, 1928, 1930, 1933, 1936, 1939, 1943, 1946, 1949, 1953, and 1956. My main sample period of interest is from 1920 till 1938, over which unfortunately there are not a lot of overlapping years between the taxation dataset and the conscript dataset. Therefore, the ultimate analysis with the inclusion of taxation variables as controls or outcome variables over the same sample period of interest (1920-1938) would suffer from a significant reduction in sample size. This might be a concern for subsequent interpretation as the effect identified in this sub-sample might be due to selection bias, if the years in which the tax data is missing are non-random and potentially correlated with adverse weather shocks, etc.

Therefore, in order to fill in certain missing values for the per capita head tax rate variable to further increase the sample size, I exploited the structure in the dataset where the values for the total annual head tax collection is non-missing, while those for per capita head tax rate are missing, given that there's a mechanical arithmetic relationship between the two variables. As indicated by equation (8) below, the total annual head tax collected in a certain district is the outcome of the per capita head tax rate multiplied by a share (S_{ict}) of the district population (Pop_{ict}) over whom such taxation was levied. Given the previously estimated district-level annual population and together with the non-missing values of head tax rate and total head taxation collected, an estimated annual district-

level share of population levied \hat{S}_{ict} could be computed (equation (9)). Given this estimated value of district-level levied population share, I further calculated the district-level mean population share to be levied with head taxation \hat{S}_i . Assuming this time-constant and district-specific share to be a rather faithful reflection of the “taxable component” of local district population during the colonial years, I subsequently filled in the missing values of head tax rate following the method as indicated in equation (10). Overall, around 60 observations of per capita head tax rates are filled in (compared to the original sample size of 650 observations matched with military outcomes, this is not a trivial increase), making the ultimate matched sample size stay at around 710 observations. Ultimately, given that the head tax rate was registered in nominal terms (unit: franc) at the time, it was further divided by the colonial franc deflator constructed by [Villa \(1997\)](#) in order to account for potential effects of in-(de-)flation, especially during the times of the 1930s at peak of the Great Depression when the prices of export commodities in FWA suffered severe slumps ([Blattman et al., 2007](#)).

$$HeadTaxCollected_{ict} = HeadTaxrate_{ict} * Pop_{ict} * S_{ict} \quad (8)$$

$$\hat{S}_{ict} = \frac{HeadTaxCollected_{ict}}{Pop_{ict} * HeadTaxrate_{ict}} \quad (9)$$

$$HeadTaxrate_{ict} = \frac{HeadTaxCollected_{ict}}{Pop_{ict} * \hat{S}_i} \quad (10)$$

6 Summary Statistics

6.1 Main variables analyses

In total, there are three main groups of variables utilized throughout this paper’s analyses. Firstly, the weather shock variables constructed from both the Delaware and UEA data sources, secondly the conscription variables based on the district conscript files and ultimately the colonial revenue and expenditure variables such as head taxation, district-level colonial population estimates, etc.

In terms of weather shocks, in table 1, if we take the first-six-month-based annual deviation measures (constructed from Delaware data) as examples, we could observe that the standardized rainfall

and temperature deviations range mostly between minus three to positive three standard deviations, with means of close to zero and standard deviations close to one. As for the conscription variables, the average district-level annual target recruit number stays around 110 to 133 soldiers (depending on the way that the data is filled in), which is actually a bit higher than the mean range for the "first portion" soldiers ultimately recruited¹⁵. This hints at a potential scenario where the district administrators might be consistently "undershooting" the target quotas, hence indicating competing interests for scarce labor at different levels of the French colonial administration. Furthermore, the overall present rate is quite high and stands at around 83.05%. However, on the other hand, this also indicates that the annual district-level absenteeism rate is around 17%. On the other hand, the mean fitness and volunteering rates are much lower, standing respectively at 33% and 13%. Ultimately, the average lottery rate is also very close to that of fitness rate, standing at around 32.7% across the entire FWA federation.

Cross-sectional geographical distribution of the intensity of the various outcome variables of interest also deserves a bit more attention. From Figure 5, it seems that present rates are particularly high in Cote d'Ivoire, the hinterland of Mali and some huge administrative regions in Mauritania and Niger. As for fitness rates (upper panel of Figure 6), Cote d'Ivoire, Dahomey and certain southern regions of Niger also stand out with relatively high rates outcomes. Ultimately, as for volunteering rates, besides the same three regions concurrently with high "judged fitness rates", volunteering initiative also seem to be quite prevalent in Guinea (lower panel of Figure 6).

Overall, if we temporarily leave the colonies of Mauritania and Niger aside¹⁶, the geographical distributional patterns of the main outcomes of interest more or less align with the historical account from [M. J. Echenberg \(1991\)](#), where he documented that peacetime military conscription was mostly in order in colonies such as Cote d'Ivoire and Dahomey, where conscription had been more or less routinized over the years and the process of which was no longer regarded as "too alien" to the everyday life of the indigenous people.

On the other hand, Senegal also stands out to be the district to be collectively endowed with relatively low present rates, low fitness rates and low volunteering rates. This is also in accordance

¹⁵With a mean around 110 if recuperated absentees are taken into account, and mean of 83 if both volunteers and recuperated absentees are not taken into account.

¹⁶Given the fact that these two regions both are geographically remote, thinly populated and enjoy much smaller shares of the overall sample, hence not the most important focuses of military conscription during the colonial times ([M. J. Echenberg, 1991](#))

with the general historical account that Senegal, as the location of the FWA headquarters, peacetime military conscription was not treated as the most important annual administrative mission to be duly executed. Furthermore, Senegal was often served as a last resort for filling in conscription deficiency if the overall recruitment target was not met for a particular year across the entire FWA.

Ultimately, given the fact there are two sources (district- or individual-based) over which the volunteering rate could be computed, I also calculated the district-level sample-period (1920-1938) average volunteering rates independently from the two sources and reported them graphically in Figure 7. As can be seen from the graph, the overlapping of the intensity of volunteering is indeed existent and positive, but not of highly significant magnitude. In fact, the correlation coefficient of the annual district-level measures constructed from the two sources stands at around 0.58, which is not sufficiently high if they represent essentially the same outcome. This could be mostly due to the fact that the individual data were digitized from a specific sampling methodology, with an average yearly sampling rate of 10% and specific over-sampling is applied to the years of 1925 and 1938. Hence, the individual-data-based volunteering rate may not be an ideal alternative candidate for the volunteering rates constructed based on district-level data.

In addition to the cross-sectional distributive patterns of the main outcomes of interests, one of the most striking findings in terms of time-varying statistics is that there's a very significant secular decline in terms of fitness rates across all eight colonies over time (Figure 8), while such a pattern is not observed for both present and volunteering rates (Figure 9 and 10). The main underlying rationales as to why such a consistent downward secular trend is present for fitness rate alone cannot be properly explored for the moment given the limitation of the datasets at hand, yet such a pattern needs to be taken account whenever regression analyses pertaining to fitness rates are conducted in the following parts of the paper.

6.2 Correlation analyses

Given that the weather shock variables are computed from two independently constructed sources, it's important to analyze whether the Delaware-based weather shocks and the UEA-based shocks consistently correlate with one another, or if not it's imperative to further understand what underlying rationales are driving the differing values of weather shocks constructed from these two different

sources.

Table B1 in the appendix reports the correlations among the annual district-level rainfall averages¹⁷ from the two data sources. As can be seen, the two measures are highly positively correlated (correlation coefficient: 0.9748, row 3, column 1). Average rainfall measures over the sample period under study (1920-1938) are also included in this correlation table. Although this variable is only district-specific and time-invariant, it's important to notice that this variable is also highly positively correlated with the district-specific and time-varying annual rainfall measures¹⁸, which indicates to an extent the consistency between short-run rainfall measures and long-term rainfall indicators over the entire sample period (1920-1938). The same pattern of high positive correlation is also observed for average annual temperature measures constructed from the two data sources (table B2). Although the correlation (0.8901, row 3, column 1 in table B2) is slightly lower than that for rainfall measures.

In order to understand better the sample deviation weather variables which would be mainly exploited as exogenous shock for the subsequent empirical analysis, correlational explorations between the sample average and sample deviation measures were duly attempted.

In terms of temperature measures, as can be seen from table B3, although the correlation between sample averages constructed from the two sources is highly significant and positive (0.9624, row 3, column 1), the correlation between the standard deviation and average of the sample-period district-level temperature measures is drastically reduced. What is particularly striking is that for measures computed with Delaware data, the coefficient is only 0.085 (albeit still being highly significant, row 2, column 1) between temperature standard deviation and temperature average. Such a correlation indicates that the districts that have the highest sample-period average temperatures across the entire FWA, at the same time, aren't the same districts that enjoy the largest standard deviations (although the correlation is still positive). This is also reflected in the graph representation (Figure 11) of the same variables explored in this aforementioned correlation table, where we could observe that districts with the highest average temperature (shaded in dark blue in the left upper panel of Figure 11) are not necessarily the districts with the largest temperature standard deviations in the same period (shaded in dark blue in the left lower panel of Figure 11), although an overall positive correlation between the two

¹⁷All the annual, annual average and related standard deviations of the weather measures reported from table B1 to table B4 in the appendix are annual measures based on the first six monthly data of a year, given the previous analysis of the historical reality that it's the weather variations, having occurred in these first six months of a given year, that should most relevantly affect the military participation outcomes, hence also mainly harnessed for the subsequent empirical analysis as well.

¹⁸Correlation coefficient for Delaware data: row 2, column 1; Corresponding coefficient for UEA data: row 4, column 3.

variables is still visible even graphically. In the same vein, the correlation between the two measures constructed from UEA data is also reduced, although less drastically and stands at around 0.6011 (row 4, column 3). Furthermore, the temperature standard deviation computed with Delaware data is even less positively correlated with the standard deviation measure based on UEA data (coefficient 0.3398), this would explain why the correlation of the temperature deviation measures constructed from the two different weather data sources are not that highly correlated, with the correlation coefficient value dropping to a staggering 0.2490 in table B5.

This type of issue is less salient for the rainfall measures, as can be seen in table B4, the correlation between sample-period rainfall average and sample-period rainfall standard deviation is very high and significant regardless of the data sources employed (with average coefficient value surpassing 0.90). Furthermore, the standard deviation measures constructed from the two data sources are also highly correlated (coefficient 0.9093). This would further explain the relatively high correlation (0.7605) of the sample-period rainfall deviation measures constructed based on the two different weather data sources in table B5.

There are two major takeaways from the correlation analyses conducted above. First of all, notwithstanding a less salient correlation between the sample-period temperature average and its corresponding standard deviation, the overall rather significant correlation between the mean and the standard deviation measures of the two weather variables (temperature and precipitation) indicate the necessity to standardize the main explanatory variable - weather deviation from the mean – by its sample-period standard deviation, as some variation in the raw deviation measure (simply extracting the sample-period mean from the annual district-level measure) could be due to the fluctuation in its long-term standard deviation, instead of being a variation in the true inter-temporal deviation alone, which is what we are interested in as a more faithful definition of “weather shocks”. Secondly, the low correlation between the two standard deviations of temperature measures respectively constructed with Delaware and UEA data indicates that either one of the two suffers from more historical measurement error, or that the two data sources both suffer from measurement errors, but in rather different directions given their respective spatial interpolation and cross validation methodologies. Such a scenario is a bit worrisome, because the high correlation of the two rainfall deviation measures indicate that rainfall shocks constructed from separate data sources could serve as robustness checks on one another’s

impacts on military outcomes, while such an approach seems rather implausible for the temperature shocks.

Given that the Delaware-based temperature measures seem to be applied more frequently in the past literature (Christian et al., 2015; Dell et al., 2012), temperature shocks constructed from this source are exploited as the main explanatory variables for subsequent empirical analysis, while corresponding shocks constructed with UEA data are used as “potential” robustness checks and alternative explorations.

Last but not least, given the previous analysis that in principle, there’s only a limited time window via which weather shocks could have an effect on the military participation outcomes, namely shocks that occurred during the first half of a given calendar year, it would be interesting and empirically important to see how this first-half-year deviation measure is correlated with the total-annual (based on the twelve monthly weather data points in a given year) and second-half-year (based on weather data points from July to December in a given year) deviation measures¹⁹, given the fact that I would use the second-half-year deviation variables as placebo tests later.

As can be seen from table B6, the correlation between the first-half-year rainfall deviation and second-half-year rainfall deviation is very low, with a correlation coefficient value of only 0.1616 (row 3, column 1). This might give us confidence that the two shock measures are varying in their own distinctive manners and hence the association with military participation outcomes could also potentially differ. Furthermore, the correlation between the first-half-year rainfall deviation and total-annual deviation is also not that high, with a correlation coefficient of 0.5715 (row 2, column 1), which is much lower than that between the second-half-year deviation and annual deviation (0.8846, row 3, column 1). This might indicate that the magnitude in the variation in rainfall occurred in the second half of the year slightly dominate that of the variation in the first half of the year.

Moving on to the correlations of temperature deviations, in table B7, we could observe that the correlation between the first-half-year deviation and second-half-year deviation is not very high either (0.4989), although much more so than the correlation for the corresponding rainfall deviations. On the other hand, rather strikingly, the correlations of annual-total deviation respectively with first-half-year and second-half-year deviations are very close to each other in terms of magnitude (with a difference smaller than 0.05). This might hint at the fact that temperature variations in a given year are much

¹⁹All these deviation measures as reported in table B6 and table B7 are currently constructed with Delaware data.

more evenly spread out across the twelve months of the year than rainfall variations are.

7 Results

7.1 Variance Decomposition

Before diving into the main empirical analysis of the impacts of recruitment quota and weather shocks on the various outcomes of interest, it's important to first understand how much of the variation in the outcome variables of interest that would already be explained by time-invariant variables (due to either colony or district fixed effects) or other time-varying unobserved characteristics. In order to compare the relative magnitudes, especially that of the year fixed effects against that of district fixed effects, I employed Least Squares Dummy Variables (LSDV) regressions to assess each part's contribution to the overall adjusted R-squared values for the outcomes of interest. The results are all mainly reported in table B8 in the appendix, where a more detailed discussion of sources of variation given different fixed effects specifications is included.

The main takeaway from this analysis is that, ultimately, across all the three main outcome variables, even after having accounted for both colony- and district-specific linear trends, the total adjusted R-squared for the three only range from around 0.34 to 0.48. This indicates that there's still a huge proportion of the variation in these three variables, which is district-specific and time-varying, that cannot be explained by the simple fixed effects analysis presented in table B8. On the one hand, this gives confidence that there's a lot more room to explore in terms of evaluating the effects of either recruitment quota or weather shocks on these outcomes of interest, while on the other hand, we might also worry that a huge share of the variation in these outcome variable might be due to measurement errors such as inaccurate recording during the functioning of the drafting commission boards.

7.2 Results of the impacts of recruitment target changes

As analysed in equation (1) in the section on theoretical hypothesis, a given annual target could be fulfilled mainly at four different stages of the recruitment procedure. Hence in this sub-section, I would analyse how a change in the recruitment target could affect enumeration, presence, fitness and lottery outcomes separately. Special focus would be given to presence and fitness outcomes, given that

as previously argued, they are most likely to be subject to endogenous adjustments after a change in the recruitment quota.

7.2.1 Direct impacts on the recruitment procedures

To start with, I first analyzed if the district administrators were indeed adhering to the target size changes in general, such that if they complied with any target changes ordered from the higher authorities, for a given increase in the target size in a certain district, the increase in the ultimate "first-portion" recruited should be of similar magnitude.

Rather strikingly, it seems that the district administrators were not complying with the recruitment quotas assigned by the higher-ranked officials to the fullest. In table 2, where the "first option" outcome is defined as the sum of the soldiers who entered the military via the lottery and those who volunteered, across all the specifications, when the raw target was increased by 100, on average the ultimate size of the "first-portion" increased by round 20 to 30 soldiers. If anything, it seems that the competing interests for labor were already manifest in the fact that the target variations for a given district over the years were, more often than not, not fully fulfilled.

Bearing this overall picture in mind, there's still a significant fraction of the target changes (20 to 30%) realized in the end. Thus, it would be important to subsequently understand, which is also the main research inquiry as raised in the theoretical section, that when the district administrators were complying with such target increase, where did the adjustment principally take place?

Firstly, I analysed if raw enumeration numbers were responding to the change in recruitment target. The results are reported in table C1 in the appendix. In general, it seems that the effects of targeting on enumeration are more or less minimal. Furthermore, district population seems to be exerting a positive influence on the raw enumeration figure itself (as the significant coefficients from column 7 and column 8 suggest), although the significance disappears when district-specific linear trends are controlled for. If anything, it seems that the very raw enumeration list was not principally adjusted in response to a change in the recruitment quota, but might potentially be co-moving with other indicators of district recruitment capacity, such as the annual district-level population estimate.

More interestingly, the impacts of targeting on present rates reported in table 3 seem to be painting a more nuanced picture. From column 1 to column 3, when the missing indicator of target and the

district annual population estimates are controlled for, there seems to be nearly no impact of targeting on present rate at all, with the values of the coefficient estimates being very close to zero. Similar null results are also obtained when the outcome of interest is the absolute number of people who are present at the conscription center in a given year (results reported in table C2 in the appendix).

In order to replenish this sub-sample analysis, the alternative measure of filling in the missing values of the target number, as discussed previously, is employed in order not to miss out on the potentially important association between target and present outcomes within the missing sub-dataset. Rather surprisingly, contrary to the non-significant results when the missing indicator is added, the effect of targeting on present rate appears to stay significant across all specifications from column 4 to column 6 in table 3, even after the district population controls are added in as well. However, these results should be interpreted with a pinch of salt as the fill-in method itself might entail certain measurement error compared to the true targeting values.

Overall, although the results do not appear to be very robust, if anything, when there's more pressure of recruitment from higher colonial authorities (manifested as an increase in the number of target recruit for that district), the district-level authorities (either it being the administrators or other members of the drafting commission board) seem to be trying harder than usual to ensure that more soldiers who were enumerated as eligible for military conscription would ultimately show up for the medical examination at the drafting committee center. Although overall the magnitudes of the coefficients seem rather small at first sight, the fractional nature of the outcome variable should be taken into account. If we take the coefficient estimate on the adjusted target in column 6 as an example and further given the fact the average number of district-level target recruits is around 100, it indicates that when the number of target assigned to a particular district increased by half on average, present rate would correspondingly increase by around 2 percentage points.

As previously discussed, the potential effect of a target increase is not limited to ensuring that more enumerated autochthons would ultimately show up, but it could also endogenously affect the "deemed" fitness rates of the soldiers who were present. Such an impact is indicated by results reported in table C3 in the appendix. Here, contrary to the results found for present rate and raw enumeration, the impact of targeting on fitness rates remains consistently significant across all specification.

Although across the board, the magnitudes of the coefficient estimates are similar to those of the impact of adjusted target on present rate, it needs to be taken into account that the average fitness rate across FWA from 1920 to 1939 (around 33%) is much lower than present rate (around 84%). In general, it seems that when the conscription target increases by one standard deviation, which is around 60 soldiers²⁰, the endogenous fitness rate would also correspondingly increase by a magnitude of 3 to 5 percentage points, which is around a 10 to 15% increase compared to the average value of fitness rate.

Even more strikingly, contrary to the null impact of targeting on the absolute figure of indigenous Africans either enumerated or present, target actually significantly affected the absolute number of indigenous Africans who were “deemed fit” as well. In table 4, we could observe that across the two measures of target numbers, there’s always a highly significant positive impact of targeting on the “deemed fit” figure. Indeed, given the previous discussion that when the outcome is in “absolute level”, there’s a higher probability of omitted variable bias, hence district-level annual population estimate and district-specific annual linear trends are subsequently controlled for as well. In order to more readily interpret the magnitude of the results obtained, the coefficient estimate in column 6 indicates that, when the target number increased by around 100, there would be 70 more people who would be “deemed fit” after the medical examinations had been performed. This is a very sizeable effect as it readily indicates that a majority of the increase in target number was actually responded by an increase in the figure of people who were judged fit for the army.

To more readily interpret how these additional fit people were contributing to the ultimate rise in the number of “first portion” soldiers, a simple calculation could be performed. Given that the average lottery rate among the fit was round 33% and assuming that the district-level drafting commission couldn’t act on the volunteering rate (which is explored below as well), then when the target size was increased by 100, 33% of the 70 additional “deemed fit” soldiers were recruited as “first portion”, which was around 21 to 22 more soldiers in figure. This corresponds nicely to the previously identified impact of targeting on “first portion”, which is more or less of the same magnitude as the impact of fitness adjustment on “first-portion” increase. Hence, it could be argued that when the district administrators were complying with a target increase assigned by the colonial officials, such that the

²⁰This standard deviation is the one for the target variable that is purged of district fixed effects. This is to ensure that the variation in terms of standard deviation value of the target variable is capturing inter-temporal variation, yet not cross-sectional variation, given that the variation of the main regression specification ultimately concerns the variation in a given district over years. Intuitively, this standard deviation is much smaller than the standard deviation of the normal target variable, which is around 105.

“first portion” was indeed increased, the bulk of these additional “first portion” soldiers were achieved via fitness adjustments.

Furthermore, in order to interpret the fitness increase as a result in itself, if we believe the general health conditions net of huge shocks or other aggregate trends in terms of health improvement to be rather stable over time, then after having included specific fixed effects, there’s rather little reason left to believe why when the recruitment target was unexpectedly increased in a district in a given year, the indigenous Africans to be recruited would all of a sudden exhibit “better health conditions”. Hence overall, the results above invite more speculation as to whether the increase in fitness outcomes imply a lowering of medical examination standards, hence potentially soldiers of lower health qualities were supplied in years of target increases. The following sub-section would try to explore this further.

7.2.2 Heterogeneous impacts given labor constraint and target pressure

As previously argued, if the effect of targeting on fitness adjustment mainly stemmed from regions that had known a large labor constraint of recruitment up till the year where the increase in target number occurred, then it’s more likely that the increase in fitness outcomes was due to a relaxation of medical examination standards, instead of genuine efforts exerted to follow up on the enumerated labor or give the best labor away to the military as a last resort. As such labor recruitment constraint could be proxied by the lagged lottery rate in a given district, table 5 presents the results of estimating equation (3).

Column 1 to column 3 in table 5 reports the results of the sub-sample where certain target values are missing. Firstly, the interaction term between target and lagged lottery rate significantly enters the regression specification in column 1 where year and district fixed effects are controlled for. However, such significance disappears at a rather fine margin when more stringent colonial- or district-specific linear trends are added in the regression, although the target variable and the interaction term are always jointly significant (not reported) in column 2 and column 3. In addition, the sign of the interaction term is always positive, which is consistent with the previous hypothesis that additional labor constraint is seemingly associated with an increase in fitness outcomes. More strikingly, it seems that the auto-correlation of the fitness variable at lag one is significantly positive, hence the rationale raised before to control for the lagged dependent variable is warranted. Ultimately, the pure effect of lagged

lottery rate remains consistently negative and insignificant.

On the other hand, when the adjusted target measure is employed in the regression, the interaction term turns significantly positive from column 4 to column 6. Although in these adjusted-target-based regression specifications, the pure association between lagged lottery rate and current fitness rate becomes significantly negative, even after the lagged fitness rate and all types of fixed effects are controlled for. This indicates that there could be other kind of endogenous association between these two variables which may not be completely explained by the structure of the current regression model. However, such an association wouldn't affect our interpretation very much in the end, as given the endogenous nature of the lagged lottery rate variable, it would be inappropriate to analyse the results in the fashion that given a certain district target size, what the impact on fitness rate would be given a one standard deviation increase in the lagged lottery rate. Instead, as previously argued, lagged lottery rate is essentially a proxy for local labor recruitment constraint, which should be taken as an indicator of the given status quo to further analyse the heterogeneous impacts of additional changes in target size. As both the interaction term and the target variable's coefficients are highly significant and positive, the initial hypothetical heterogeneous impacts of a target increase given varying labor constraints is still valid. Specifically, for a district with a mean past-year lottery rate standing at around 0.10 (25th percentile), a one standard deviation increase in the target size of around 60 soldiers in the current year would increase the current-year fitness rate by 4.0 percentage points. Such a magnifying effect of a target increase is larger for districts with higher labor constraints. For example, for a district with a past-year lottery rate of 0.75, which stands at around the 90th percentile of the lagged lottery rate distribution, a one standard deviation increase in the target size would result in a rise of the fitness rate by as large as 6.3 percentage points. Although the overall fitness rate could potentially be lower in the district with higher lagged lottery rate due to the significant negative association between the lagged lottery rate variable and current-year fitness rate, the impact of target interacted with lagged lottery is always significantly positive and this is where the ultimate interest of empirical exploration here lies.

On the whole, the analyses above present us with a more nuanced interpretation of the impacts of targeting on fitness adjustment. It seems that higher (more positive) fitness adjustments are indeed taking place in regions where the conscription labor constraint is also running high (manifested in a

high lottery rate from last year). All of this makes it more likely that the adjustment in fitness rate is a rather endogenous and negotiated decision on the spot, instead of being the result of genuine efforts exerted by the district administrators to “faithfully” supply the best local labor to the military so as the conscription pressure demands. It is imaginable that the district administrator could have been engaging in negotiations with the medical examiners and other military personnel in the drafting commission, such that the increased target pressure has made the scarcity of local labor a more pressing and even threatening matter for local development, fitness rate adjustments hence might be the best ecclesiastic outcome to both satisfy the target quantity on the one hand, and not drain the strength of the local labor force to the fullest on the other.

To give more confidence that the labor constraint effect is mainly acting on fitness adjustment, similar regression analysis is performed with present rate as the outcome of interest and the results are reported in table C4 in the appendix. However, it seems that such an interactive underlying mechanism via labor constraint pressure is not existent for the impact of target on presence, as the coefficients on the interaction term always stay highly insignificant across specifications.

Last but not least, two additional robustness checks are conducted to ensure that the major impact of a target change is centering around the adjustment of fitness rate, but not elsewhere. One suspicion as raised above is that the district administrators could very simply negotiate to increase the lottery rate given a sudden target spike. Results on the impact of targeting on lottery rate itself are reported in table C5 in the appendix and such results preclude the aforementioned scenario, as the coefficients remain highly insignificant and the magnitude stays around zero. Last but not least, another piece of evidence to rule out the possibility that the results found above are rather due to spurious or a mechanical correlation between the variables of interest is to examine if such a corresponding relationship exists between target numbers and volunteering rates. Intuitively speaking, there would be rather little rationale as to how target number would affect the pro-activeness of the enumerated soldiers to volunteer, given that the latter is mostly an individual-based decision, while the effect of the former is mostly on the administrative capacity of the lower-level colonial authorities. As reported in table C6 in the appendix, such an effect is almost non-existent as the coefficients are always nearly indistinguishable from zero and highly insignificant.

7.3 Results of the impacts of weather shocks on military participation

7.3.1 Reduced-form effects of weather shocks on volunteering and present outcomes

Moving forward to estimating the impacts of weather shocks on military participation, the effects of annual sample-period weather shocks on volunteering rates are reported in table 6, estimating after equation (4).

First of all, in terms of temperature shocks, on the one hand, negative temperature deviations seem to be exerting a consistently negative and significant impact on volunteering rates across all regression specifications, which means that when the negative shock turned more negative (i.e. the weather conditions become more extreme), there was an increase in volunteering initiative. While on the other hand, the impact of positive temperature deviations is only partially positively significant and turns null when more fixed effect controls are added. If anything, negative temperature shocks seemed to be ratcheting up people's volunteering initiative more than potential positive heat-wave shocks.

On the other hand, in terms of the effect of rainfall shocks, only positive rainfall deviation has a consistently significant effect on volunteering participation into the army. In the preferred specification with district-specific linear time trends and all weather shock variables jointly included in the same regression (column 7 of table 6), the positive rainfall shock coefficient could be interpreted as that on average, for a given district, a one standard deviation increase in the standardized annual positive rainfall deviation would lead to a 2.9 percentage-point increase in volunteering rate. This is a rather sizeable effect given that the average volunteering rate across the entire FWA was around 13% from 1920 till 1938. Furthermore, this impact of positive rainfall shock might be hinting that when there was a higher risk of flooding, which could potentially hurt the agricultural earning or general living conditions of the indigenous, people would prefer to secure a place in the military by volunteering more. Although such "agriculture income effect" stories for both rainfall and temperature shocks are too early to conclude at this stage, more subsequent analyses would be complemented in the following sections.

In the same vein, similar empirical explorations are performed in analyzing the effects of weather shocks on present rates and the results are reported in table 7. Contrary to the results found for volunteering rates, the sole important weather shock factor on present rate seems to be positive temperature shocks, namely in years when it turned abnormally hot, which could be increasing risks of drought,

people showed up more frequently to the military.

7.3.2 Heterogeneous effects of weather shocks on volunteering and present outcomes

Given the previous discussion that the reduce-form effect of weather shocks on military participation could be hiding other underlying patterns of impacts, the heterogeneous effects of weather shocks estimating equation (5) would be duly explored as well.

The results of heterogeneous impacts on volunteering rates are presented in table 8, where if we restrict our attention to the first three columns, we could observe that the only coefficient significant across all three regression specifications is the one on the interaction term between palm line cultivation and positive rainfall deviations, while the positive rainfall deviation term alone becomes highly insignificant across all specifications. This is informative of a potential underlying story that all the encouragement effect of positive rainfall deviations on volunteering rates identified in previous analyses seemed to stem from its effect exerted in particularly rainfall-abundant (palm-cultivating) regions. Furthermore, the magnitude of the positive coefficient on the interaction term is almost three times as large as that in column 7, table 6. This indicates that the positive effect of positive rainfall deviation on volunteering rates was much more salient in rainfall-abundant regions of FWA.

Intuitively speaking, such results add more confidence to the interpretation of the effect going through a negative agricultural income channel due to extreme weather shocks (in this particular case potential “flooding events”), as it was in the already relatively more rainfall-abundant regions that an extreme positive rainfall shock rendered the risks of flooding more salient, henceforth damaging the harvest prospects of agricultural plants for that particular year.

On the other hand, in terms of temperature deviations, the only consistently significant term across all regression specifications in table 8 is the interaction term between the palm line indicator and negative temperature deviation. The coefficient is significantly negative, which indicates that when the weather got even colder (a decrease in the negative temperature shock) in conventionally cooler palm-cultivating areas in FWA, volunteering rate actually increased. Such a painting of the reality to an extent complements the potential flooding story as just analyzed, if we believe that extreme positive rainfall shocks are usually accompanied with cooling effects, such as a sustained slump in temperature at the same time, then these two consistently significant interaction terms could be read as “two sides of

the same coin”, such that when an extreme flood hit the coastal and tropical regions of FWA in a given year, and in the meantime temperature also significantly dropped, the prospects of earning sufficient income from agricultural activities became grim and such a threat to basic livelihoods propelled the indigenous to view military as an insurance device of last resort where they could at least guarantee a minimum level of living.

The sporadically significant interaction term between the palm cultivation indicator and positive temperature shock presents a puzzle. It indicates that when it became hotter in regions that conventionally enjoy a cooler climate, the indigenous would volunteer more than the ones in traditionally hot areas that were also struck by a heat wave.

Moving away from the heterogeneous effects on volunteering rates, the same empirical analysis on present rates is conducted in table 9. In contrast to the null effect of rainfall deviations in the rather more reduced-form analysis in table 7, the two terms that are consistently significant across all regression specifications are the negative rainfall deviation and the interaction between negative rainfall deviation and the palm cultivation indicator. The significant negative coefficient on negative rainfall deviation indicates that in regions that conventionally did not have palm cultivation (in other words hotter and less rain-abundant on average), a negative rainfall shock induced people to show up more frequently to the military conscription center. While on the other hand, in addition to this negative effect, when the same negative rain shock struck, people living in the regions with conventionally more rainfall seemed to be responding less to the enumeration calls and were less likely to present themselves at the conscription centers. This effect is hard to square with a potential agricultural income channel at play, and further given the fact the region with this effect manifested is conventionally rain-abundant, therefore it’s rather less likely that a negative rainfall shock would induce risks of drought.

On the other hand, in contrast to the consistently significant effects of positive temperature deviation on present rates in table 7, the heterogeneous effects of temperature deviations on present rates, however, seem quite null across almost all specifications in table 9. This points to a potential channel that the effects observed in table 7 might be evenly spread across all regions without specific climatic concentration patterns, hence maybe also less likely to carry an underlying income channel story either.

7.3.3 Further explorations on potential flooding and drought events

The previous heterogeneity analysis more concretely reveals the fact that certain potential flooding and drought events induced by rainfall and temperature shocks were potentially motivating the indigenous to volunteer and present themselves more frequently to military conscription. Furthermore, if the supposed shock-income-participation nexus is indeed at work, then rather naturally we could expect that the most extreme forms of weather shocks should be the events triggering the negative income channels to the fullest. In the following, results of the impacts of weather shocks constructed via further linear-spline-splitting approaches (equation (6)) are reported.

The first three columns of table 10 reports the results of rainfall shocks on volunteering rates exploiting the “standard-deviation division” linear-spline-splitting approach. As could be observed, the only significant term across all specifications is the “most positive” rainfall shock. The coefficient in column 3 could be interpreted as the following: for rainfall deviations that are larger than one (standard deviation), a one standard deviation increase would lead to a 4.1 percentage point increase in the district-level volunteering rate. The “most positively extreme” rainfall deviations solely exerting the effect on volunteering outcome is consistent with a potential flooding story as painted above. Furthermore, another splitting method based on the four quartiles of the deviation distribution give very consistent results (reported in table D1 in the appendix), with the most positive deviations exerting the only and positive effects as well.

The results on the effect of temperature shocks, however, is a bit harder to interpret (column 4 to 6, table 10). Firstly, nonetheless, it’s clear that the most negative temperature shocks were associated with an increase in volunteering participation, which is consistent with the results found before, such that extreme rainfall inducing flooding events is most plausibly accompanied with a significant drop in temperature. However, the differing impact of positive temperature deviation at different ranges paints a puzzle. If the effect is well-identified, it seems that firstly an increase in positive temperature deviation induced more volunteering and at the extreme, such positive deviation actually undercut the original initiative to do so. The results for all types of deviations just discussed are consistent across the two spline-splitting methodologies. Ultimately, an inclusion of all the weather shock measures in column 7 doesn’t change the significance and magnitude of the coefficients of interest by much.

Furthermore, the impact patterns for present rates are equally worthy of discussion. Firstly, absent

the heterogeneity analysis, the further break-down of the rainfall shocks into more splines actually reveals that the most negative rainfall shocks were exerting a significant negative effect on present rates (table 11), which is not present in the simpler positive/negative binary explanatory variable specification as discussed previously. This echoes the findings in table 9, where the heterogeneity analysis of the impacts of weather shock on present rate reveals that in conventionally arid regions, a negative rainfall shock would actually induce more indigenous to show up for conscription. If anything, there seems to be a drought-income-presence nexus channel at play, although it's not as robust or as concretely identified as the flooding-income-volunteering nexus.

On the other hand, this finer splitting approach doesn't render the interpretation of temperature shocks easier than before. If anything, there's a consistently positive effect of positive temperature deviation (although within the initial positive range between zero and one standard deviation only) on present rates, which corresponds to the positive impact of positive temperature deviation on present rates as identified in table 7, which supports the drought channel to a certain extent, but not to the fullest.

Given the rather indicative findings exploiting the finer linear-spline-splitting approaches, I attempted to combine this approach with the heterogeneity analysis performed above. The results are reported in table D3 and table D4 in the appendix, where we could see that if we limit our attention to rainfall deviations, for the impact on volunteering rates (table D3), only the interaction between the most extreme positive rainfall deviation and the palm line indicator are significant and for the impact on present rates (table D4), the raw term of the most negative rainfall deviation is also consistently significant across specifications. Both scenarios are consistent with the respective underlying channels painted above.

One lingering puzzle up till now could be that why it seems that there's a significant flooding effect on volunteering, while drought seems to be more at play for present rates.

First of all, we need to take into account as per discussed that volunteering rate can be regarded as a more behavior-based outcome than present rates, which could be the result of concerted efforts between both the colonial authorities and the indigenous Africans. As such, the potential agricultural income channel as painted above would be more likely to be at play for volunteering initiative than present rates with even everything else held constant for the moment.

Furthermore, in terms of the differential effect between flooding and droughts, one reason might be due to the fact that weather shocks, especially flooding events could affect the presence outcomes not solely, or principally via the hypothesized income channel. Another main reason why flooding might prevent people from showing up to the conscription center is if excessive rainfall made transport from the residential areas to the conscription centers more difficult, due to either a blockage of roads or a lack of proper access in such severe weather conditions. This is consistent with the more qualitative historical evidence that the enumerated indigenous had to travel for a few days, sometimes even weeks to arrive at the conscription center, the journey of which could be an arduous process for many, if the weather conditions aggravated the accessibility of the locality of the drafting commissions. Thus, the negative income channel on stimulating people to show up and the difficulty to access channel on making it practically implausible to reach the conscription center might have counteracted each other's impacts on present rate in the end.

Ultimately, in terms of the effects of drought events, it's important to bear in mind that the effects on present rate are not very clearly identified to start with. Even if an effect is indeed existent between droughts and present rates, in order to better understand why the effect is null for volunteering, we might need other weather shock measures that could essentially capture drought risks better than rainfall or temperature separately included in the regression to answer this question.

7.4 Impacts of weather shocks on taxation and associated adjustments in military outcomes

The impacts of weather shocks might not be limited to military participation outcomes. District administrators could be endogenously adjusting the head taxation rates given the varying taxable capacity in a given year, which arguably can be influenced by significant weather shocks.

First of all, in exploring the head tax rate as an outcome of interest in itself, as previously mentioned, it's key to identify the relevant-time-period weather shocks that should be influencing the drafting of the annual head tax rate in reality. As previously discussed, if there's any association between tax rate and weather shocks, it's most reasonable to expect the current-year per capita head tax adjustment to majorly respond to the weather shocks endured by the district from the year before.

Table 12 reports the results of weather shocks' impact on district-level head tax rate with such

underlying assumption. The independent variables, the lagged rainfall and temperature measures indicate the respective district-specific weather shocks from the previous year. As can be seen, the only significant coefficients are associated with positive temperature deviations, and the sign of the coefficients further indicates that when a heat wave had struck a district in the previous year, the district-level authorities would be more likely to lower the head tax rate to be levied in the following year, which seems to be a certain “appeasement policy” at play. While on the other hand, the impacts of rainfall shocks remain highly insignificant.

Second of all, for the adjustment in tax rate to interfere the interpretation of weather shocks on military outcomes, there are two scenarios that should be treated separately. Firstly, given that the main empirical analysis of weather shock effects centers around the impact of current-year weather shocks on current-year military participation outcomes, for the adjustment in tax rate, which principally should only respond to the weather shocks from the previous year, to interfere this current-year effect, it must be that the weather shocks from last year should have similar effects on current-year military participation outcomes as current-year weather shocks do. In other words, there is a high year-to-year correlation of weather shocks. This could be readily examined by directly regressing the military participation outcomes on lagged weather shock variables.

Results for such regressions are presented in table 13 and table 14 with volunteering rate and present rate as respective outcomes. As we could see there’s almost no discernible impact of past-year weather shocks on current-year military participation in almost any form, with only very marginally significant effect of positive lagged rainfall deviation on current-year present rate. Hence, in this hypothetical scenario, there’s little reason to believe that the adjustment in head taxation is contaminating the impact of weather shocks on either volunteering or present outcomes.

The second scenario, however, albeit being less likely, is still explored out of caution. The previous assumption constraining the response of tax adjustment to weather shocks endured from the last year, although valid, could not be further supported with very detailed historical evidence at hand. Hence I test if there exists certain responsive adjustment in head tax rate given a weather shock occurred during the first six months of a given year, by directly regressing the head tax rate on the first-six-month-based weather shock measures in a given year. The results are reported in table E1 in the appendix. Although the coefficients remain significant across a range of specifications, it’s rather

unfathomable as to how these estimates should be interpreted. On the whole, if we assume that the tax adjustments were actually taking place in reality, it appears that head rates were unexpectedly adjusted upward when the weather conditions turned more extreme (either in terms of rainfall or temperature shocks), at times when the taxable base actually became thinner if negative agricultural income shocks were at play.

A more direct way to test if the head tax adjustment was twisting the impact of weather shocks on military outcomes is to directly add head tax rate as a control variable in the main weather shock regression. As discussed previously, the dataset containing the taxation controls and other public expenditure variables records only a very limited number of overlapping years with the conscript dataset, hence in order to preserve as large a sample size as possible, the missing values of head tax rates for the years with only data from the conscription dataset are linearly interpolated as a function of years at the district level. Ultimately, this helps to recover the sample size back to around 1,300 observations. Table 15 and table 16 report the results with such interpolated head tax rate as a control variable, respectively with volunteering and present rates as outcomes. For volunteering rates, it could be observed that the main significant coefficients supporting the previous interpretation still remains, such that the coefficients for both most positive rainfall deviation and most negative temperature deviation remain significant and of the same signs as before. The impacts on present rates (table 16), however, turn rather collectively insignificant with the inclusion of the tax control variable. However, given the fact the relationship between negative rainfall shock and present rate is not as robust as that one between positive rainfall shock and volunteering rates, a more detailed heterogeneity analysis might reveal a different reading of the coefficient estimates.

Such heterogeneity analyses with taxation controls are conducted in table E2 and table E3 in the appendix for volunteering and present rate as respective outcomes. Besides the consistently significant coefficients for the impacts on volunteering rates, even more strikingly, in table E3, the heterogeneity effect analysis reveals a consistently significant and large negative effect of the most negative rainfall deviation on present rates, after the head tax rate is controlled for, which is in accordance with the drought channel operating through negative income shocks, hence affecting the presence outcome.

8 Robustness Checks

8.1 Placebo test: Impacts of second-six-month weather shocks on military participation

As previously analysed, given the historical recruitment reality, the time period over which weather shocks should have a real tangible impact over military participation should be between January and June. Hence, weather shocks that occurred between July and December could serve as an ideal candidate for robustness checks on the effect of first-half-year weather shocks upon conscription participation outcomes. That being said, it doesn't necessarily mean that the impact of weather shocks that occurred in the second half of the year would always be insignificantly associated with military participation outcomes in that year. As previously analysed in terms of the correlation magnitude of various deviation measures, for temperature shocks, the deviations are quite evenly spread across the entire year, with no particular concentration of extreme temperature deviations in either half of the year. Hence, there might be some mechanical correlation between military participation outcome and second-half-year temperature shocks, given the latter's significant correlation with the first-half-year temperature shocks. The same could be said about the rainfall shocks, although the kind of mechanical correlation is expected to a lesser extent, given the rather low correlation between rainfall deviations in the two half years as previously shown.

That being said, what is important in this part of the analysis is that the impacts of the most extreme first-half-year weather shocks that support the key underlying channels of the previous stories, for instance the flooding-income-volunteering and drought-income-presence nexuses shouldn't be observed in any overly significant manner for the impacts of second-half-year weather shocks.

The heterogeneous impacts of second-six-month weather shocks on volunteering rates are reported in table 17, where we could observe that there's no consistently significant association between any kind of rainfall shocks and volunteering rates. What's worth mentioning is that the coefficient on the interaction term between the palm line indicator and positive rainfall deviation, which signifies the flooding negative income channel of the rainfall effect on volunteering initiative and is consistently significant in the first-half-year weather shock regression outcomes, becomes consistently insignificant in table 17.

In terms of temperature deviations, although we do observe a lot of significant associations across the board, none of them can actually be rationally explained with a potential underlying channel exerting negative income stress upon the local agricultural activities.

Firstly, the previous flooding effect on volunteering rate is also supported by a significant impact of negative temperature deviations in palm regions. Here although we do still observe a significant relationship between such interaction term (of palm dummy and negative temperature shock) and the volunteering rate, the significance now becomes only sporadic and the coefficient value is also much smaller than that in table 8. Secondly, the significant coefficient on the interaction term between positive temperature deviation and palm line indicator is the same as that observed in the last row of table 8. This could be mostly due to high correlations of temperature shocks in a given year of the sample period under study, as the previous correlation analysis indicates. Last but not least, the significant negative association between the pure positive temperature deviation and volunteering is hard to square with any income story at hand. If an effect does exist, it indicates that in traditionally hot regions where an additional heat wave struck, hence potentially further increased the risks of drought, people would actually volunteer less into the army.

In the same vein, the drought-income-presence channel also seems to have disappeared in analysing the impacts of second-half-year weather shocks on present rates. As we could see in the first row of table 18, the previous consistently significant effect of pure negative rainfall deviation (in non-palm-cultivating arid regions) now becomes only sporadically significant, and the significant coefficient on the interaction term between palm line dummy and negative rainfall deviation seems to further indicate a spurious correlation, as if the effect holds, it indicates that when there's less rain in conventionally rain-abundant regions, people would present themselves less frequently to the army. Ultimately, the associations between temperature shocks and present rates are also only sporadically significant.

In order to further replenish the placebo test using second-half-year weather shocks, the results using four-linear-spline divisions are reported in table F1 and table F2 in the appendix, where the same effect patterns are observed, such that there's no significant association between second-half-year rainfall shocks and volunteering rate at all (table F1) and the same goes for non-correlation between the most negative rainfall shocks and present rates (table F2).

8.2 Non-linear limited dependent variable regression outcomes

Given the bounded nature of my outcome variables, such that volunteering rate and present rate are both bounded between zero and one, it's been suggested by [Papke and Wooldridge \(1996\)](#) that a fractional logit or probit model should be preferred to a linear model, as linear prediction of the estimates does not necessarily comply with the "zero to one" bounded nature of the dependent variables under study here. Given that around 25% of the volunteering rate values are very close or equal to zero (the same proportion applies to present rate values close or equal to one), another regression specification modelling the effects in a non-linear manner should be attempted.

Besides the bounded fractional outcome concerns, when a regression is modelled in a non-linear probit or logistic fashion in a panel setting, the employment of time-invariant fixed effects (district fixed effects in my scenario) would oftentimes entail bias in estimates unless the time periods are sufficiently large ([Greene, 2002](#)). Hence for unbalanced panel dataset as the one under study here, [Wooldridge \(2018\)](#) further suggested that a fractional logistic model with correlated random effects should be exploited. His suggestion is basically a specific modelling of the unobserved time-invariant heterogeneities, in which he proposes that time averages of the observed covariates and time period dummies (the number of time periods each unit appears in the sample) should be added to control for any potential endogeneity issues resulting from correlation between observed covariates and underlying time-invariant heterogeneities. As such, I adopted an unbalanced fractional logit estimation in table 19 and table 20 for analyzing the effects of sample-period climatic deviations (using Delaware data) on both present and volunteering rates. Rather strikingly, the results obtained are quite consistent with those obtained with linear panel fixed effect specifications. For example, in a similar fashion as the results obtained in table 10, in table 19 we also observe a significant positive coefficient on the most positive rainfall deviation and a significantly negative coefficient on the most negative temperature deviation. The magnitudes of the marginal effects are also very similar to what we obtained previously, such that a one standard deviation increase in rainfall shock in its most positive range would further increase the volunteering rate by around 5 percentage points.

The effects are even more cleanly identified in table 20 on the non-linear impacts of weather shocks on present rates. The only consistently significant terms across specifications seem to be the most negative rainfall deviation and the most negative temperature deviation as well. The significance of

the previous term further supports the drought-income-presence nexus as analyze before, and the magnitude of its marginal effect is much larger than that of the impact from negative temperature deviation, which has not been detected in previous analysis.

Overall, the results from the non-linear model estimation to an extent alleviates the concern that the results found previously could be biased, or overly imprecise due to the lack of attention paid to the bounded nature of the outcome variables and finer non-linear effects of weather shocks.

8.3 UEA-data-based weather shock regression outcomes

Given the detailed discussion beforehand that the weather shocks could be constructed from two independent sources, the deviation measures so as calculated with data from University of East Anglia (UEA) could be used as alternative explanatory variables for robustness check on the impacts of Delaware-based weather shocks. Although given the very low correlation between the temperature deviations constructed from the two sources, the validity of the robustness checks at the end of the day may be principally limited to the impacts of rainfall deviation measures. But further given the fact that most of the interpretable significant impacts identified previously stem from rainfall shocks, such lack of robustness counterpart for temperature deviations may not be a large concern in the end.

Given that a lot of military participation regressions could be essentially replicated with UEA data, the results are all reported in section G of the appendix. Overall, the impacts of rainfall shocks appear to be very robust when they are constructed from UEA data, such that a significant positive impact of (most) positive rainfall shock (mainly concentrated in palm-growing regions) on volunteering rates and a significant negative impact of (most) negative rainfall shock (mainly concentrated in arid Sahel regions) on present rates are both consistently observed across different specifications. On the other hand, the impact of temperature shocks no longer holds, for example the significant negative impact of (most) negative temperature shock (concentrated in palm-growing regions) on volunteering rate completely disappears and the impacts of temperature shocks on present rate become also very volatile, with a lot of sign flipping across various regression specifications that cannot be readily interpreted.

9 Discussion of results and future research orientations

With all the results at hand, there's still a wide range of implications for potential future research.

Firstly, in terms of the impacts of targeting on conscription procedure adjustments, one striking, as well as puzzling result that stands out is the rather low ultimate fulfilment of the recruitment target. Tentative evidence seems to suggest that the district administrators were not complying with such target orders from higher-ranked officials for the bulk of the time. Is it because the number of subjective volunteers was sufficient enough to make up for gap with the target? Or more intrinsically, the district authorities saw this as an opportunity to preserve more labor for local exploitation, instead of to be sent away for the French Army? Some other evidence also seems to suggest that the target increase was exerting significant positive increase in second portion, who were left out of the lottery to be so-called “military reservists” and would remain in the districts for local activities, such as the infamous activation of the second portion in French Sudan for the construction of the large-scale irrigation system *Office du Niger* in the 1930s (M. Echenberg & Filipovich, 1986). If such is the case, it points to a more drastic and interesting painting of rather “fierce” competition among different ranks of French colonial administration for the most important scarce resource of the time: prime-age young male labor. A better grappling of this issue at a more fundamental scale is out of the scope of this paper, yet the suggestive hypotheses as previously raised could pave the way for potential future analysis on furthering the complexities and infighting in institutional responses to the ruling constraints of European colonial states in Africa.

Second of all, although the empirical evidence suggests that most of these effects of targeting concentrate on the adjustment in fitness outcomes, but not on changes in enumeration or lottery rates, we need to bear in mind that the effects as such identified are still in essence in a “reduce-form” fashion. The decomposition of the target to be fulfilled in equation (1) further indicates that the adjustments at each stage of the recruitment procedure could all be affected by adjustments having taken place at all previous stages. Without a cleaner decomposition of the “sole effects” uniquely stemming from each single sub-step of the recruitment procedure, what has been identified previously could be mixing and bundling the adjustment responses from different steps together. As such, a more detailed arithmetic decomposition is still needed ensure that the bulk of effect of target size increase is concentrating on an increase in the fitness outcomes.

In addition, the magnifying effect of an increase in fitness rate given a target size rise in districts with heavier labor recruitment constraint signifies the potential supply of soldiers with worse physical

qualities to the French Army. Such a conclusion could be further verified with actual data indicating the physical conditions of the individuals. The individual files available only contain height measures restricted to those of the "incorporated soldiers", which is not sufficient to infer the general "health conditions" of all the indigenous people who showed up to the conscription centers. Hence, more dis-aggregate data on the physical conditions of the indigenous, especially data such as weight or other health indicators, should be collected via further data extraction in colonial archives if available.

Furthermore, the ultimate research interest on evaluating the impact of target on the functioning of the conscription system is to demonstrate the potential "mal-functioning" and inefficiency of such top-down direct French colonial rule, due to either competing interests or asymmetry of information at different levels of the administration. It would be interesting to capture such potential interplay of the varying interests among the colonial officials, military personnel, district administrators and eventually local chiefs as previously mentioned. Essentially, more exhaustive data on the salary-based employment relationship between the chiefs and the district administrators should be collected to delve deeper into such potential mechanisms.

Moving onto the effects of weather shocks on military participation, one area where future research could improve upon is on the impact of temperature shocks. The fact that the overall impact of temperature shock is not as cleanly identified as rainfall could be due to a variety of reasons. Firstly, the impact of temperature shocks on military participation outcomes working through agricultural income channels is rather weak, or at least not as salient as that of rainfall shocks. Secondly, the measurement of historical temperature, especially that dating back to the beginning of the 20th century in a region with perhaps raw and incomplete weather collection methods, could have been tinged with a great deal of measurement errors, especially given the rather diverging shock measures constructed from the two sources at hand. In order to further address such issues, on the one hand, it would be preferable to extensively survey the existence of potential historical weather-station-based temperature data in French West Africa, or to exploit other weather shock measures which simultaneously exploit both the temperature and precipitation dimensions of the weather conditions, such as the Standardized Precipitation-Evapotranspiration Index (S.P.E.I.) developed by (Vicente-Serrano et al., 2010) and recently exploited by (Harari and Ferrara (2018) to analyse the impacts of contemporary weather shocks on conflicts in Africa. Rather unfortunately, the S.P.E.I. data do not cover sufficiently

disaggregate geographical data points for FWA from 1920 to 1938. In the future with more fine-tuning and expansion of the dataset, an investigation of the impacts of more well-rounded weather shocks could be attempted.

Besides weather shocks inducing negative income shocks on the livelihoods of the indigenous agricultural smallholders, there are other channels via which such significant negative income fluctuations could be taking place. French West Africa was a vibrant commodity cash-crop exporting region during the colonial years (Hopkins, 2014) and given the price volatility of a few kinds of main cash crops at the time, especially during the years of Great Depression (1930s) which also happens to a key time window under analysis in this paper, there's reason to believe that such price fluctuation could have significantly affected the basic earnings of the indigenous Africans in the field. Such an analysis requires very dis-aggregate data on the time-varying district-level intensities of cash crop plantations, such as cocoa, groundnut, palm oil and cotton in FWA during the colonial times. This would require more extensive survey as well as digitization of colonial crop plantation distributions given the availability of archival files.

Ultimately, the research in this paper only offers a brief glimpse at the potential historical impacts of military conscription during the colonial years. An equally interesting inquiry, which could be seen as the next research step of the current project, is to investigate the historical persistence of long-term developmental effects of military conscription, especially given the historical fact that a lot of second-portion military reservists were activated as forced labor for public infrastructure projects during colonial times (Van Waijenburg, 2018; M. Echenberg & Filipovich, 1986), such exploitative drainage of local prime-age agricultural labor might have resulted in unexpected long-term developmental divergence across different regions in FWA.

10 Concluding Remarks

In this paper, I apply panel fixed effects strategies to investigate the detailed functioning of the understudied colonial military conscription system in French West Africa during the interwar period (1920-1939).

On the one hand, the conscription system serves as a lens to better understand the rather intricate and stringent top-down direct French colonial rule in West Africa. In particular, when the military

conscript target assigned by the colony lieutenant governor was increased, the district administrators, together with other military personnel at the district level would devise varying strategies to cope with such an increase in recruitment quota. Strikingly, the administrators seemed not to be complying with the target number to the fullest and even if when they complied, they would only negotiate to endogenously increase the number of soldiers that would be “deemed fit” and hence met the criteria to be drafted into the military.

Such “endogenous adjustments” on the “fitness outcomes” might, in the end, go against the initial intentions of the colonial official who had wanted to enlarge the size of the French Army. As it’s been further supported that the increase in the fitness rate was most salient in regions with high existing labor recruitment constraints, this increase in fitness outcomes could most probably be attributed to a decrease in the fitness standards for conscription and the district administrators in the end could be supplying soldiers of worse physique to the military.

On the other hand, in terms of the role played by the conscription system on the daily lives of the indigenous Africans, despite its overall extractive nature, rather strikingly military conscription in colonial times provided the indigenous Africans as an important “insurance shelter” in times of negative agricultural income shocks induced by weather fluctuations. Specifically, in a bad agricultural year that witnessed an increase in flooding risks in rain abundant regions, the locals would be more willing to volunteering themselves into the military where they’d be exempted from the head tax rate levy, and correspondingly, when the risks of droughts increased in traditionally arid regions of FWA, the individuals would also be more likely to subjectively present themselves to the army.

An important line of future research would be to further identify other seemingly “extractive” colonial institutions, the functioning of which was understood by the indigenous and hence exploited by them to their own advantage as an “insurance lever” against extreme economic difficulties or other types of life-time crises. For instance, the French colonial authorities at the time also required the local chiefs or elites to send their children to study under the French education system. The local elites might have supplied “at least one” of their children for insurance purposes. Hypothetically, we could also observe a sudden spike of such supply in years of extreme economic conditions or political shocks, such as during wartimes or sustained famines. And such unexpected “insurance option” might in the end produce certain historical persistence of human capital accumulation as well.

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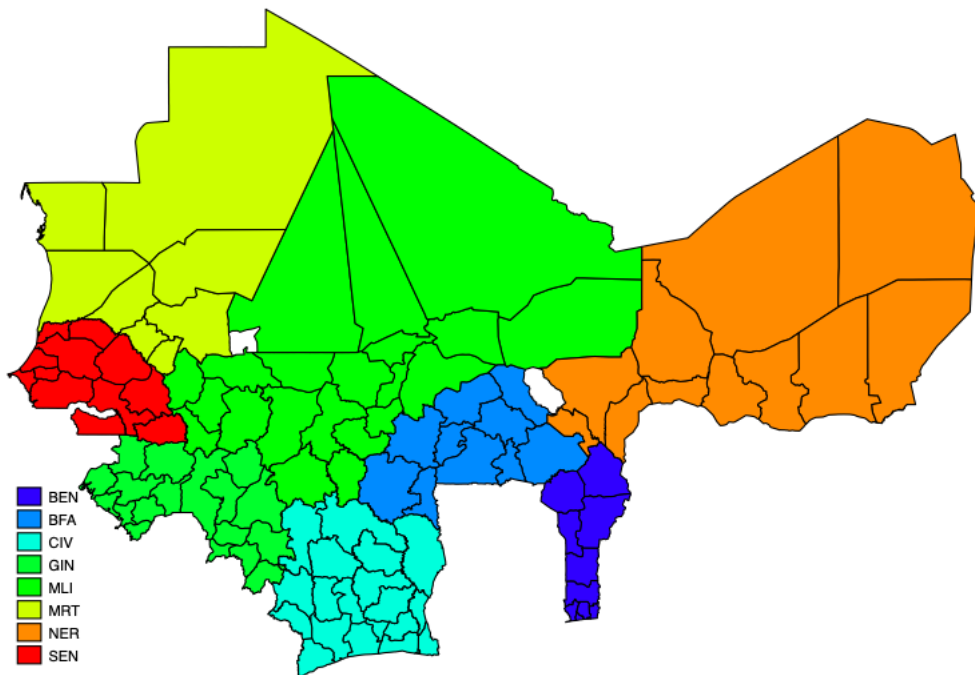
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11 Main Figures and Tables

Figure 1: Administrative Regions of French West Africa (1925)

Administrative Regions of French West Africa (1925)



"SEN" refers to Senegal. "BEN" refers to Dahomey (Benin). "CIV" refers to Cote d'Ivoire. "MLI" refer to French Sudan (Mali). "BFA" refers to Burkina Faso. "MRT" refer to Mauritania. "GIN" refers to Guinea. "NER" refers to Niger. The districts are delineated at their 1925 administrative boundaries.

Figure 2: Districts within palm tree cultivation regions (shaded in dark blue)

Districts with palm cultivation

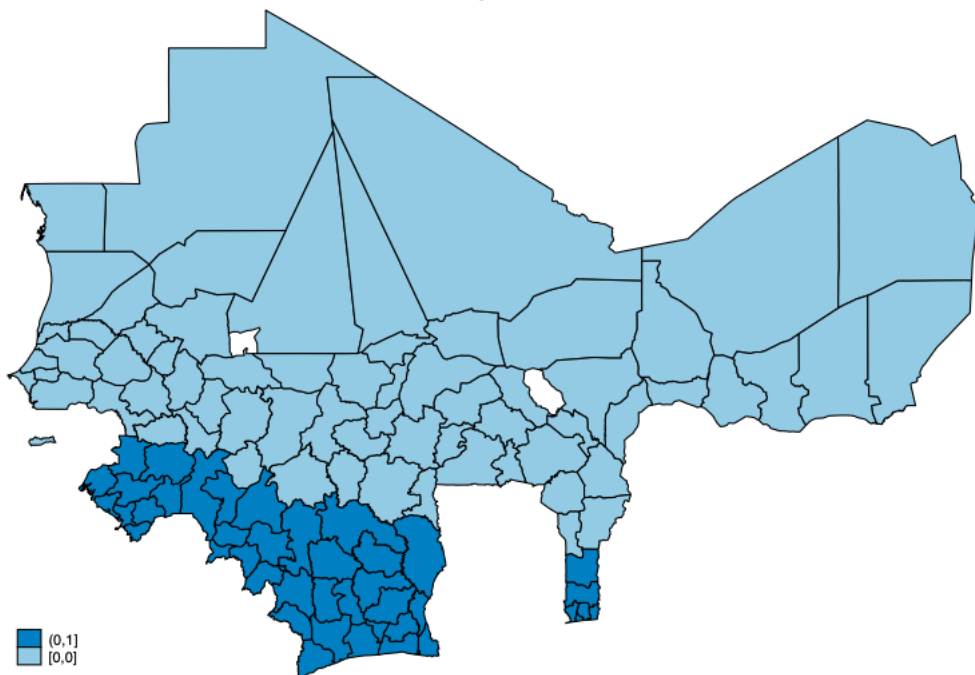


Figure 3: District within top 50% and 25% of rainfall distributions(shaded in dark blue)

Districts within the top 50% of rainfall intensity

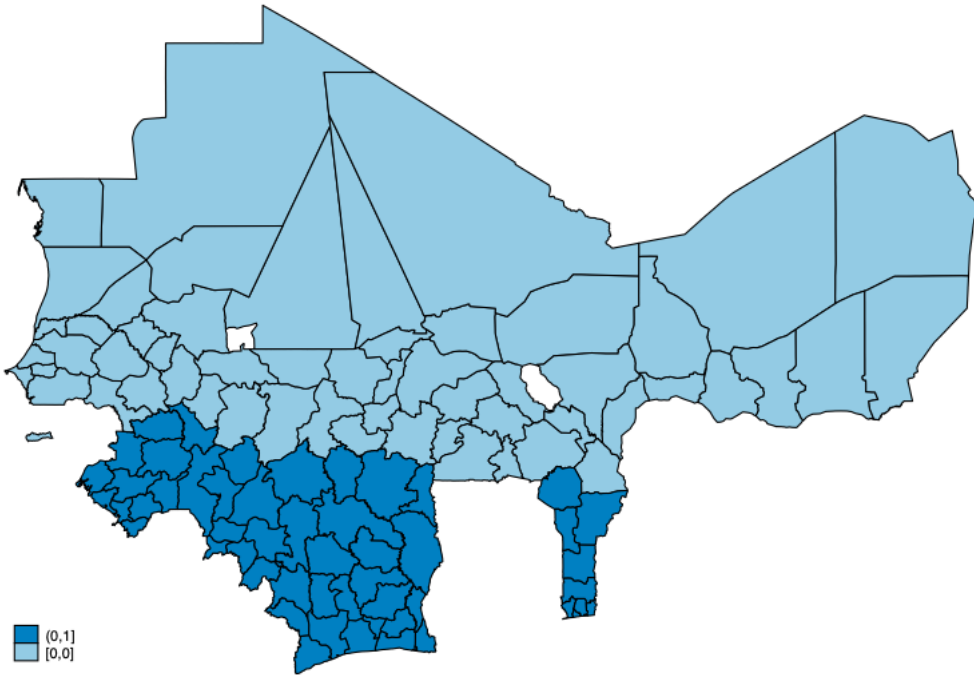


Figure 4: Districts within bottom 50% of temperature distributions (shaded in dark blue)

Districts within the bottom 50% of temperature intensity

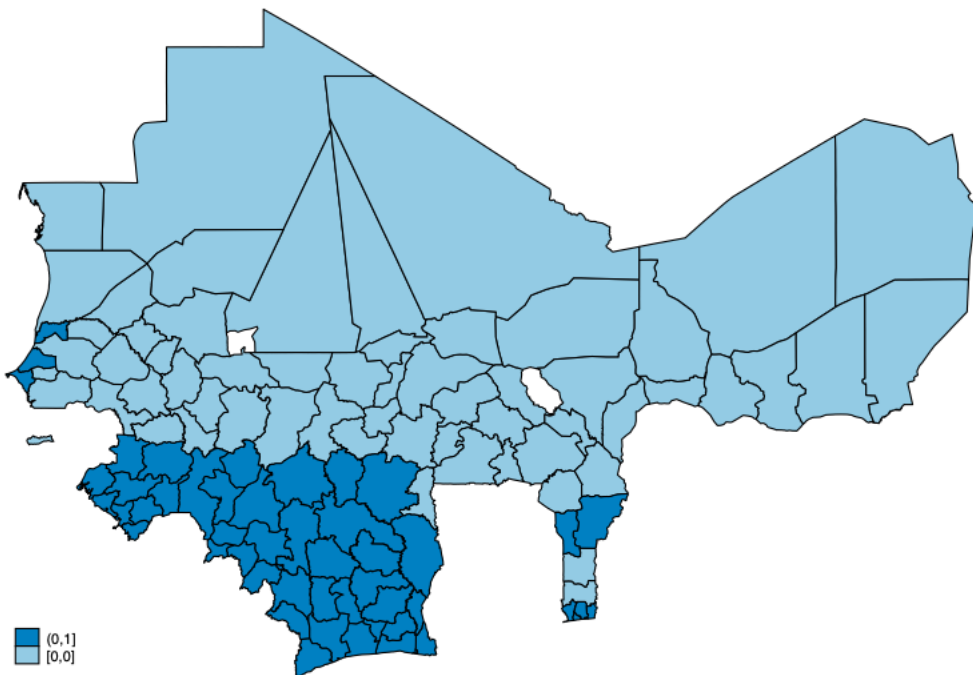
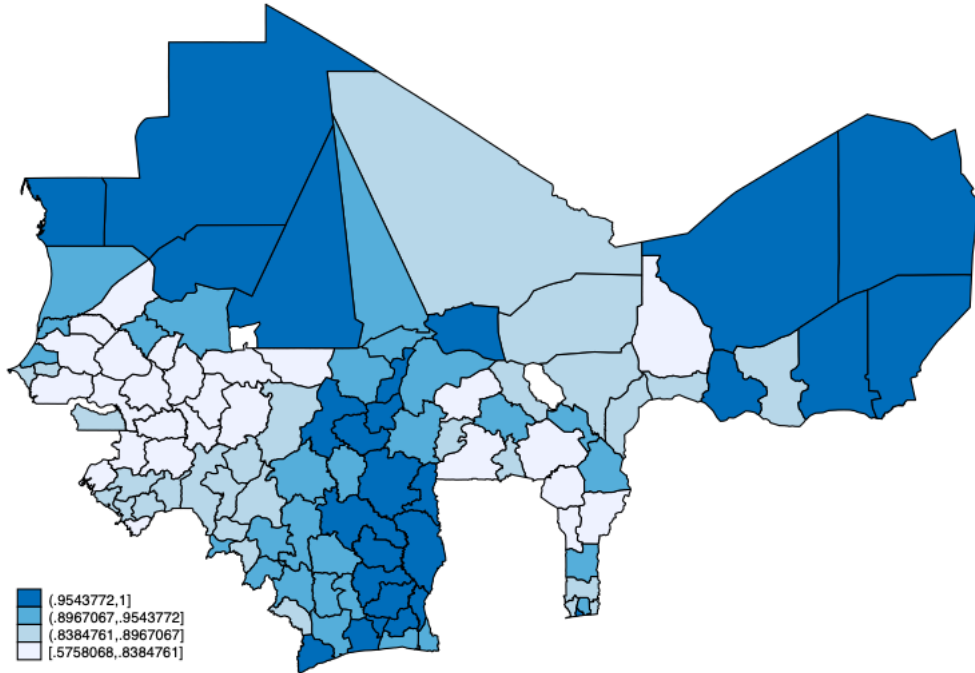


Figure 5: Average present and absenteeism rates distribution (1920-1939)

Distribution of present rates(1920-1939)



Distribution of absenteeism rates (1920-1939)

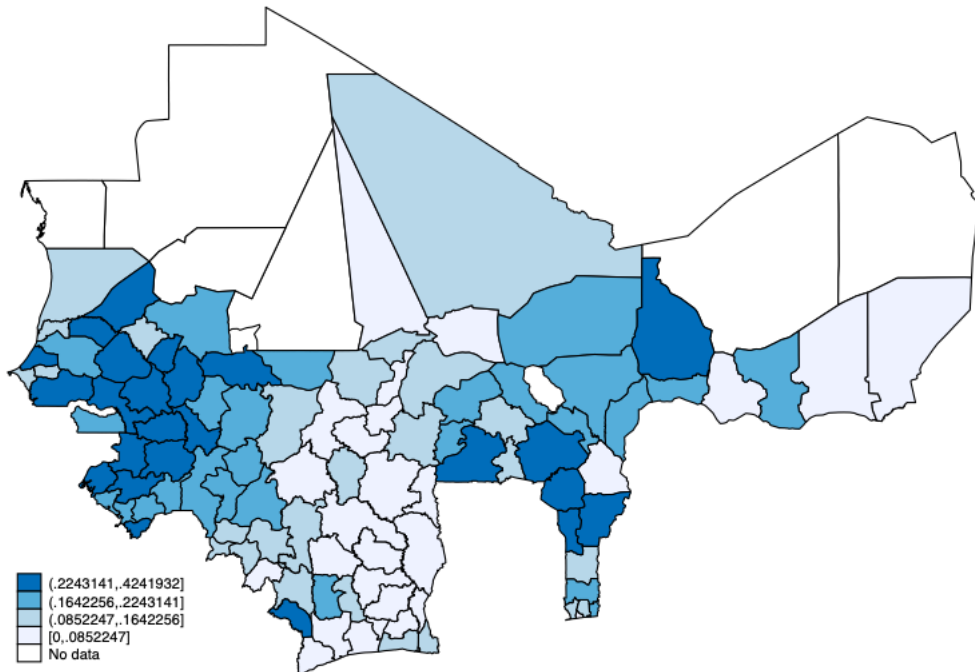
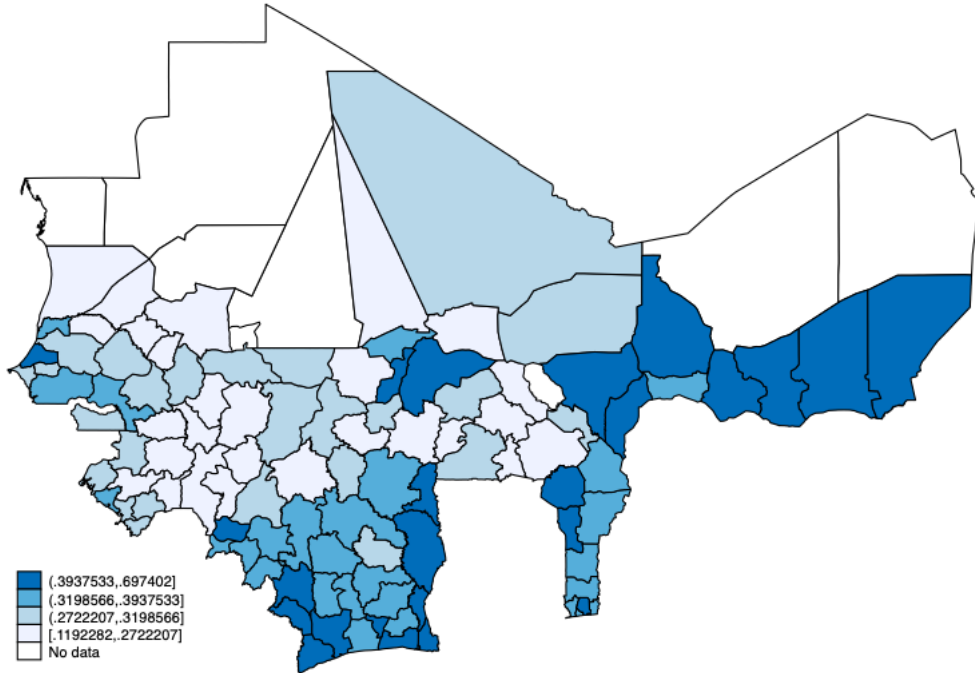


Figure 6: Average fitness and volunteering rates distribution (1920-1939)

Distribution of fitness rates (1920-1939)



Distribution of volunteering rates (1920-1939)

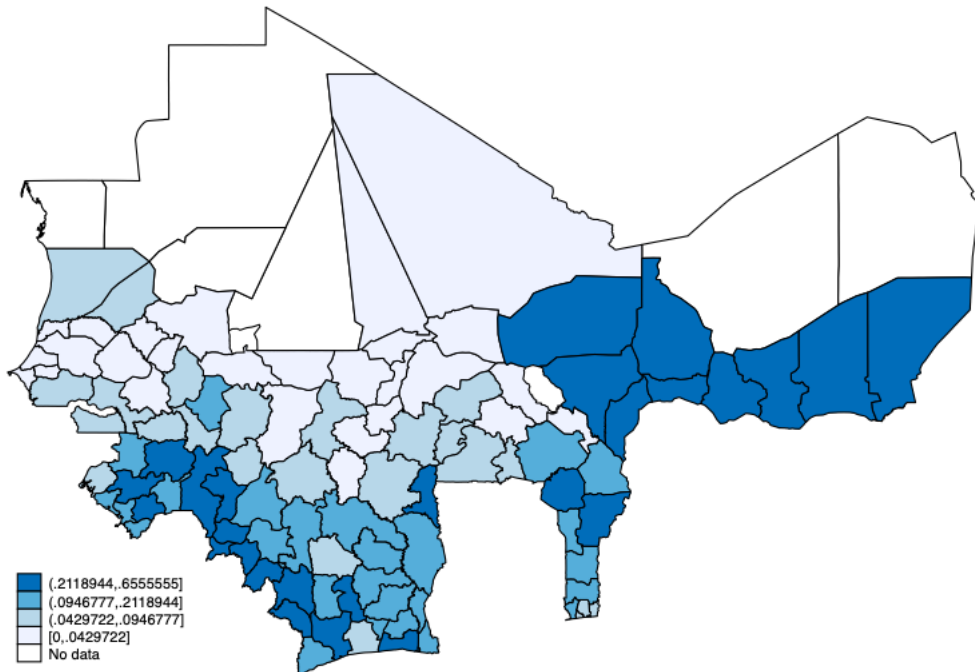
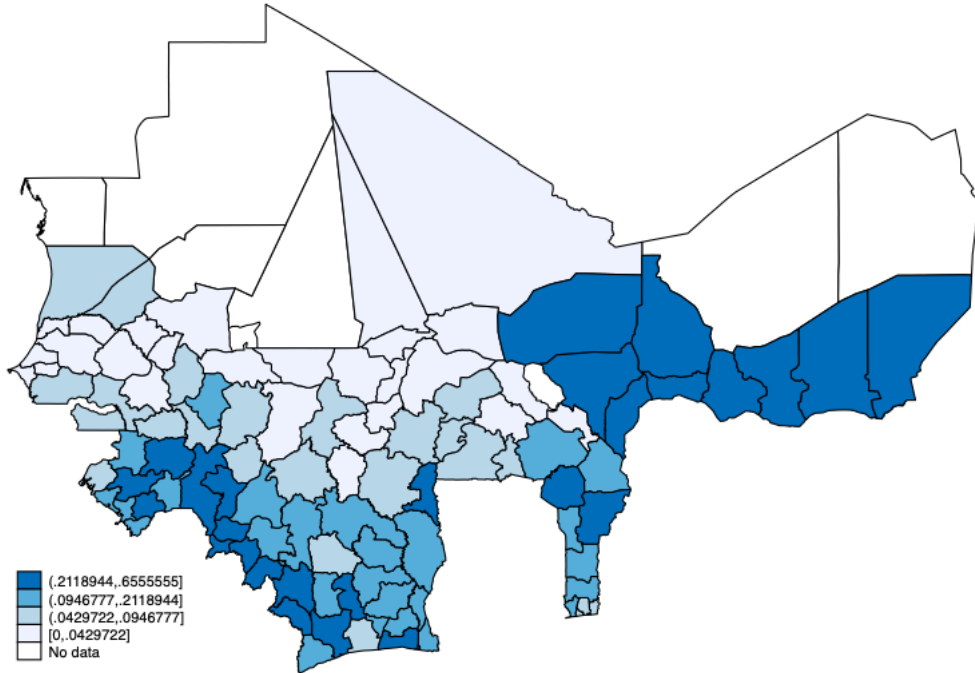


Figure 7: Average volunteering rates from two sources (1920-1939)

Volunteering rates (district data)



Volunteering rates (individual data)

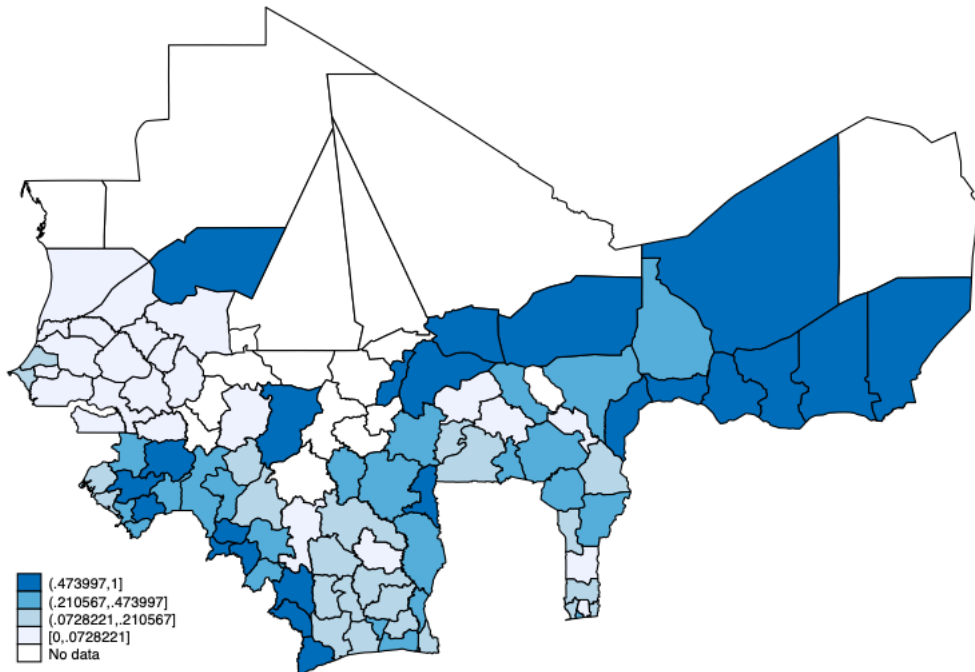
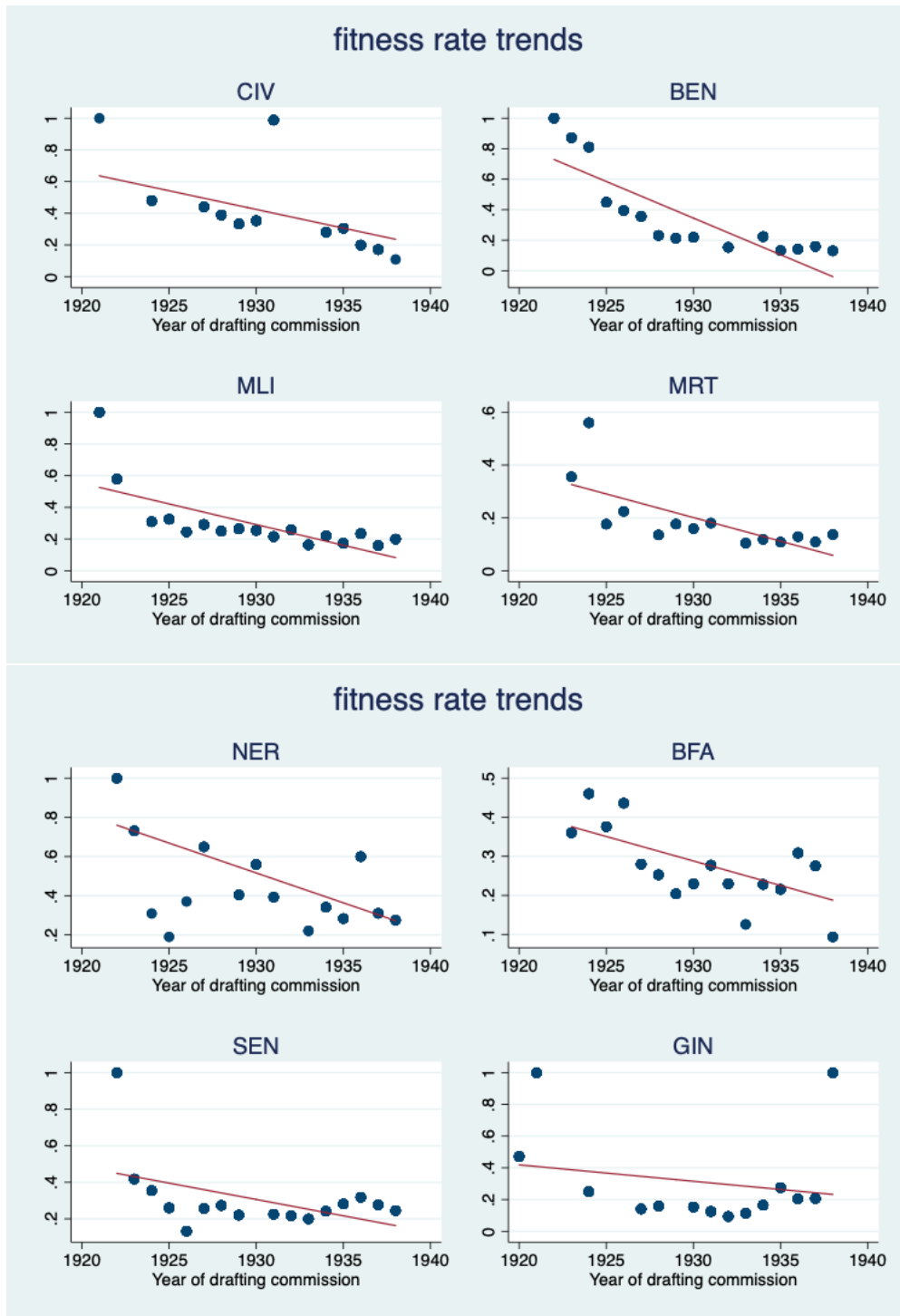
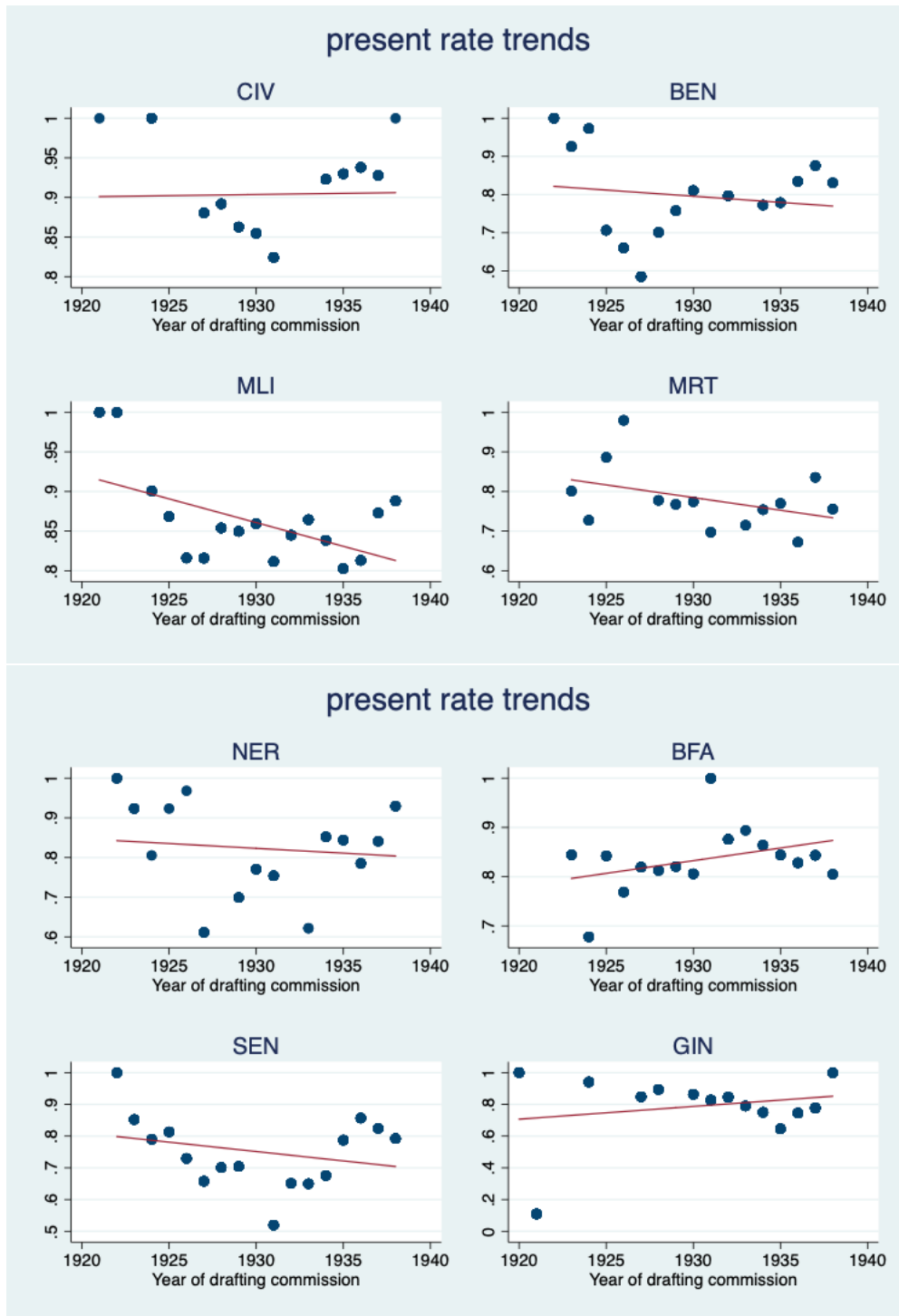


Figure 8: Fitness rates



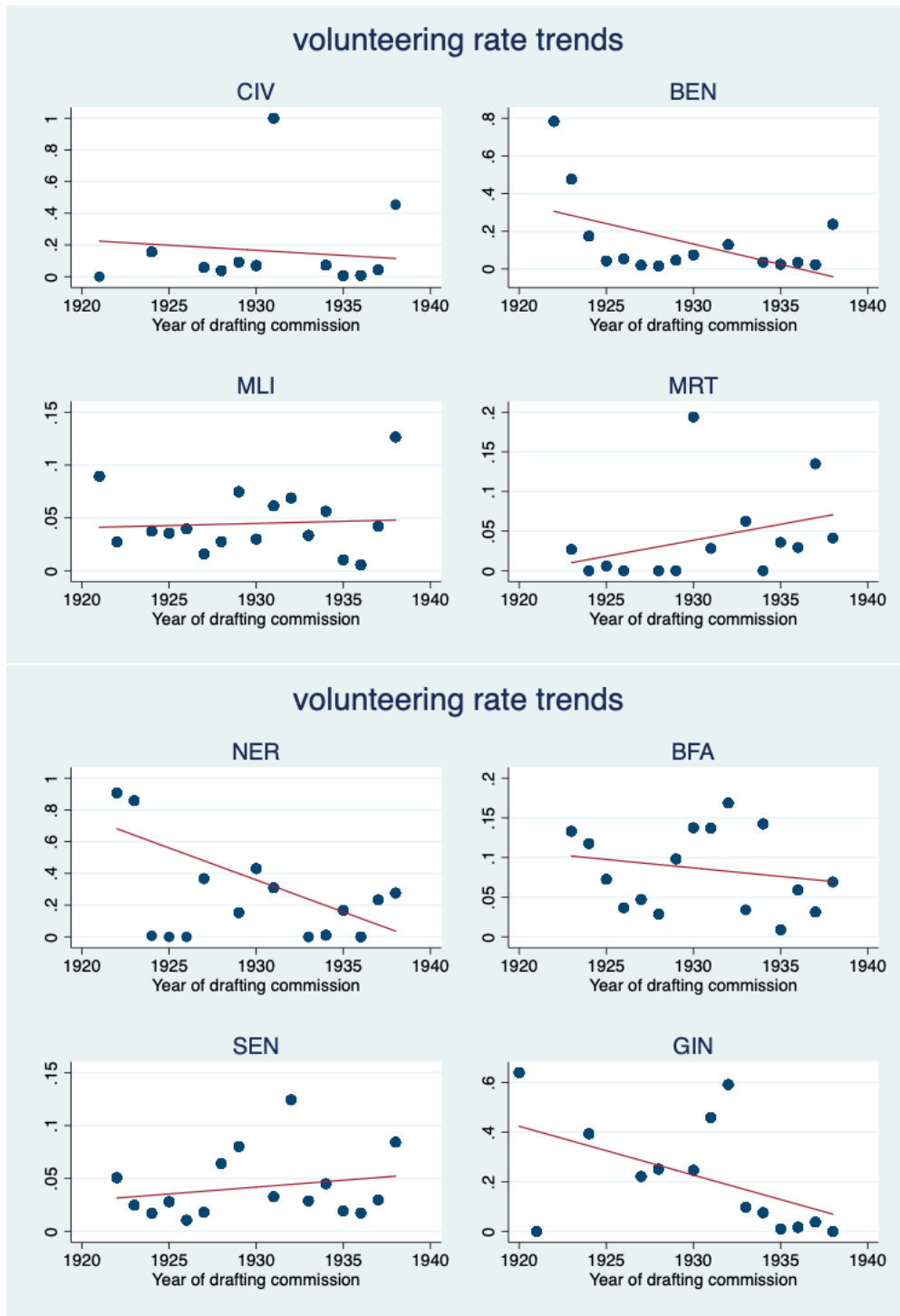
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Figure 9: Present rates



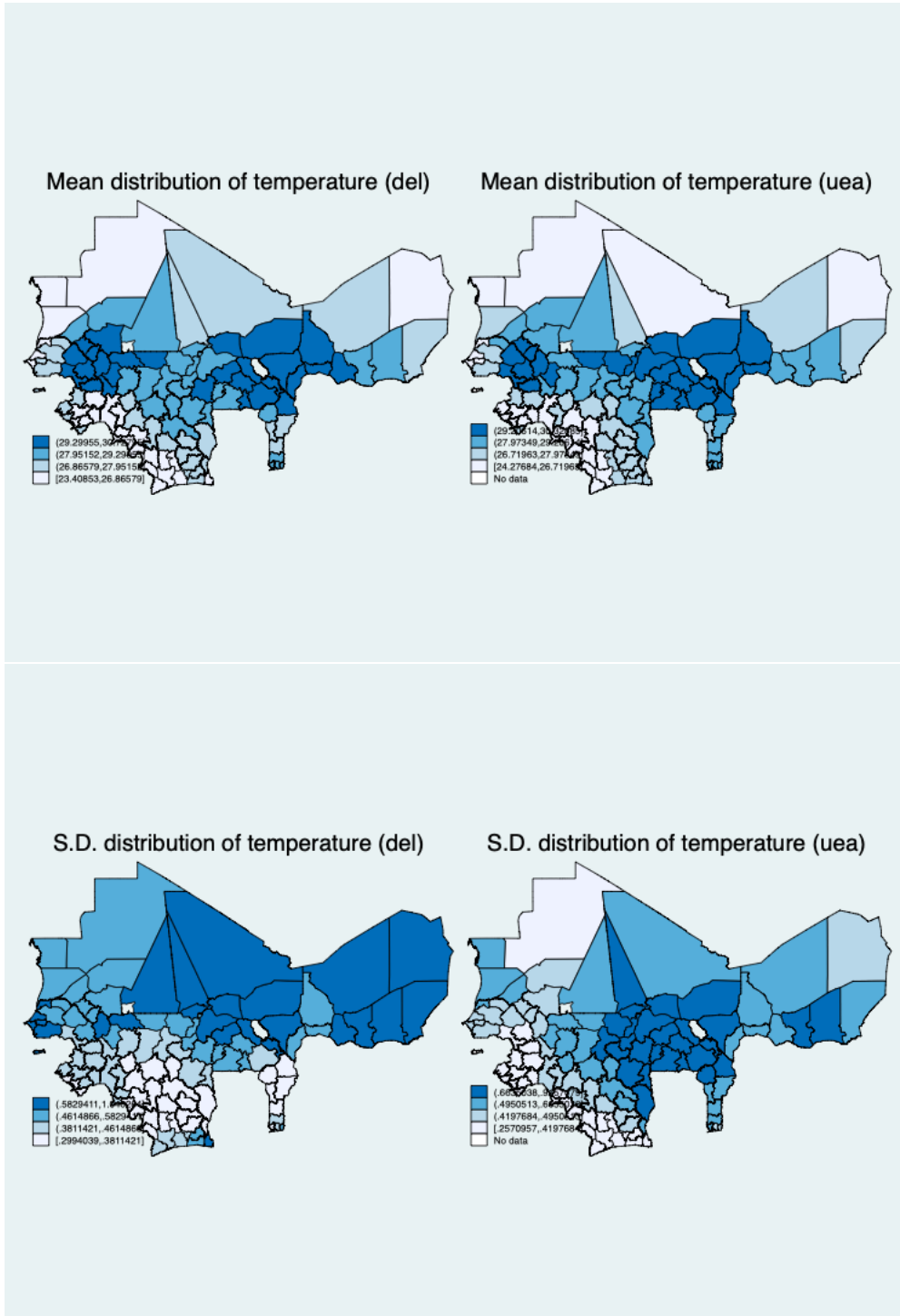
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Figure 10: volunteering rates



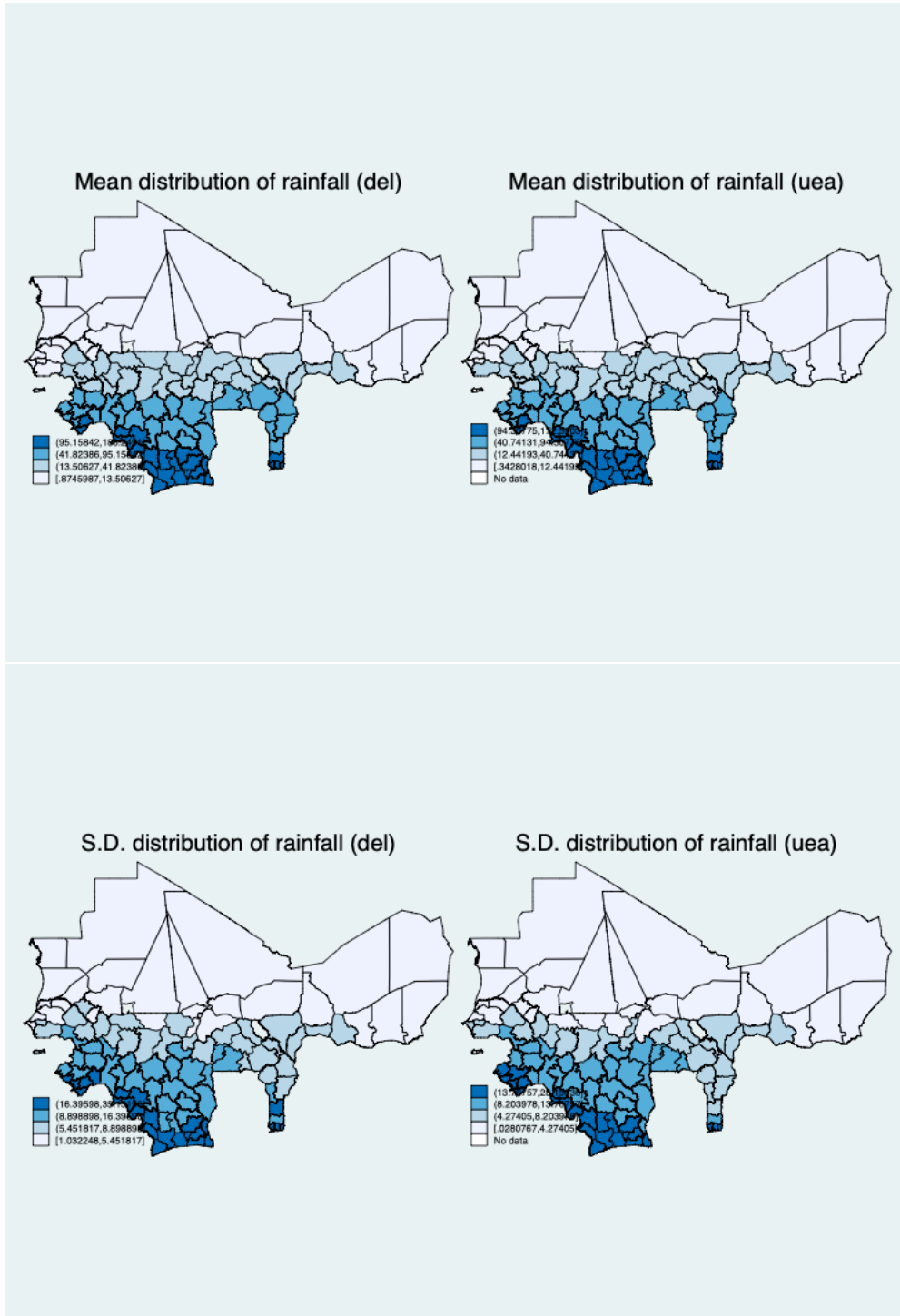
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Figure 11: Average Temperature and its Standard Deviations



Weather measures constructed with Delaware data are on the left panel, while weather measures constructed with UEA data are on the right panel.

Figure 12: Average Rainfall and its Standard Deviations



Weather measures constructed with Delaware data are on the left panel, while weather measures constructed with UEA data are on the right panel.

Table 1: Summary statistics of main variables of interest

VARIABLES	(1) N	(2) mean	(3) sd	(4) min	(5) max
annual avr. rain (Delaware)	1,460	96.75	60.75	5.320	379.9
annual avr. temp (Delaware)	1,460	27.28	1.411	22.68	30.26
annual avr. rainfall (UEA)	1,460	91.65	51.62	4.071	272.4
annual avr. temp (UEA)	1,460	27.24	1.420	23.22	30.85
sample avr. temp (Delaware)	1,460	27.26	1.352	23.66	29.60
sample temp s.d. (Delaware)	1,460	0.410	0.115	0.241	0.694
sample avr. temp (UEA)	1,460	27.28	1.343	23.82	29.50
sample temp s.d. (UEA)	1,460	0.438	0.167	0.190	0.775
sample avr. rainfall (Delaware)	1,460	96.67	59.16	8.087	302.9
sample rainfall s.d. (Delaware)	1,460	12.23	6.134	2.108	33.63
sample avr. rainfall (UEA)	1,460	91.56	50.75	5.194	235.7
sample rainfall s.d. (UEA)	1,460	9.411	3.826	0.662	19.48
rainfall deviation (Del, first-half)	1,460	0.0107	1.002	-2.506	3.386
temp deviation (Del, first-half)	1,460	0.0401	0.974	-3.663	2.469
rainfall deviation (UEA, first-half)	1,444	.01629	1.017	-2.340	2.943
temp deviation (UEA, first-half)	1,444	-.0452	1.00	-2.546	2.267
Target	730	133.8	117.4256	2	982
Target2	1,440	110.1	104.5	1.930	982
Enumerated	1,460	1,649	1,666	0	10,734
Absentees	1,460	329.9	610.5	0	5,213
Present	1,460	1,364	1,339	3	9,457
Unfit	1,460	1,046	1,136	0	9,185
Fit	1,460	317.7	364.7	2	4,931
First Portion (incl. recaptured)	1,460	111.8	107.1	0	730
First Portion (net of recaptured)	1,460	106.14	104.67	0	696
First Portion (net of volunteers)	1,460	83.05	93.28	0	629
Volunteers	1,460	23.10	44.77	0	591
Reservists (Second Portion)	1,460	204.5	317.1	0	4,644
Recaptured Absentees	1,460	4.235	20.21	0	305
Present rate	1,460	0.837	0.188	0.00814	1
Absent rate	1,457	0.165	0.188	0	0.992
Fitness rate	1,460	0.332	0.267	0.01000	1
Volunteering rate	1,460	0.130	0.249	0	1
Lag lottery rate	1,460	0.326	0.275	0	1
Log head tax rate	710	2.644	.5759	.1701	4.190
Log head tax rate (interpolated)	1,313	2.707	.4546	.1701	4.190
Estimated district population	2,220	30766.7	102902.9	2374.983	666169.4

Table 2: Impact of recruitment target on first portion recruits

VARIABLES	(1) First Portion	(2) First Portion	(3) First Portion	(4) First Portion	(5) First Portion	(6) First Portion
target	0.2722*** (0.0728)	0.2357*** (0.0686)	0.2071*** (0.0713)			
target missing	26.6280*** (8.4224)	27.4491*** (8.0364)	24.7960*** (8.1732)			
district population	-0.0006 (0.0004)	-0.0002 (0.0004)	0.0190 (0.0177)	-0.0004 (0.0005)	-0.0002 (0.0004)	0.0241 (0.0187)
target2				0.3617*** (0.0944)	0.3114*** (0.0886)	0.2667*** (0.0936)
Observations	1,460	1,460	1,460	1,446	1,446	1,446
R-squared	0.351	0.391	0.491	0.369	0.406	0.498
District FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
Colony linear trend	NO	YES	NO	NO	YES	NO
District linear trend	NO	NO	YES	NO	NO	YES

Dependent variable is the number of "first portion"soldiers (net of recuperated absentees). "target" is the conscript quota (in original number) assigned to a district in a given year. "Target missing" is a dummy indicator taking on value one when the "target" variable equals to zero (which means missing in actuality). "Target2" is the adjusted target number, after the missing values of the "target" variable are filled in based on the correlation between the annual target and the ultimate incorporated number of soldiers in a given year. *** p<0.01, ** p<0.05, * p<0.1

Table 3: Impact of recruitment target on present rates

VARIABLES	(1) present	(2) present	(3) present	(4) present	(5) present	(6) present	
target	0.0000 (0.0001)	0.0001 (0.0001)	0.0001 (0.0001)				
target missing	-0.0236 (0.0153)	-0.0233 (0.0148)	-0.0229 (0.0163)				
district population	0.0000 (0.0000)	0.0000 (0.0000)	0.0001*** (0.0000)	0.0000 (0.0000)	0.0000 (0.0000)	0.0002*** (0.0000)	Dependent
target2				0.0002** (0.0001)	0.0003*** (0.0001)	0.0004*** (0.0001)	
Observations	1,456	1,456	1,456	1,433	1,433	1,433	
R-squared	0.163	0.184	0.267	0.171	0.192	0.273	
District FE	YES	YES	YES	YES	YES	YES	
Year FE	YES	YES	YES	YES	YES	YES	
Colony linear trend	NO	YES	NO	NO	YES	NO	
District linear trend	NO	NO	YES	NO	NO	YES	

variable is present rate (ranging from zero to one). "Target missing" is a dummy indicator taking on value one when the "target" variable equals to zero (which means missing in actuality). "Target2" is the adjusted target number, after the missing values of the "target" variable are filled in based on the correlation between the annual target and the ultimate incorporated number of soldiers in a given year. Standard errors are clustered at the district level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 4: Impact of recruitment target on fitness number

VARIABLES	(1) fit	(2) fit	(3) fit	(4) fit	(5) fit	(6) fit
target	0.7633*** (0.1362)	0.6903*** (0.1336)	0.5119*** (0.1672)			
target missing	53.0828** (25.7178)	49.3643* (26.2569)	24.0749 (26.5000)			
district population	0.0012 (0.0016)	0.0016 (0.0016)	-0.3188*** (0.0680)	0.0015 (0.0016)	0.0018 (0.0016)	-0.2960*** (0.0679)
target2				1.0290*** (0.1669)	0.9318*** (0.1500)	0.6991*** (0.1676)
Observations	1,459	1,459	1,459	1,435	1,435	1,435
R-squared	0.112	0.122	0.226	0.117	0.129	0.228
District FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
Colony linear trend	NO	YES	NO	NO	YES	NO
District linear trend	NO	NO	YES	NO	NO	YES

Dependent variable is the number of "judged fit" indigenous Africans (among who showed up for conscription) in a district in a given year. "target" is the conscript quota (in original number) assigned to a district in a given year. "target missing" is a dummy indicator taking on value one when the "target" variable equals to zero (which means missing in actuality). "Target2" is the adjusted target number, after the missing values of the "target" variable are filled in based on the correlation between the annual target and the ultimate incorporated number of soldiers in a given year. "lagged lottery" refers to the lottery rate from the previous year in the same district. The same applies to "lagged fitness", which is the fitness rate from the previous year in a given district. Standard errors are clustered at the district level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 5: Impact of recruitment target on fitness rate (with lagged lottery rate as proxy for labor constraint)

VARIABLES	(1) fitness	(2) fitness	(3) fitness	(4) fitness	(5) fitness	(6) fitness
target	0.0002 (0.0001)	0.0003** (0.0001)	0.0004*** (0.0001)			
lagged lottery	-0.0292 (0.0295)	-0.0436 (0.0308)	-0.0214 (0.0307)	-0.0543* (0.0320)	-0.0697** (0.0336)	-0.0721** (0.0334)
target * lagged lottery	0.0006*** (0.0002)	0.0003 (0.0002)	0.0003 (0.0002)			
lagged fitness	0.3361*** (0.0417)	0.2087*** (0.0412)	0.0582 (0.0527)	0.3484*** (0.0414)	0.2336*** (0.0433)	0.1001* (0.0508)
district population	-0.0000** (0.0000)	-0.0000*** (0.0000)	-0.0005*** (0.0001)	-0.0000** (0.0000)	-0.0000** (0.0000)	-0.0005*** (0.0001)
target missing	0.0295 (0.0221)	0.0105 (0.0227)	-0.0017 (0.0270)			
target2				0.0004*** (0.0002)	0.0005*** (0.0001)	0.0006*** (0.0001)
target 2 * lagged lottery				0.0006*** (0.0002)	0.0004** (0.0002)	0.0006** (0.0003)
Observations	1,180	1,180	1,180	1,161	1,161	1,161
R-squared	0.382	0.424		0.392	0.431	0.546
District FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
Colony linear trend	NO	YES	NO	NO	YES	NO
District linear trend	NO	NO	YES	NO	NO	YES

Dependent variable is fitness rate (ranging from zero to one). "target" is the conscript quota (in original number) assigned to a district in a given year. "Target missing" is a dummy indicator taking on value one when the "target" variable equals to zero (which means missing in actuality). "Target2" is the adjusted target number, after the missing values of the "target" variable are filled in based on the correlation between the annual target and the ultimate incorporated number of soldiers in a given year. "lagged lottery" refers to the lottery rate from the previous year in the same district. The same applies to "lagged fitness", which is the fitness rate from the previous year in a given district. Standard errors are clustered at the district level. *** p<0.01, ** p<0.05, * p<0.1

Table 6: Impact of first-six-month weather shocks on volunteering rates (Delaware data)

VARIABLES	(1) volunteer	(2) volunteer	(3) volunteer	(4) volunteer	(5) volunteer	(6) volunteer	(7) volunteer
negative temperature deviation	-0.0291*** (0.0107)	-0.0379*** (0.0096)	-0.0364*** (0.0101)				-0.0360*** (0.0099)
positive temperature deviation	0.0514*** (0.0115)	0.0218* (0.0112)	0.0177 (0.0123)				0.0151 (0.0117)
negative rainfall deviation				-0.0096 (0.0143)	-0.0099 (0.0119)	-0.0051 (0.0129)	-0.0044 (0.0130)
positive rainfall deviation				0.0313*** (0.0102)	0.0317*** (0.0100)	0.0297*** (0.0106)	0.0291*** (0.0103)
Observations	1,460	1,460	1,460	1,460	1,460	1,460	1,460
R-squared	0.245	0.350	0.409	0.240	0.350	0.409	0.414
District FE	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES
Colony linear trend	NO	YES	NO	NO	YES	NO	NO
District linear trend	NO	NO	YES	NO	NO	YES	YES

Dependent variable is volunteering rate in a district in a given year (ranging from zero to one). The weather deviation variables are district-specific and yearly, the construction of which is based on the monthly weather measures in a given district from January to June in a given year. All weather deviations are standardized by district-specific standard deviation of annual weather measures during the sample period (1920-1938). Standard errors are clustered at the district level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 7: Impact of first-six-month weather shocks on present rates (Delaware data)

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	present	present	present	present	present	present	present
negative temperature deviation	-0.0038 (0.0049)	-0.0018 (0.0074)	0.0011 (0.0075)				0.0012 (0.0074)
positive temperature deviation	0.0041 (0.0059)	0.0200** (0.0093)	0.0316*** (0.0106)				0.0316*** (0.0106)
negative rainfall deviation				0.0065 (0.0087)	-0.0028 (0.0114)	-0.0021 (0.0131)	-0.0043 (0.0132)
positive rainfall deviation				-0.0041 (0.0059)	0.0023 (0.0076)	0.0043 (0.0085)	0.0031 (0.0085)
Observations	1,460	1,460	1,460	1,460	1,460	1,460	1,460
R-squared	0.135	0.183	0.255	0.135	0.180	0.249	0.255
District FE	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES
Colony linear trend	NO	YES	NO	NO	YES	NO	NO
District linear trend	NO	NO	YES	NO	NO	YES	YES

Dependent variable is present rate in a district in a given year (ranging from zero to one). The weather deviation variables are district-specific and yearly, the construction of which is based on the monthly weather measures in a given district from January to June in a given year. All weather deviations are standardized by district-specific standard deviation of annual weather measures during the sample period (1920-1938). Standard errors are clustered at the district level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 8: Impact of first-six-month weather shocks on volunteering rates (Delaware data and palm line)

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	volunteer	volunteer	volunteer	volunteer	volunteer	volunteer	volunteer	volunteer	volunteer
negative rainfall deviation	-0.0161 (0.0210)	-0.0137 (0.0175)	-0.0143 (0.0188)				-0.0156 (0.0213)	-0.0086 (0.0179)	-0.0079 (0.0192)
palm line * negative rainfall deviation	0.0120 (0.0243)	0.0048 (0.0229)	0.0111 (0.0243)				0.0063 (0.0252)	-0.0074 (0.0242)	-0.0030 (0.0258)
positive rainfall deviation	-0.0033 (0.0111)	-0.0064 (0.0101)	-0.0071 (0.0110)				-0.0058 (0.0111)	-0.0076 (0.0100)	-0.0079 (0.0109)
palm line * positive rainfall deviation	0.0776*** (0.0184)	0.0856*** (0.0177)	0.0843*** (0.0191)				0.0758*** (0.0178)	0.0834*** (0.0167)	0.0827*** (0.0180)
negative temperature deviation				-0.0127 (0.0101)	-0.0168* (0.0098)	-0.0212** (0.0101)	-0.0068 (0.0106)	-0.0117 (0.0102)	-0.0158 (0.0107)
palm line * negative temperature deviation				-0.0602***	-0.0790***	-0.0575**	-0.0547**	-0.0739***	-0.0524**
positive temperature deviation				(0.0226)	(0.0215)	(0.0230)	(0.0225)	(0.0211)	(0.0225)
				0.0452***	-0.0002	-0.0076	0.0433***	-0.0033	-0.0107
				(0.0146)	(0.0125)	(0.0147)	(0.0147)	(0.0124)	(0.0144)
palm line * positive temperature deviation				0.0264 (0.0248)	0.0705*** (0.0257)	0.0752*** (0.0270)	0.0167 (0.0227)	0.0613*** (0.0233)	0.0648*** (0.0246)
Observations	1,460	1,460	1,460	1,460	1,460	1,460	1,460	1,460	1,460
R-squared	0.254	0.365	0.423	0.249	0.358	0.415	0.264	0.374	0.431
District FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Colony linear trend	NO	YES	NO	NO	YES	NO	NO	YES	NO
District linear trend	NO	NO	YES	NO	NO	YES	NO	NO	YES

Dependent variable is volunteering rate in a district in a given year (ranging from zero to one). The weather deviation variables are district-specific and yearly, the construction of which is based on the monthly weather measures in a given district from January to June in a given year. All weather deviations are standardized by district-specific standard deviation of annual weather measures during the sample period (1920-1938). palm line is a dummy indicator taking on value one if a given district falls within the delineation of historical palm-cultivating regions. Standard errors are clustered at the district level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 9: Impact of first-six-month weather shocks on present rates (Delaware data and palm line)

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	present	present	present	present	present	present	present	present	present
negative rainfall deviation	-0.0227** (0.0095)	-0.0378*** (0.0134)	-0.0397** (0.0159)				-0.0226** (0.0095)	-0.0388*** (0.0139)	-0.0432*** (0.0164)
palm line * negative rainfall deviation	0.0689*** (0.0170)	0.0764*** (0.0222)	0.0793*** (0.0252)				0.0682*** (0.0173)	0.0764*** (0.0226)	0.0816*** (0.0259)
positive rainfall deviation	-0.0019 (0.0069)	0.0047 (0.0087)	0.0052 (0.0091)				-0.0017 (0.0070)	0.0046 (0.0087)	0.0047 (0.0091)
palm line * positive rainfall deviation	-0.0062 (0.0118)	-0.0081 (0.0148)	-0.0066 (0.0171)				-0.0075 (0.0119)	-0.0089 (0.0146)	-0.0082 (0.0171)
negative temperature deviation				-0.0066 (0.0058)	-0.0041 (0.0075)	0.0020 (0.0076)	-0.0022 (0.0060)	0.0034 (0.0079)	0.0100 (0.0082)
palm line * negative temperature deviation				0.0060 (0.0095)	0.0112 (0.0153)	-0.0018 (0.0163)	0.0058 (0.0098)	0.0116 (0.0143)	-0.0003 (0.0152)
positive temperature deviation				-0.0052 (0.0067)	0.0117 (0.0113)	0.0233* (0.0130)	-0.0069 (0.0068)	0.0110 (0.0114)	0.0231* (0.0130)
palm line * positive temperature deviation				0.0289** (0.0144)	0.0205 (0.0188)	0.0214 (0.0209)	0.0260* (0.0138)	0.0126 (0.0184)	0.0127 (0.0208)
Observations	1,460	1,460	1,460	1,460	1,460	1,460	1,460	1,460	1,460
R-squared	0.145	0.192	0.261	0.138	0.184	0.256	0.148	0.196	0.268
District FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Colony linear trend	NO	YES	NO	NO	YES	NO	NO	YES	NO
District linear trend	NO	NO	YES	NO	NO	YES	NO	NO	YES

Dependent variable is present rate in a district in a given year (ranging from zero to one). The weather deviation variables are district-specific and yearly, the construction of which is based on the monthly weather measures in a given district from January to June in a given year. All weather deviations are standardized by district-specific standard deviation of annual weather measures during the sample period (1920-1938). palm line is a dummy indicator taking on value one if a given district falls within the delineation of historical palm-cultivating regions. Standard errors are clustered at the district level. *** p<0.01, ** p<0.05, * p<0.1

Table 10: Impact of first-six-month weather shocks on volunteering rates (four linear splines, standard-deviation division)

VARIABLES	(1)		(2)		(3)		(4)		(5)		(6)		(7)	
	volunteer	volunteer	volunteer	volunteer	volunteer	volunteer	volunteer	volunteer	volunteer	volunteer	volunteer	volunteer	volunteer	volunteer
negative rainfall deviation (2)	-0.0006 (0.0342)	-0.0158 (0.0318)	-0.0401 (0.0353)											-0.0436 (0.0357)
negative rainfall deviation (1)	-0.0033 (0.0217)	-0.0000 (0.0187)	0.0148 (0.0197)											0.0128 (0.0193)
positive rainfall deviation (1)	0.0041 (0.0219)	0.0115 (0.0198)	0.0128 (0.0203)											0.0121 (0.0201)
positive rainfall deviation (2)	0.0605*** (0.0215)	0.0513** (0.0200)	0.0409* (0.0215)											0.0409* (0.0209)
negative temperature deviation (2)														-0.0883*** (0.0208)
negative temperature deviation (1)														-0.0065 (0.0191)
positive temperature deviation (1)														0.0625** (0.0266)
positive temperature deviation (2)														-0.1034*** (0.0279)
Observations	1,460	1,460	1,460	1,460	1,460	1,460	1,460	1,460	1,460	1,460	1,460	1,460	1,460	1,460
R-squared	0.242	0.351	0.410	0.255	0.361	0.420	0.425	0.425	0.425	0.425	0.425	0.425	0.425	0.425
District FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Colony linear trend	NO	YES	NO	NO	YES	NO	NO	NO	YES	YES	NO	NO	NO	NO
District linear trend	NO	NO	YES	NO	YES	NO	NO	NO	NO	NO	YES	YES	YES	YES

Dependent variable is volunteering rate in a district in a given year (ranging from zero to one). "negative rainfall deviation (2)" takes on values for standardized rainfall shocks that are smaller than minus one. "negative rainfall deviation (1)" takes on value for standardized rainfall shocks ranging from minus one to zero. "positive rainfall deviation (1)" takes on value for standardized rainfall shocks ranging between zero and one. "positive rainfall deviation (2)" takes on value for standardized rainfall shocks that are larger than one. The same applies for the four temperature deviation measures. The weather deviation variables are district-specific and yearly, the construction of which is based on the monthly weather measures in a given district from January to June in a given year. Standard errors are clustered at the district level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 11: Impact of first-six-month weather shocks on present rates (four linear splines, standard-deviation division)

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	present	present	present	present	present	present	present
negative rainfall deviation (2)	-0.0691** (0.0335)	-0.0573* (0.0334)	-0.0662* (0.0387)				-0.0674* (0.0376)
negative rainfall deviation (1)	0.0278 (0.0188)	0.0259 (0.0182)	0.0311 (0.0188)				0.0271 (0.0192)
positive rainfall deviation (1)	-0.0153 (0.0169)	-0.0168 (0.0165)	-0.0182 (0.0168)				-0.0182 (0.0165)
positive rainfall deviation (2)	0.0076 (0.0172)	0.0130 (0.0177)	0.0170 (0.0181)				0.0157 (0.0182)
negative temperature deviation (2)				-0.0215 (0.0135)	-0.0275** (0.0135)	-0.0247* (0.0136)	-0.0253* (0.0141)
negative temperature deviation (1)				0.0161 (0.0172)	0.0184 (0.0172)	0.0225 (0.0189)	0.0220 (0.0189)
positive temperature deviation (1)				0.0218 (0.0144)	0.0306* (0.0162)	0.0401** (0.0185)	0.0399** (0.0193)
positive temperature deviation (2)				-0.0277 (0.0240)	-0.0163 (0.0235)	-0.0012 (0.0264)	-0.0010 (0.0268)
Observations	1,457	1,457	1,457	1,457	1,457	1,457	1,457
R-squared	0.163	0.183	0.253	0.163	0.186	0.258	0.262
District FE	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES
Colony linear trend	NO	YES	NO	NO	YES	NO	NO
District linear trend	NO	NO	YES	NO	NO	YES	YES

Dependent variable is present rate in a district in a given year (ranging from zero to one). "negative rainfall deviation (2)" takes on values for standardized rainfall shocks that are smaller than minus one. "negative rainfall deviation (1)" takes on value for standardized rainfall shocks ranging from minus one to zero. "positive rainfall deviation (1)" takes on value for standardized rainfall shocks ranging between zero and one. "positive rainfall deviation (2)" takes on value for standardized rainfall shocks that are larger than one. The same applies for the four temperature deviation measures. The weather deviation variables are district-specific and yearly, the construction of which is based on the monthly weather measures in a given district from January to June in a given year. Standard errors reported in parentheses are clustered at the district level. *** p<0.01, ** p<0.05, * p<0.1

Table 12: Impact of lagged weather shock on deflated log head tax rates (Delaware data)

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	log head tax	log head tax	log head tax	log head tax	log head tax	log head tax	log head tax
Lagged negative temperature deviation	-0.0254* (0.0128)	0.0096 (0.0120)	0.0050 (0.0136)				0.0043 (0.0139)
Lagged positive temperature deviation	-0.0668*** (0.0129)	-0.0883*** (0.0133)	-0.0881*** (0.0140)				-0.0873*** (0.0139)
Lagged negative rainfall deviation				0.0030 (0.0241)	0.0150 (0.0197)	0.0076 (0.0230)	0.0125 (0.0221)
Lagged positive rainfall deviation				-0.0161 (0.0157)	-0.0125 (0.0150)	-0.0180 (0.0172)	-0.0117 (0.0162)
Observations	710	710	710	710	710	710	710
R-squared	0.737	0.778	0.825	0.723	0.766	0.813	0.825
District FE	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES
Colony linear trend	NO	YES	NO	NO	YES	NO	NO
District linear trend	NO	NO	YES	NO	NO	YES	YES

Dependent variable is log head tax per capita in a district in a given year, deflated with franc deflators from [Villa \(1997\)](#). The lagged weather deviation variables are district-specific and yearly, the construction of which is based on the monthly weather measures in a given district from January to December in the year before. All weather deviations are standardized by district-specific standard deviation of annual weather measures during the sample period (1920-1938). Standard errors reported in parentheses are clustered at the district level. *** p<0.01, ** p<0.05, * p<0.1

Table 13: Impact of lagged weather shock on volunteering rates (Delaware data)

VARIABLES	(1) volunteer	(2) volunteer	(3) volunteer	(4) volunteer	(5) volunteer	(6) volunteer	(7) volunteer
Lagged negative temperature deviation	0.0052 (0.0072)	-0.0033 (0.0081)	-0.0032 (0.0085)				-0.0033 (0.0088)
Lagged positive temperature deviation	0.0086 (0.0117)	-0.0091 (0.0114)	-0.0055 (0.0128)				-0.0071 (0.0125)
Lagged negative rainfall deviation				0.0231 (0.0156)	0.0091 (0.0149)	0.0185 (0.0166)	0.0188 (0.0165)
Lagged positive rainfall deviation				0.0061 (0.0104)	0.0090 (0.0091)	0.0052 (0.0101)	0.0055 (0.0102)
Observations	1,460	1,460	1,460	1,460	1,460	1,460	1,460
R-squared	0.236	0.345	0.404	0.238	0.346	0.406	0.406
District FE	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES
Colony linear trend	NO	YES	NO	NO	YES	NO	NO
District linear trend	NO	NO	YES	NO	NO	YES	YES

Dependent variable is volunteering rate in a district in a given year (ranging from zero to one). The lagged weather deviation variables are district-specific and yearly, the construction of which is based on the monthly weather measures in a given district from January to December in the year before. All weather deviations are standardized by district-specific standard deviation of annual weather measures during the sample period (1920-1938). Standard errors reported in parentheses are clustered at the district level. *** p<0.01, ** p<0.05, * p<0.1

Table 14: Impact of lagged weather shocks on present rates (Delaware data)

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	present	present	present	present	present	present	present
Lagged negative temperature deviation	-0.0099 (0.0068)	-0.0108 (0.0066)	-0.0074 (0.0070)				-0.0081 (0.0069)
Lagged positive temperature deviation	-0.0047 (0.0126)	0.0059 (0.0125)	0.0112 (0.0129)				0.0106 (0.0130)
Lagged negative rainfall deviation				0.0004 (0.0114)	0.0018 (0.0109)	0.0033 (0.0117)	0.0027 (0.0116)
Lagged positive rainfall deviation				0.0096 (0.0091)	0.0123 (0.0088)	0.0158* (0.0095)	0.0162* (0.0095)
Observations	1,457	1,457	1,457	1,457	1,457	1,457	1,457
R-squared	0.161	0.181	0.250	0.160	0.182	0.252	0.253
District FE	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES
Colony linear trend	NO	YES	NO	NO	YES	NO	NO
District linear trend	NO	NO	YES	NO	NO	YES	YES

Dependent variable is volunteering rate in a district in a given year (ranging from zero to one). The lagged weather deviation variables are district-specific and yearly, the construction of which is based on the monthly weather measures in a given district from January to December in the year before. All weather deviations are standardized by district-specific standard deviation of annual weather measures during the sample period (1920-1938). Standard errors reported in parentheses are clustered at the district level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 15: Impact of weather shocks on volunteering rates (Delaware data, four linear splines with log head tax control)

VARIABLES	(1) volunteer	(2) volunteer	(3) volunteer	(4) volunteer	(5) volunteer	(6) volunteer	(7) volunteer
negative rainfall deviation (2)	0.0010 (0.0230)	-0.0098 (0.0223)	-0.0189 (0.0264)				-0.0262 (0.0270)
negative rainfall deviation (1)	-0.0023 (0.0314)	-0.0013 (0.0292)	0.0182 (0.0296)				0.0184 (0.0296)
positive rainfall deviation (1)	0.0146 (0.0278)	0.0251 (0.0265)	0.0253 (0.0272)				0.0197 (0.0269)
positive rainfall deviation (2)	0.0422** (0.0167)	0.0337** (0.0167)	0.0409** (0.0180)				0.0430** (0.0173)
log head tax (interpolated)	-0.2588*** (0.0495)	-0.2073*** (0.0451)	-0.2500*** (0.0556)	-0.2248*** (0.0484)	-0.1888*** (0.0446)	-0.2234*** (0.0534)	-0.2479*** (0.0556)
negative temperature deviation (2)				-0.0736*** (0.0135)	-0.0598*** (0.0124)	-0.0683*** (0.0125)	-0.0698*** (0.0121)
negative temperature deviation (1)				0.0131 (0.0206)	-0.0044 (0.0224)	0.0154 (0.0235)	0.0238 (0.0244)
positive temperature deviation (1)				0.1065*** (0.0344)	0.1112*** (0.0335)	0.1104*** (0.0356)	0.0956*** (0.0357)
positive temperature deviation (2)				-0.0437** (0.0192)	-0.0720*** (0.0197)	-0.0829*** (0.0212)	-0.0844*** (0.0219)
Observations	1,313	1,313	1,313	1,313	1,313	1,313	1,313
R-squared	0.323	0.350	0.419	0.334	0.359	0.427	0.437
District FE	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES
Colony linear trend	NO	YES	NO	NO	YES	NO	NO
District linear trend	NO	NO	YES	NO	NO	YES	YES

Dependent variable is volunteering rate in a district in a given year (ranging from zero to one). "negative rainfall deviation (2)" takes on values for standardized rainfall shocks that are smaller than minus one. "negative rainfall deviation (1)" takes on value for standardized rainfall shocks ranging from minus one to zero. "positive rainfall deviation (1)" takes on value for standardized rainfall shocks ranging between zero and one. "positive rainfall deviation (2)" takes on value for standardized rainfall shocks that are larger than one. The same applies for the four temperature deviation measures. The weather deviation variables are district-specific and yearly, the construction of which is based on the monthly weather measures in a given district from January to June in the given year. All weather deviations are standardized by district-specific standard deviation of annual weather measures during the sample period (1920-1938). "log head tax (interpolated)" refers to the head tax per capita levied in a district in a given year, the missing values of which are linearly interpolated as a function of the years in the sample period (1920-1938). Standard errors reported in parentheses are clustered at the district level. *** p<0.01, ** p<0.05, * p<0.1

Table 16: Impact of weather shocks on present rates (Delaware data, four linear splines with head tax control)

VARIABLES	(1)		(2)		(3)		(4)		(5)		(6)		(7)	
	present	present	present	present	present	present	present	present	present	present	present	present	present	present
negative rainfall deviation (2)	-0.0487*	-0.0403	-0.0410											-0.0469
	(0.0274)	(0.0270)	(0.0307)											(0.0300)
negative rainfall deviation (1)	0.0472	0.0438	0.0560*											0.0546
	(0.0352)	(0.0331)	(0.0336)											(0.0330)
positive rainfall deviation (1)	-0.0060	-0.0128	-0.0196											-0.0213
	(0.0238)	(0.0223)	(0.0239)											(0.0234)
positive rainfall deviation (2)	-0.0037	0.0030	0.0060											0.0023
	(0.0127)	(0.0126)	(0.0131)											(0.0130)
log head tax (interpolated)	-0.0450	-0.0673	-0.0862											-0.0709
	(0.0442)	(0.0507)	(0.0639)											(0.0650)
negative temperature deviation (2)				-0.0356	-0.0543									-0.0674
				(0.0495)	(0.0543)									(0.0684)
negative temperature deviation (1)				0.0018	-0.0016									0.0024
				(0.0110)	(0.0116)									(0.0122)
positive temperature deviation (1)				-0.0126	-0.0059									-0.0049
				(0.0260)	(0.0260)									(0.0298)
positive temperature deviation (2)				0.0207	0.0406									0.0590*
				(0.0262)	(0.0278)									(0.0343)
				-0.0039	0.0175									0.0311
				(0.0181)	(0.0169)									(0.0198)
Observations	1,313	1,313	1,313	1,313	1,313	1,313	1,313	1,313	1,313	1,313	1,313	1,313	1,313	1,313
R-squared	0.200	0.233	0.319	0.197	0.235	0.326	0.328	0.328	0.328	0.328	0.328	0.328	0.328	0.328
District FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Colony linear trend	NO	YES	NO	NO	YES	NO	NO	NO	YES	YES	NO	NO	NO	NO
District linear trend	NO	NO	YES	NO	YES	NO	NO	NO	NO	NO	YES	YES	YES	YES

Dependent variable is present rate in a district in a given year (ranging from zero to one). "negative rainfall deviation (2)" takes on values for standardized rainfall shocks that are smaller than minus one. "negative rainfall deviation (1)" takes on value for standardized rainfall shocks ranging from minus one to zero. "positive rainfall deviation (1)" takes on value for standardized rainfall shocks ranging between zero and one. "positive rainfall deviation (2)" takes on value for standardized rainfall shocks that are larger than one. The same applies for the four temperature deviation measures. The weather deviation variables are district-specific and yearly, the construction of which is based on the monthly weather measures in a given district from January to June in the given year. All weather deviations are standardized by district-specific standard deviation of annual weather measures during the sample period (1920-1938). "log head tax (interpolated)" refers to the head tax per capita levied in a district in a given year, the missing values of which are linearly interpolated as a function of the years in the sample period (1920-1938). Standard errors reported in parentheses are clustered at the district level. *** p<0.01, ** p<0.05, * p<0.1

Table 17: Second-six-month weather shocks on volunteering rates (Delaware data and palm line)

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	volunteer	volunteer	volunteer	volunteer	volunteer	volunteer	volunteer	volunteer	volunteer
negative rainfall deviation	0.0101 (0.0153)	-0.0025 (0.0159)	-0.0106 (0.0175)				0.0044 (0.0156)	-0.0059 (0.0160)	-0.0159 (0.0177)
palm line * negative rainfall deviation	0.0217 (0.0232)	0.0352 (0.0238)	0.0555** (0.0260)				0.0307 (0.0230)	0.0402* (0.0232)	0.0627** (0.0252)
positive rainfall deviation	0.0031 (0.0109)	-0.0056 (0.0108)	-0.0036 (0.0119)				0.0008 (0.0111)	-0.0064 (0.0110)	-0.0057 (0.0122)
palm line * positive rainfall deviation	0.0296 (0.0265)	0.0424 (0.0259)	0.0348 (0.0276)				0.0271 (0.0266)	0.0397 (0.0261)	0.0330 (0.0277)
negative temperature deviation				-0.0072 (0.0108)	-0.0166* (0.0085)	-0.0241*** (0.0090)	-0.0081 (0.0110)	-0.0168* (0.0085)	-0.0249*** (0.0090)
palm line * negative temperature deviation				-0.0399* (0.0215)	-0.0360* (0.0198)	-0.0291 (0.0199)	-0.0362 (0.0219)	-0.0306 (0.0200)	-0.0212 (0.0200)
positive temperature deviation				-0.0562*** (0.0198)	-0.0481*** (0.0178)	-0.0469** (0.0194)	-0.0560*** (0.0200)	-0.0504*** (0.0181)	-0.0512** (0.0196)
palm line * positive temperature deviation				0.1156*** (0.0269)	0.0851*** (0.0255)	0.0978*** (0.0276)	0.1138*** (0.0271)	0.0857*** (0.0258)	0.1004*** (0.0281)
Observations	1,460	1,460	1,460	1,460	1,460	1,460	1,460	1,460	1,460
R-squared	0.241	0.352	0.413	0.248	0.355	0.416	0.254	0.362	0.426
District FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Colony linear trend	NO	YES	NO	NO	YES	NO	NO	YES	NO
District linear trend	NO	NO	YES	NO	NO	YES	NO	NO	YES

Dependent variable is volunteering rate in a district in a given year (ranging from zero to one). The weather deviation variables are district-specific and yearly, the construction of which is based on the monthly weather measures in a given district from July to December in a given year. All weather deviations are standardized by district-specific standard deviation of annual weather measures during the sample period (1920-1938). palm line is a dummy indicator taking on value one if a given district falls within the delineation of historical palm-cultivating regions. Standard errors reported in parentheses are clustered at the district level. *** p<0.01, ** p<0.05, * p<0.1

Table 18: Second-six-month weather shocks on present rates (Delaware data and palm line)

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	present	present	present	present	present	present	present	present	present
negative rainfall deviation	-0.0235*** (0.0082)	-0.0219 (0.0136)	-0.0216 (0.0141)				-0.0200** (0.0083)	-0.0206 (0.0141)	-0.0192 (0.0146)
palm line * negative rainfall deviation	0.0736*** (0.0181)	0.0645*** (0.0238)	0.0572** (0.0255)				0.0740*** (0.0179)	0.0638*** (0.0232)	0.0541** (0.0250)
positive rainfall deviation	0.0035 (0.0076)	0.0082 (0.0109)	0.0091 (0.0109)				0.0047 (0.0075)	0.0082 (0.0108)	0.0091 (0.0107)
palm line * positive rainfall deviation	0.0163 (0.0114)	0.0213 (0.0155)	0.0304* (0.0170)				0.0136 (0.0114)	0.0173 (0.0148)	0.0270 (0.0166)
negative temperature deviation				-0.0044 (0.0068)	-0.0116 (0.0075)	-0.0087 (0.0079)	-0.0063 (0.0067)	-0.0129* (0.0074)	-0.0102 (0.0079)
palm line * negative temperature deviation				-0.0134 (0.0097)	-0.0477*** (0.0116)	-0.0481*** (0.0125)	-0.0110 (0.0098)	-0.0408*** (0.0118)	-0.0394*** (0.0128)
positive temperature deviation				0.0076 (0.0125)	0.0022 (0.0180)	0.0142 (0.0185)	0.0074 (0.0122)	-0.0002 (0.0182)	0.0123 (0.0187)
palm line * positive temperature deviation				-0.0311** (0.0149)	0.0497** (0.0240)	0.0403 (0.0243)	-0.0329** (0.0153)	0.0502** (0.0240)	0.0398 (0.0240)
Observations	1,460	1,460	1,460	1,460	1,460	1,460	1,460	1,460	1,460
R-squared	0.156	0.197	0.266	0.141	0.193	0.261	0.162	0.208	0.276
District FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Colony linear trend	NO	YES	NO	NO	YES	NO	NO	YES	NO
District linear trend	NO	NO	YES	NO	NO	YES	NO	NO	YES

Dependent variable is present rate in a district in a given year (ranging from zero to one). The weather deviation variables are district-specific and yearly, the construction of which is based on the monthly weather measures in a given district from July to December in a given year. All weather deviations are standardized by district-specific standard deviation of annual weather measures during the sample period (1920-1938). palm line is a dummy indicator taking on value one if a given district falls within the delineation of historical palm-cultivating regions. Standard errors reported in parentheses are clustered at the district level. *** p<0.01, ** p<0.05, * p<0.1

Table 19: Non-linear impacts of weather shocks on volunteering rates (unbalanced panel fractional logit model with four linear splines)

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	volunteer	marginal effect	volunteer	marginal effect	volunteer	marginal effect
negative temperature deviation (1)	-0.4948** (0.2245)	-0.0483** (0.0225)			-0.3873* (0.2206)	-0.0373* (0.0219)
negative temperature deviation (2)	-0.5770** (0.2284)	-0.0563** (0.0228)			-0.6450*** (0.2310)	-0.0620*** (0.0225)
positive temperature deviation (1)	1.1344*** (0.2440)	0.1107*** (0.0252)			1.1128*** (0.2426)	0.1070*** (0.0248)
positive temperature deviation (2)	-0.7153** (0.3140)	-0.0698** (0.0312)			-0.8045*** (0.3021)	-0.0774*** (0.0297)
negative rainfall deviation (1)			-0.1190 (0.2393)	-0.0119 (0.0241)	-0.2220 (0.2452)	-0.0213 (0.0238)
negative rainfall deviation (2)			-0.1212 (0.3694)	-0.0121 (0.0370)	-0.2930 (0.3590)	-0.0282 (0.0348)
positive rainfall deviation (1)			0.0253 (0.2008)	0.0025 (0.0200)	0.0140 (0.1996)	0.0013 (0.0192)
positive rainfall deviation (2)			0.5085*** (0.1833)	0.0508*** (0.0182)	0.5206*** (0.1627)	0.0501*** (0.0156)
Observations	1,460	1,460	1,460	1,460	1,460	1,460
Year dummies	YES	YES	YES	YES	YES	YES
Year period dummies	YES	YES	YES	YES	YES	YES
Time averages	YES	YES	YES	YES	YES	YES

Dependent variable is volunteering rate in a district in a given year (ranging from zero to one). "negative rainfall deviation (2)" takes on values for standardized rainfall shocks that are smaller than minus one. "negative rainfall deviation (1)" takes on value for standardized rainfall shocks ranging from minus one to zero. "positive rainfall deviation (1)" takes on value for standardized rainfall shocks ranging between zero and one. "positive rainfall deviation (2)" takes on value for standardized rainfall shocks that are larger than one. The same applies for the four temperature deviation measures. The weather deviation variables are district-specific and yearly, the construction of which is based on the monthly weather measures in a given district from January to June in a given year. All weather deviations are standardized by district-specific standard deviation of annual weather measures during the sample period (1920-1938). Standard errors reported in parentheses are clustered at the district level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 20: Non-linear impacts of weather shocks on present rates (unbalanced panel fractional logit model with four linear splines)

VARIABLES	(1) present	(2) marginal effect	(3) present	(4) marginal effect	(5) present	(6) marginal effect
negative temperature deviation (1)	0.1524 (0.1185)	0.0200 (0.0155)			0.1443 (0.1192)	0.0188 (0.0155)
negative temperature deviation (2)	-0.2111** (0.1028)	-0.0277** (0.0136)			-0.2067** (0.1049)	-0.0269* (0.0139)
positive temperature deviation (1)	0.1530 (0.1119)	0.0201 (0.0146)			0.1514 (0.1173)	0.0197 (0.0152)
positive temperature deviation (2)	-0.1696 (0.1745)	-0.0223 (0.0227)			-0.1476 (0.1735)	-0.0192 (0.0225)
negative rainfall deviation (1)			0.0591 (0.1482)	0.0078 (0.0196)	0.1068 (0.1493)	0.0139 (0.0196)
negative rainfall deviation (2)			-0.5290** (0.2598)	-0.0697** (0.0343)	-0.4716* (0.2555)	-0.0615* (0.0334)
positive rainfall deviation (1)			-0.0279 (0.1226)	-0.0037 (0.0162)	-0.1056 (0.1216)	-0.0138 (0.0159)
positive rainfall deviation (2)			0.0308 (0.1127)	0.0041 (0.0149)	0.0820 (0.1168)	0.0107 (0.0153)
Observations	1,457	1,457	1,457	1,457	1,457	1,457
Year dummies	YES	YES	YES	YES	YES	YES
Year period dummies	YES	YES	YES	YES	YES	YES
Time averages	YES	YES	YES	YES	YES	YES

Dependent variable is present rate in a district in a given year (ranging from zero to one). "negative rainfall deviation (2)" takes on values for standardized rainfall shocks that are smaller than minus one. "negative rainfall deviation (1)" takes on value for standardized rainfall shocks ranging from minus one to zero. "positive rainfall deviation (1)" takes on value for standardized rainfall shocks ranging between zero and one. "positive rainfall deviation (2)" takes on value for standardized rainfall shocks that are larger than one. The same applies for the four temperature deviation measures. The weather deviation variables are district-specific and yearly, the construction of which is based on the monthly weather measures in a given district from January to June in a given year. All weather deviations are standardized by district-specific standard deviation of annual weather measures during the sample period (1920-1938). Standard errors reported in parentheses are clustered at the district level. *** p<0.01, ** p<0.05, * p<0.1

Appendices

Zhexun Fred MO

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1 Additional summary statistics

Table A1: Colony-specific summary statistics for military conscript variables

VARIABLES	(1)	(2)	(3)	(4)	(5)
	Upper Volta N	mean	sd	min	max
target	149	152.2	190.5	0	730
target2	149	235.2	155.4	16.40	730
enumerated	149	3,299	2,130	109	9,392
BA	149	642.6	896.6	0	4,500
present	149	2,725	1,648	105	8,147
unfit	149	2,038	1,429	14	7,543
fit	149	687.6	597.4	37	4,931
First Portion	149	271.9	154.3	0	730
second portion	149	418.1	544.9	0	4,644
First Portion (net of volunteer)	149	216.6	137.3	0	629
volunteer	149	43.78	56.54	0	255
Recuperated Absentees	149	10.60	33.51	0	226
present rate	149	0.845	0.165	0.250	1
absent rate	149	0.155	0.165	0	0.750
fitness rate	149	0.293	0.195	0.0479	0.978
volunteer	149	0.0860	0.139	0	1

VARIABLES	(1)	(2)	(3)	(4)	(5)
	Cote d'Ivoire N	mean	sd	min	max
target	233	40.32	66.27	0	291
target2	229	84.36	62.56	12.28	338.6
enumerated	233	991.6	1,032	8	5,147
BA	233	80.60	138.9	0	1,075
present	233	992.1	925.9	6	4,682
unfit	233	696.6	748.4	0	4,157
fit	233	295.5	324.7	6	2,079
First Portion	233	90.60	73.41	5	400
second portion	233	206.3	301.3	0	1,879
First Portion (net of volunteer)	233	66.94	63.35	0	381
volunteer	233	22.28	40.37	0	329
Recuperated Absentees	233	1.378	5.970	0	43
present rate	233	0.928	0.110	0.216	1
absent rate	233	0.0716	0.110	0	0.784
fitness rate	233	0.403	0.260	0.0484	1
volunteer	233	0.162	0.292	0	1

VARIABLES	(1)	(2)	(3)	(4)	(5)
	Guinea N	mean	sd	min	max
target	267	100.4	111.4	0	982
target2	267	118.3	103.6	20	982
enumerated	267	1,665	1,955	14	10,734
BA	267	445.9	922.6	0	5,213
present	267	1,347	1,376	14	9,457
unfit	267	1,153	1,318	0	9,185
fit	267	193.9	183.7	14	1,289
First Portion	267	95.83	83.70	0	696
second portion	267	98.04	163.5	0	1,289
First Portion (net of volunteer)	267	52.33	59.49	0	357
volunteer	267	36.79	66.98	0	591
Recuperated Absentees	267	0	0	0	0
present rate	267	0.804	0.243	0.00814	1
absent rate	267	0.205	0.242	0	0.992
fitness rate	267	0.296	0.323	0.0230	1
volunteer	267	0.205	0.284	0	1

VARIABLES	(1)	(2)	(3)	(4)	(5)
	French Sudan N	mean	sd	min	max
target	321	39.10	77.95	0	425
target2	321	107.8	86.41	2.310	460.0
enumerated	321	2,019	1,455	40	7,167
BA	321	285.0	365.9	0	2,876
present	321	1,734	1,329	40	6,492
unfit	321	1,323	1,111	0	6,000
fit	321	411.5	349.7	12	2,172
First Portion	321	117.9	93.48	0	500
second portion	321	277.7	320.5	0	2,025
First Portion (net of volunteer)	321	93.78	89.30	0	493
volunteer	321	17.57	38.66	0	238
Recuperated Absentees	321	6.551	30.11	0	305
present rate	321	0.861	0.139	0.234	1
absent rate	321	0.139	0.139	0	0.766
fitness rate	321	0.293	0.219	0.0458	1
volunteer	321	0.0447	0.0906	0	0.880

VARIABLES	(1)	(2)	(3)	(4)	(5)
	Senegal N	mean	sd	min	max
target	190	91.47	99.22	0	525
target2	181	123.3	98.64	10	525
enumerated	190	1,310	1,095	17	5,315
BA	190	326.4	348.0	0	1,920
present	190	983.4	906.4	17	4,146
unfit	190	734.7	704.6	0	3,437
fit	190	248.7	253.7	4	1,526
First Portion	190	104.7	93.05	0	525
second portion	190	149.6	207.1	0	1,317
First Portion (net of volunteer)	190	90.43	81.71	0	464
volunteer	190	8.647	16.58	0	136
Recuperated Absentees	190	5.632	12.20	0	82
present rate	190	0.754	0.194	0.170	1
absent rate	190	0.246	0.194	0	0.830
fitness rate	190	0.312	0.225	0.01000	1
volunteer rate	190	0.0413	0.0665	0	0.418

VARIABLES	(1)	(2)	(3)	(4)	(5)
	Dahomey N	mean	sd	min	max
target	153	50.32	59.68	0	272
target2	153	78.71	55.31	4.667	272
enumerated	153	1,580	1,357	15	5,578
BA	153	411.3	642.9	0	3,873
present	153	1,168	1,036	15	4,491
unfit	153	908.7	873.9	0	3,687
fit	153	259.8	283.1	15	2,534
First Portion	153	83.20	56.54	4	336
second portion	153	180.4	255.1	0	2,323
First Portion (net of volunteer)	153	61.59	49.78	0	247
volunteer	153	17.81	23.19	0	130
Recuperated Absentees	153	3.797	16.43	0	158
present rate	153	0.798	0.204	0.185	1
absent rate	153	0.202	0.204	0	0.815
fitness rate	153	0.383	0.316	0.0396	1
volunteer rate	153	0.150	0.268	0	1

VARIABLES	(1)	(2)	(3)	(4)	(5)
	Mauritania N	mean	sd	min	max
target	63	3.651	8.031	0	35
target2	58	9.228	6.880	2	35
enumerated	63	352.8	291.8	18	1,517
BA	63	100.7	138.8	0	540
present	63	252.2	189.4	18	989
unfit	63	210.2	166.8	7	884
fit	63	42	46.78	2	264
First Portion	63	19.38	18.78	2	78
second portion	63	24.84	42.06	0	264
First Portion (net of volunteer)	63	14.90	16.66	0	63
volunteer	63	1.603	4.784	0	33
Recuperated Absentees	63	0.556	2.408	0	16
present rate	63	0.784	0.160	0.362	1
absent rate	63	0.216	0.160	0	0.638
fitness rate	63	0.198	0.156	0.0336	0.851
volunteer rate	63	0.0391	0.0847	0	0.370

VARIABLES	(1)	(2)	(3)	(4)	(5)
	Niger N	mean	sd	min	max
target	94	11.91	33.59	0	165
target2	88	36.74	32.17	1.930	165
enumerated	94	876.6	1,510	0	9,331
BA	94	279.6	536.8	0	3,133
present	94	613.4	1,166	3	8,497
unfit	94	407.6	959.5	0	7,831
fit	94	205.8	331.6	2	1,598
First Portion	94	47.96	43.95	1	243
second portion	94	164.0	321.6	0	1,598
First Portion (net of volunteer)	94	19.99	36.07	0	162
volunteer	94	22.27	28.23	0	130
Recuperated Absentees	94	5.298	22.32	0	164
present rate	91	0.842	0.228	0.0313	1
absent rate	91	0.158	0.228	0	0.969
fitness rate	94	0.491	0.292	0.0114	1
volunteer rate	94	0.403	0.437	0	1

2 Correlation tables and variance decomposition

Table B1: Correlation of average rainfalls

	(1)			
	annual avr. rainfall (Delaware)	sample avr. rainfall (Delaware)	annual avr. rainfall (UEA)	sample avr. rainfall (UEA)
annual avr. rainfall (Delaware)	1.0000			
sample avr. rainfall (Delaware)	0.9653***	1.0000		
annual avr. rainfall (UEA)	0.9748***	0.9664***	1.0000	
sample avr. rainfall (UEA)	0.9558***	0.9901***	0.9760***	1.0000
<i>N</i>	1460			

t statistics in parentheses
 * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table B2: Correlation of average temperatures

	(1)			
	annual avr. temp (Delaware)	sample avr. temp (Delaware)	annual avr. temp (UEA)	sample avr. temp (UEA)
annual avr. temp (Delaware)	1.0000			
sample avr. temp (Delaware)	0.9530***	1.0000		
annual avr. temp (UEA)	0.8901***	0.9071***	1.0000	
sample avr. temp (UEA)	0.9177***	0.9624***	0.9426***	1.0000
N	1460			

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table B3: Correlation of sample-period (1920-1939) temperatures

	(1)			
	sample avr. temp (Delaware)	sample s.d. temp (Delaware)	sample avr. temp (UEA)	sample s.d. temp (UEA)
sample avr. temp (Delaware)	1.0000			
sample s.d. temp (Delaware)	0.0850***	1.0000		
sample avr. temp (UEA)	0.9624***	0.0681**	1.0000	
sample s.d. temp (UEA)	0.5326***	0.2186***	0.6011***	1.0000
N	1460			

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table B4: Correlation of sample-period (1920-1939) rainfalls

	(1)			
	sample avr. rainfall (Delaware)	sample s.d. rainfall (Delaware)	sample avr. rainfall (UEA)	sample s.d. rainfall (UEA)
sample avr. rainfall (Delaware)	1.0000			
sample s.d. rainfall (Delaware)	0.9142***	1.0000		
sample avr. rainfall (UEA)	0.9901***	0.9111***	1.0000	
sample s.d. rainfall (UEA)	0.8767***	0.9093***	0.8964***	1.0000
<i>N</i>	1460			

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table B5: Correlation of sample-period first-six-month weather deviation measures from both Delaware and UEA data

(1)		
	rainfall deviation(Delaware, first-half)	rainfall deviation (UEA, first-half)
rainfall deviation(Delaware, first-half)	1.0000	
rainfall deviation(UEA, first-half)	0.7605***	1.0000

(1)		
	temp deviation(Delaware, first half)	temp deviation (UEA, first half)
temp deviation(Delaware, first half)	1.0000	
temp deviation(UEA, first half)	0.2490***	1.0000
<i>N</i>	1460	

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table B6: Correlation of annual versus six-month deviation measures (rainfall)

	(1)		
	rain deviation(Del, first-half)	rain deviation(Del, first-half)	rain deviation(Del, second-half)
	1.0000		
rain deviation(Del, annual)	0.5715***	1.0000	
rain deviation(Del, second-half)	0.1616***	0.8846***	1.0000
<i>N</i>	1460		

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table B7: Correlation of annual versus six-month deviation measures (temperature)

	(1)		
	temp deviation(Del, first-half)	temp deviation(Del, first-half)	temp deviation(Del, second-half)
temp deviation(Del, first-half)	1.0000		
temp deviation(Del, annual)	0.8839***	1.0000	
temp deviation(Del, second-half)	0.4989***	0.8385***	1.0000
N	1460		

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The upper panel of table B8 reports the variance decomposition for fitness rate. First of all, time-invariant variables explain very little the total variation in fitness rate. As can be seen from column 1 and column 2, when colony and district fixed effects are separately added onto the regression, the overall adjusted R-squared value amounts to a mere 0.050. On the other hand, however, macro year trends in the entire FWA seem to explain a far larger share of the total variation in fitness rate, as can be seen in column 3, year fixed effects significantly raise the adjusted R-squared value to 0.329. This concurs with the previous graphs on the colony-specific trends of fitness rate over the years, where we could detect a clear downward trend of fitness rates across all eight colonies in FWA over the sample period of interest. Furthermore, even when we add in more colony- and district-specific linear trends, the macro-level year fixed effects still explain around 70% of the total variation of the fitness rate variable that is accounted for by the current regression specification.

Contrary to the variation in fitness rates, district fixed effects play a far more important role in the variation of both present rates and volunteering rates. For present rates, although with colony fixed effects only the adjusted R-squared value is a mere 0.070, district fixed effects actually explain around 20% of the total variation in present rates. In comparison, year fixed effects explain only around 10.3% of the total present rate variation. Hence, this makes the relative share of the adjusted R-squared value due to district fixed effects compared to year fixed effects reverse in relation to the fitness rate scenario, with district fixed effects explaining 60% of the adjusted R-squared value, while year fixed effects occupying only 30% of the explain variation in present rates. The relative mitigated share of variation explained by macro time trends also corresponds to the scenario painted in the colony-level time trend graphs of present rates, where it's hard to detect any consistent macro trends over the entire sample period.

The scenario for the decomposition of variation for volunteering rate mirrors that of the present rate in terms of the relative magnitude of the year fixed effects compared to district fixed effects in explaining the total variation in volunteer, notwithstanding its own other rather distinctive particularities. Compared to the variation in present rate, a larger share of the time-invariant component of the volunteering variation is actually due to colony-specific variation, instead of district-specific variation. As can be observed in the lower panel of table B8, from column 1 to column 2 with district fixed effects having replaced colony fixed effects, the adjusted R-squared value only increases from

0.144 to 0.186. Furthermore, the adjusted R-squared increases from 0.369 to 0.457 when colony-specific linear trends are added, while the addition of district-specific linear trends only merely increases the adjusted R-squared value to 0.467.

Table B8: LSDV Regression Results: Variance Decomposition with Fixed Effects

VARIABLES	(1) fitness rate	(2) fitness rate	(3) fitness rate	(4) fitness rate	(5) fitness rate	(6) fitness rate
Adjusted R-squared	0.055	0.050	0.329	0.384	0.463	0.480
Share of R^2 due to $\hat{\alpha}_d$	–	1.00	–	0.13	0.11	0.10
Share of R^2 due to $\hat{\alpha}_t$	–	–	1.00	0.86	0.71	0.69
Colony FE	YES	NO	NO	NO	NO	NO
District FE	NO	YES	NO	YES	YES	YES
Year FE	NO	NO	YES	YES	YES	YES
Colony linear trend	NO	NO	NO	NO	YES	NO
District linear trend	NO	NO	NO	NO	NO	YES
Observations	1,460	1,460	1,460	1,460	1,460	1,460

VARIABLES	(1) present rate	(2) present rate	(3) present rate	(4) present rate	(5) present rate	(6) present rate
Adjusted R-squared	0.070	0.197	0.103	0.316	0.329	0.337
Share of R^2 due to $\hat{\alpha}_d$	–	1.00	–	0.62	0.60	0.58
Share of R^2 due to $\hat{\alpha}_t$	–	–	1.00	0.33	0.31	0.31
Colony FE	YES	NO	NO	NO	NO	NO
District FE	NO	YES	NO	YES	YES	YES
Year FE	NO	NO	YES	YES	YES	YES
Colony linear trend	NO	NO	NO	NO	YES	NO
District linear trend	NO	NO	NO	NO	NO	YES
Observations	1,460	1,460	1,460	1,460	1,460	1,460

VARIABLES	(1) volunteering	(2) volunteering	(3) volunteering	(4) volunteering	(5) volunteering	(6) volunteering
Adjusted R-squared	0.144	0.186	0.178	0.369	0.457	0.467
Share of R^2 due to $\hat{\alpha}_d$	–	1.00	–	0.50	0.41	0.40
Share of R^2 due to $\hat{\alpha}_t$	–	–	1.00	0.48	0.39	0.38
Colony FE	YES	NO	NO	NO	NO	NO
District FE	NO	YES	NO	YES	YES	YES
Year FE	NO	NO	YES	YES	YES	YES
Colony linear trend	NO	NO	NO	NO	YES	NO
District linear trend	NO	NO	NO	NO	NO	YES
Observations	1,460	1,460	1,460	1,460	1,460	1,460

Dependent variables are all in rates (ranging from zero to one). $\hat{\alpha}_d$ refers to district fixed effects. $\hat{\alpha}_t$ refers to time fixed effects. Standard errors are clustered at the district level. *** p<0.01, ** p<0.05, * p<0.1.

3 Impact of recruitment targets on conscription procedures

Table C1: Impact of recruitment target on soldier enumeration

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	enumerated	enumerated	enumerated	enumerated	enumerated	enumerated	enumerated	enumerated	enumerated
target	-1.1186 (2.0820)	-0.2337 (2.4760)	-2.6949 (2.7671)	-0.4358 (0.9051)	-0.1481 (0.9086)	-1.2283 (1.1674)	-0.5671 (1.0346)	-0.5910 (1.0481)	-1.2718 (1.0624)
target missing				69.4658 (125.8365)	75.5111 (126.1026)	-20.8869 (148.3667)	3.2972 (140.0107)	31.5032 (140.3128)	-28.6601 (128.7080)
district population							0.0338*** (0.0065)	0.0349*** (0.0059)	-0.1607 (0.5767)
Observations	727	727	727	1,459	1,459	1,459	1,459	1,459	1,459
R-squared	0.280	0.303	0.457	0.232	0.249	0.406	0.277	0.287	0.406
District FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Colony linear trend	NO	YES	NO	NO	YES	NO	NO	YES	NO
District linear trend	NO	NO	YES	NO	NO	YES	NO	NO	YES

Dependent variable is raw enumeration in a district in a given year. "target" is the conscript quota (in original number) assigned to a district in a given year. "Target missing" is a dummy indicator taking on value one when the "target" variable equals to zero (which means missing in actuality). "Target2" is the adjusted target number, after the missing values of the "target" variable are filled in based on the correlation between the annual target and the ultimate incorporated number of soldiers in a given year. Standard errors are clustered at the district level. *** p<0.01, ** p<0.05, * p<0.1

Table C2

VARIABLES	(1) present	(2) present	(3) present	(4) present	(5) present	(6) present	
target	-0.2840 (0.6580)	-0.1271 (0.5807)	-0.3649 (0.4865)				
target missing	-21.8945 (84.0515)	3.5819 (89.0411)	-18.7603 (74.7355)				
district population	0.0270*** (0.0094)	0.0243** (0.0097)	-0.0433 (0.2875)	0.0268*** (0.0099)	0.0233** (0.0100)	-0.0031 (0.2833)	Dependent
target2				0.4781 (0.9896)	0.7327 (0.9105)	0.2360 (0.7546)	
Observations	1,459	1,459	1,459	1,435	1,435	1,435	
R-squared	0.258	0.284	0.420	0.262	0.289	0.421	
District FE	YES	YES	YES	YES	YES	YES	
Year FE	YES	YES	YES	YES	YES	YES	
Colony linear trend	NO	YES	NO	NO	YES	NO	
District linear trend	NO	NO	YES	NO	NO	YES	

variable is raw number of presence. "target" is the conscript quota (in original number) assigned to a district in a given year. "Target missing" is a dummy indicator taking on value one when the "target" variable equals to zero (which means missing in actuality). "Target2" is the adjusted target number, after the missing values of the "target" variable are filled in based on the correlation between the annual target and the ultimate incorporated number of soldiers in a given year. Standard errors are clustered at the district level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table C3

VARIABLES	(1) fitness	(2) fitness	(3) fitness	(4) fitness	(5) fitness	(6) fitness
target	0.0003*** (0.0001)	0.0004*** (0.0001)	0.0003*** (0.0001)			
target missing	-0.0072 (0.0227)	-0.0212 (0.0227)	-0.0266 (0.0235)			
district population	-0.0000 (0.0000)	-0.0000* (0.0000)	-0.0003*** (0.0001)	-0.0000 (0.0000)	-0.0000 (0.0000)	-0.0003*** (0.0001)
target2				0.0005*** (0.0001)	0.0005*** (0.0001)	0.0004*** (0.0001)
Observations	1,459	1,459	1,459	1,435	1,435	1,435
R-squared	0.377	0.462	0.540	0.374	0.456	0.532
District FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
Colony linear trend	NO	YES	NO	NO	YES	NO
District linear trend	NO	NO	YES	NO	NO	YES

Dependent variable is fitness rate (ranging from zero to one). "target" is the conscript quota (in original number) assigned to a district in a given year. "Target missing" is a dummy indicator taking on value one when the "target" variable equals to zero (which means missing in actuality). "Target2" is the adjusted target number, after the missing values of the "target" variable are filled in based on the correlation between the annual target and the ultimate incorporated number of soldiers in a given year. Standard errors are clustered at the district level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table C4

VARIABLES	(1) present	(2) present	(3) present	(4) present	(5) present	(6) present
target	0.0001* (0.0001)	0.0002** (0.0001)	0.0002** (0.0001)			
lagged lottery	0.0377 (0.0264)	0.0167 (0.0245)	0.0099 (0.0308)	0.0481 (0.0326)	0.0267 (0.0312)	0.0206 (0.0403)
target * lagged lottery	-0.0001 (0.0002)	-0.0002 (0.0002)	-0.0001 (0.0003)			
district population	0.0000 (0.0000)	0.0000 (0.0000)	0.0002*** (0.0001)	0.0000 (0.0000)	0.0000 (0.0000)	0.0002*** (0.0001)
lagged present	0.3255*** (0.0439)	0.3805*** (0.0470)	0.2817*** (0.0574)	0.3430*** (0.0423)	0.4007*** (0.0464)	0.3112*** (0.0571)
target missing	-0.0121 (0.0157)	0.0002 (0.0166)	-0.0009 (0.0185)			
target2				0.0003*** (0.0001)	0.0003*** (0.0001)	0.0003*** (0.0001)
target 2 * lagged lottery				-0.0002 (0.0002)	-0.0002 (0.0002)	-0.0002 (0.0003)
Observations	1,166	1,166	1,166	1,148	1,148	1,148
R-squared	0.268	0.323	0.397	0.288	0.345	0.417
District FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
Colony linear trend	NO	YES	NO	NO	YES	NO
District linear trend	NO	NO	YES	NO	NO	YES

Dependent variable is present rate (ranging from zero to one). "target" is the conscript quota (in original number) assigned to a district in a given year. "Target missing" is a dummy indicator taking on value one when the "target" variable equals to zero (which means missing in actuality). "Target2" is the adjusted target number, after the missing values of the "target" variable are filled in based on the correlation between the annual target and the ultimate incorporated number of soldiers in a given year. "lagged lottery" refers to the lottery rate from the previous year in the same district. The same applies to "lagged present", which is the present rate from the previous year in a given district. Standard errors are clustered at the district level. *** p<0.01, ** p<0.05, * p<0.1

Table C5: Impact of recruitment target on lottery rate

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	lottery rate	lottery rate	lottery rate	lottery rate	lottery rate	lottery rate	lottery rate	lottery rate	lottery rate
target	0.0002 (0.0002)	0.0000 (0.0002)	0.0000 (0.0002)	0.0001 (0.0001)	-0.0000 (0.0001)	0.0000 (0.0002)	0.0001 (0.0002)	0.0001 (0.0002)	0.0001 (0.0002)
lag ottery							0.1298*** (0.0341)	0.1482*** (0.0337)	0.0591 (0.0400)
target * lag lottery							-0.0002 (0.0002)	-0.0002 (0.0002)	-0.0004 (0.0002)
district population				0.0000 (0.0000)	0.0000 (0.0000)	0.0000 (0.0001)	0.0000 (0.0000)	0.0000 (0.0000)	-0.0001 (0.0001)
target missing				0.0627** (0.0258)	0.0606** (0.0258)	0.0619** (0.0289)	0.0478* (0.0266)	0.0396 (0.0256)	0.0408 (0.0287)
Observations	727	727	727	1,459	1,459	1,459	1,169	1,169	1,169
R-squared	0.274	0.307	0.468	0.313	0.320	0.400	0.304	0.322	0.400
District FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Colony linear trend	NO	YES	YES	NO	YES	NO	NO	YES	NO
District linear trend	NO	NO	NO	NO	NO	YES	NO	NO	YES

Dependent variable is lottery rate (ranging from zero to one). "target" is the conscript quota (in original number) assigned to a district in a given year. "Target missing" is a dummy indicator taking on value one when the "target" variable equals to zero (which means missing in actuality). "Target2" is the adjusted target number, after the missing values of the "target" variable are filled in based on the correlation between the annual target and the ultimate incorporated number of soldiers in a given year. "lagged lottery" refers to the lottery rate from the previous year in the same district. Standard errors are clustered at the district level. *** p<0.01, ** p<0.05, * p<0.1

Table C6: Impact of recruitment target on volunteering rate

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	volunteer	volunteer	volunteer	volunteer	volunteer	volunteer	volunteer	volunteer
target	-0.0001 (0.0001)	0.0000 (0.0001)	0.0001 (0.0001)	-0.0001 (0.0001)	-0.0001 (0.0001)	-0.0000 (0.0001)		
target missing				-0.1001*** (0.0161)	-0.1009*** (0.0143)	-0.0910*** (0.0148)		
district population				-0.0000 (0.0000)	0.0000 (0.0000)	0.0003*** (0.0001)	0.0003*** (0.0001)	0.0003*** (0.0001)
target1						0.0000 (0.0001)	0.0000 (0.0001)	
target2								0.0003*** (0.0001)
Observations	727	727	727	1,459	1,459	1,459	1,459	1,435
R-squared	0.431	0.522	0.601	0.255	0.351	0.432	0.410	0.417
District FE	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Colony linear trend	NO	YES	NO	NO	YES	NO	NO	NO
District linear trend	NO	NO	YES	NO	NO	YES	YES	YES

Dependent variable is volunteer rate (ranging from zero to one). "target" is the conscript quota (in original number) assigned to a district in a given year. "Target missing" is a dummy indicator taking on value one when the "target" variable equals to zero (which means missing in actuality). "Target2" is the adjusted target number, after the missing values of the "target" variable are filled in based on the correlation between the annual target and the ultimate incorporated number of soldiers in a given year. Standard errors are clustered at the district level. *** p<0.01, ** p<0.05, * p<0.1

4 Impact of weather shocks on military participation

Table D1: Impact of first-six-month weather shocks on volunteer rates (four linear splines, quartile-based division)

VARIABLES	(1) volunteer	(2) volunteer	(3) volunteer	(4) volunteer	(5) volunteer	(6) volunteer	(7) volunteer
negative rainfall deviation(2)	0.0028 (0.0255)	-0.0127 (0.0238)	-0.0224 (0.0264)				-0.0275 (0.0268)
negative rainfall deviation(1)	-0.0148 (0.0372)	-0.0033 (0.0320)	0.0149 (0.0335)				0.0177 (0.0332)
positive rainfall deviation(1)	0.0036 (0.0294)	0.0134 (0.0270)	0.0165 (0.0274)				0.0081 (0.0271)
positive rainfall deviation(2)	0.0453*** (0.0167)	0.0383** (0.0160)	0.0314* (0.0167)				0.0338** (0.0162)
Negative temperature deviation(2)				-0.0638*** (0.0163)	-0.0712*** (0.0147)	-0.0775*** (0.0151)	-0.0787*** (0.0150)
Negative temperature deviation(1)				0.0152 (0.0266)	-0.0058 (0.0268)	0.0177 (0.0287)	0.0224 (0.0295)
positive temperature deviation(1)				0.1336*** (0.0393)	0.1350*** (0.0367)	0.1194*** (0.0387)	0.1121*** (0.0391)
positive temperature deviation(2)				-0.0319* (0.0185)	-0.0742*** (0.0187)	-0.0780*** (0.0194)	-0.0784*** (0.0198)
Observations	1,460	1,460	1,460	1,460	1,460	1,460	1,460
R-squared	0.241	0.350	0.409	0.256	0.364	0.423	0.428
District FE	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES
Colony linear trend	NO	YES	NO	NO	YES	NO	NO
District linear trend	NO	NO	YES	NO	NO	YES	YES

Dependent variable is volunteering rate in a district in a given year (ranging from zero to one). Standard errors are clustered at the district level. *** p<0.01, ** p<0.05, * p<0.1

Table D2: Impact of first-six-month weather shocks on present rates (four linear splines, quartile-based division)

VARIABLES	(1)		(2)		(3)		(4)		(5)		(6)		(7)	
	present	present	present	present	present	present	present	present	present	present	present	present	present	present
negative rainfall deviation(2)	-0.0496** (0.0233)	-0.0426* (0.0235)	-0.0475* (0.0267)											-0.0511* (0.0260)
negative rainfall deviation(1)	0.0414 (0.0341)	0.0392 (0.0328)	0.0480 (0.0336)											0.0447 (0.0333)
positive rainfall deviation(1)	-0.0042 (0.0244)	-0.0074 (0.0234)	-0.0108 (0.0242)											-0.0139 (0.0236)
positive rainfall deviation(2)	-0.0014 (0.0122)	0.0026 (0.0125)	0.0058 (0.0132)											0.0052 (0.0133)
Negative temperature deviation(2)				-0.0100 (0.0105)					-0.0151 (0.0106)				-0.0123 (0.0107)	-0.0129 (0.0110)
Negative temperature deviation(1)				0.0099 (0.0271)					0.0128 (0.0269)				0.0185 (0.0304)	0.0157 (0.0310)
positive temperature deviation(1)				0.0457* (0.0261)					0.0629** (0.0282)				0.0715** (0.0329)	0.0744** (0.0343)
positive temperature deviation(2)				-0.0210 (0.0181)					-0.0160 (0.0177)				-0.0022 (0.0196)	-0.0021 (0.0197)
Observations	1,457	1,457	1,457	1,457	1,457	1,457	1,457	1,457	1,457	1,457	1,457	1,457	1,457	1,457
R-squared	0.163	0.183	0.252	0.163	0.163	0.163	0.163	0.163	0.187	0.187	0.187	0.259	0.259	0.262
District FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Colony linear trend	NO	YES	NO	NO	NO	NO	NO	NO	YES	YES	YES	NO	NO	NO
District linear trend	NO	NO	YES	NO	NO	NO	NO	NO	NO	NO	NO	YES	YES	YES

Dependent variable is present rate in a district in a given year (ranging from zero to one). Standard errors are clustered at the district level. *** p<0.01, ** p<0.05, * p<0.1

Table D3: Heterogeneous impact of first-six-month weather shocks on volunteering rates (standard-deviation division and palm line)

VARIABLES	(1) volunteer	(2) volunteer	(3) volunteer	(4) volunteer	(5) volunteer	(6) volunteer	(7) volunteer
negative rainfall deviation (2)	-0.0143 (0.0595)	-0.0110 (0.0540)	-0.0565 (0.0605)				-0.0455 (0.0592)
palm line * negative rainfall deviation (2)	0.0150 (0.0708)	-0.0262 (0.0667)	0.0055 (0.0746)				-0.0342 (0.0730)
negative rainfall deviation (1)	-0.0098 (0.0307)	-0.0110 (0.0251)	0.0039 (0.0271)				0.0050 (0.0263)
palm line * negative rainfall deviation (1)	0.0223 (0.0389)	0.0332 (0.0361)	0.0295 (0.0374)				0.0169 (0.0385)
positive rainfall deviation (1)	-0.0248 (0.0258)	-0.0177 (0.0215)	-0.0195 (0.0228)				-0.0252 (0.0230)
palm line * positive rainfall deviation (1)	0.0493 (0.0456)	0.0492 (0.0422)	0.0569 (0.0429)				0.0762* (0.0427)
positive rainfall deviation (2)	0.0169 (0.0190)	0.0042 (0.0152)	-0.0019 (0.0160)				0.0004 (0.0162)
palm line * positive rainfall deviation (2)	0.1119** (0.0471)	0.1202*** (0.0444)	0.1123** (0.0487)				0.1000** (0.0461)
negative temp deviation (2)				-0.0591** (0.0226)	-0.0624*** (0.0201)	-0.0697*** (0.0209)	-0.0579*** (0.0209)
palm line * negative temp deviation (2)				-0.1051* (0.0587)	-0.0938* (0.0545)	-0.1123** (0.0565)	-0.1388** (0.0570)
negative temp deviation (1)				0.0305 (0.0273)	0.0291 (0.0229)	0.0284 (0.0244)	0.0254 (0.0239)
palm line * negative temp deviation (1)				-0.0919** (0.0392)	-0.1338*** (0.0376)	-0.0902** (0.0405)	-0.0636 (0.0421)
positive temp deviation (1)				0.0621* (0.0325)	0.0135 (0.0267)	0.0045 (0.0287)	0.0071 (0.0286)
palm line * positive temp deviation (1)				0.0978* (0.0559)	0.1776*** (0.0543)	0.1723*** (0.0564)	0.1599*** (0.0534)
positive temp deviation (2)				-0.0225 (0.0299)	-0.0538 (0.0337)	-0.0617* (0.0364)	-0.0665* (0.0368)
palm line * positive temp deviation (2)				-0.1320** (0.0593)	-0.1374** (0.0604)	-0.1177* (0.0618)	-0.1478** (0.0575)
Observations	1,460	1,460	1,460	1,460	1,460	1,460	1,460
R-squared	0.256	0.366	0.425	0.265	0.375	0.432	0.452
District FE	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES
Colony linear trend	NO	YES	NO	NO	YES	NO	NO
District linear trend	YES	NO	YES	YES	NO	YES	YES

Dependent variable is volunteering rate in a district in a given year (ranging from zero to one). Standard errors are clustered at the district level. *** p<0.01, ** p<0.05, * p<0.1

Table D4: Heterogeneous impact of first-six-month weather shocks on present rates (standard-deviation division and palm line)

VARIABLES	(1) present	(2) present	(3) present	(4) present	(5) present	(6) present	(7) present
negative rainfall deviation (2)	-0.0886** (0.0445)	-0.0729* (0.0427)	-0.0921* (0.0520)				-0.0974* (0.0522)
palm line * negative rainfall deviation (2)	0.0208 (0.0619)	0.0099 (0.0612)	0.0250 (0.0720)				0.0308 (0.0699)
negative rainfall deviation (1)	-0.0060 (0.0208)	-0.0118 (0.0207)	-0.0073 (0.0225)				-0.0132 (0.0227)
palm line * negative rainfall deviation (1)	0.0865** (0.0385)	0.0966** (0.0373)	0.0975** (0.0379)				0.1013*** (0.0377)
positive rainfall deviation (1)	-0.0305 (0.0204)	-0.0285 (0.0198)	-0.0298 (0.0204)				-0.0294 (0.0202)
palm line * positive rainfall deviation (1)	0.0330 (0.0351)	0.0235 (0.0344)	0.0195 (0.0334)				0.0221 (0.0338)
positive rainfall deviation (2)	0.0291 (0.0189)	0.0345* (0.0190)	0.0338* (0.0192)				0.0324* (0.0190)
palm line * positive rainfall deviation (2)	-0.0589 (0.0394)	-0.0581 (0.0404)	-0.0476 (0.0418)				-0.0442 (0.0437)
negative temp deviation (2)				-0.0008 (0.0138)	-0.0056 (0.0136)	-0.0020 (0.0140)	0.0145 (0.0149)
palm line * negative temp deviation (2)				-0.0763* (0.0401)	-0.0920** (0.0427)	-0.1126*** (0.0422)	-0.1264*** (0.0400)
negative temp deviation (1)				-0.0071 (0.0169)	-0.0068 (0.0169)	0.0033 (0.0191)	0.0023 (0.0188)
palm line * negative temp deviation (1)				0.0585* (0.0342)	0.0699** (0.0329)	0.0578* (0.0347)	0.0695** (0.0338)
positive temp deviation (1)				0.0099 (0.0175)	0.0302 (0.0196)	0.0367* (0.0221)	0.0391* (0.0223)
palm line * positive temp deviation (1)				0.0292 (0.0315)	0.0041 (0.0329)	0.0126 (0.0372)	0.0083 (0.0367)
positive temp deviation (2)				-0.0215 (0.0298)	-0.0168 (0.0291)	0.0017 (0.0337)	0.0028 (0.0334)
palm line * positive temp deviation (2)				-0.0072 (0.0561)	0.0029 (0.0549)	-0.0089 (0.0595)	-0.0394 (0.0596)
Observations	1,457	1,457	1,457	1,457	1,457	1,457	1,457
R-squared	0.179	0.199	0.268	0.169	0.191	0.263	0.284
District FE	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES
Colony linear trend	NO	YES	NO	NO	YES	NO	NO
District linear trend	YES	NO	YES	YES	NO	YES	YES

Dependent variable is present rate in a district in a given year (ranging from zero to one). Standard errors are clustered at the district level. *** p<0.01, ** p<0.05, * p<0.1

5 Additional tables with head tax rate as outcome and control variables

Table E1: Impact of current-year first-six-month weather shocks on deflated log tax rates (Delaware data)

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	log head tax	log head tax	log head tax	log head tax	log head tax	log head tax	log head tax	log head tax
negative temperature deviation	-0.0602*** (0.0162)	-0.0426** (0.0174)	-0.0397** (0.0193)				-0.0403** (0.0190)	
positive temperature deviation	-0.0214 (0.0222)	0.0252 (0.0193)	0.0345 (0.0236)				0.0306 (0.0236)	
negative rainfall deviation				-0.0463* (0.0254)	-0.0607** (0.0236)	-0.0671** (0.0297)	-0.0715** (0.0297)	
positive rainfall deviation				0.0396*** (0.0101)	0.0410*** (0.0101)	0.0457*** (0.0120)	0.0439*** (0.0116)	
Observations	710	710	710	710	710	710	710	710
R-squared	0.734	0.768	0.814	0.728	0.772	0.819	0.821	0.816
District FE	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Colony linear trend	NO	YES	NO	NO	YES	NO	NO	NO
District linear trend	NO	NO	YES	NO	NO	YES	YES	YES

Dependent variable is log head tax per capita in a district in a given year, deflated with franc deflators. The weather deviation variables are district-specific and yearly, the construction of which is based on the monthly weather measures in a given district from January to June in the given year. All weather deviation are standardized by district-specific standard deviation of annual weather measures during the sample period (1920-1938). Standard errors reported in parentheses are clustered at the district level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table E2: Heterogeneous impact of weather shocks on volunteering rates (with four linear splines and linear-interpolated deflated log head tax control)

VARIABLES	(1) volunteer	(2) volunteer	(3) volunteer	(4) volunteer	(5) volunteer	(6) volunteer	(7) volunteer
negative rainfall deviation (2)	-0.0123 (0.0349)	-0.0387 (0.0347)	-0.0649 (0.0391)				-0.0484 (0.0378)
palm line * negative rainfall deviation (2)	0.0249 (0.0511)	0.0482 (0.0514)	0.0816 (0.0579)				0.0133 (0.0599)
negative rainfall deviation (1)	-0.0361 (0.0363)	-0.0227 (0.0363)	0.0064 (0.0343)				-0.0005 (0.0342)
palm line * negative rainfall deviation (1)	0.0958 (0.0683)	0.0786 (0.0650)	0.0509 (0.0684)				0.0676 (0.0690)
positive rainfall deviation (1)	0.0206 (0.0228)	0.0270 (0.0230)	0.0303 (0.0241)				0.0187 (0.0245)
palm line * positive rainfall deviation (1)	-0.0351 (0.0643)	-0.0471 (0.0629)	-0.0548 (0.0650)				-0.0383 (0.0618)
positive rainfall deviation (2)	-0.0065 (0.0135)	-0.0127 (0.0124)	-0.0076 (0.0116)				-0.0050 (0.0121)
palm line * positive rainfall deviation (2)	0.1327*** (0.0404)	0.1362*** (0.0401)	0.1411*** (0.0446)				0.1337*** (0.0393)
log head tax	-0.2187*** (0.0519)	-0.2311*** (0.0515)	-0.2484*** (0.0610)	-0.1773*** (0.0525)	-0.2084*** (0.0543)	-0.2472*** (0.0630)	-0.2413*** (0.0640)
palm line * log head tax	-0.1535** (0.0623)	0.0805 (0.0907)	0.0003 (0.1356)	-0.1099* (0.0662)	0.1512 (0.1036)	0.1831 (0.1576)	0.0774 (0.1625)
negative temp deviation (2)				-0.0429*** (0.0109)	-0.0371*** (0.0102)	-0.0433*** (0.0106)	-0.0340*** (0.0110)
palm line * negative temp deviation (2)				-0.1540*** (0.0454)	-0.1471*** (0.0436)	-0.1485*** (0.0447)	-0.1509*** (0.0396)
negative temp deviation (1)				0.0546* (0.0304)	0.0425 (0.0311)	0.0555* (0.0290)	0.0495* (0.0289)
palm line * negative temp deviation (1)				-0.0993* (0.0502)	-0.1202** (0.0523)	-0.1161** (0.0549)	-0.1000* (0.0562)
positive temp deviation (1)				0.0562 (0.0417)	0.0415 (0.0396)	0.0304 (0.0404)	0.0298 (0.0401)
palm line * positive temp deviation (1)				0.1592* (0.0834)	0.2223** (0.0855)	0.2513*** (0.0867)	0.2354*** (0.0851)
positive temp deviation (2)				-0.0439* (0.0251)	-0.0705** (0.0269)	-0.0816*** (0.0303)	-0.0753** (0.0302)
palm line * positive temp deviation (2)				-0.0227 (0.0496)	-0.0251 (0.0505)	-0.0277 (0.0534)	-0.0652 (0.0542)
Observations	1,313	1,313	1,313	1,313	1,313	1,313	1,313
R-squared	0.350	0.371	0.438	0.355	0.379	0.446	0.471
District FE	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES
Colony linear trend	NO	YES	NO	NO	YES	NO	NO
District linear trend	YES	NO	YES	YES	NO	YES	YES

Table E3: Heterogeneous impact of weather shocks on present rates (with four linear splines and linear-interpolated deflated log head tax control)

VARIABLES	(1)		(2)		(3)		(4)		(5)		(6)		(7)	
	present	present	present	present	present	present	present	present	present	present	present	present	present	present
negative rainfall deviation (2)	-0.1090*** (0.0368)	-0.0871** (0.0357)	-0.1061** (0.0435)											-0.1135*** (0.0424)
palm line * negative rainfall deviation (2)	0.1260** (0.0488)	0.0956** (0.0472)	0.1208** (0.0540)											0.1320** (0.0540)
negative rainfall deviation (1)	0.0278 (0.0391)	0.0105 (0.0376)	0.0254 (0.0396)											0.0179 (0.0394)
palm line * negative rainfall deviation (1)	0.0641 (0.0724)	0.1019 (0.0678)	0.0800 (0.0683)											0.0929 (0.0682)
positive rainfall deviation (1)	-0.0401 (0.0269)	-0.0471* (0.0247)	-0.0563** (0.0271)											-0.0539** (0.0256)
palm line * positive rainfall deviation (1)	0.0844* (0.0498)	0.0908* (0.0460)	0.0908* (0.0475)											0.0802 (0.0483)
positive rainfall deviation (2)	0.0186 (0.0135)	0.0247* (0.0135)	0.0232 (0.0142)											0.0181 (0.0136)
palm line * positive rainfall deviation (2)	-0.0649** (0.0295)	-0.0666** (0.0294)	-0.0553* (0.0306)											-0.0530* (0.0309)
log head tax	-0.0854* (0.0472)	-0.0434 (0.0535)	-0.0102 (0.0653)	-0.0639 (0.0556)	-0.0336 (0.0623)	0.0002 (0.0805)	0.0094 (0.0746)							0.0094 (0.0746)
palm line * log head tax	0.0639 (0.0461)	-0.1348** (0.0613)	-0.3435** (0.1020)	0.0779 (0.0515)	-0.1062* (0.0619)	-0.3219*** (0.1132)	-0.3952*** (0.1143)							-0.3952*** (0.1143)
negative temp deviation (2)				0.0121 (0.0133)	0.0131 (0.0136)	0.0198 (0.0145)	0.0362** (0.0160)							0.0362** (0.0160)
palm line * negative temp deviation (2)				-0.0439 (0.0334)	-0.0507 (0.0335)	-0.0759** (0.0351)	-0.0850*** (0.0322)							-0.0850*** (0.0322)
negative temp deviation (1)				-0.0340 (0.0307)	-0.0302 (0.0311)	-0.0213 (0.0362)	-0.0257 (0.0350)							-0.0257 (0.0350)
palm line * negative temp deviation (1)				0.0671 (0.0560)	0.0847 (0.0562)	0.1084* (0.0596)	0.1059* (0.0563)							0.1059* (0.0563)
positive temp deviation (1)				-0.0001 (0.0332)	0.0462 (0.0371)	0.0632 (0.0437)	0.0676 (0.0434)							0.0676 (0.0434)
palm line * positive temp deviation (1)				0.0573 (0.0543)	-0.0287 (0.0576)	-0.0574 (0.0662)	-0.0767 (0.0648)							-0.0767 (0.0648)
positive temp deviation (2)				-0.0084 (0.0238)	0.0061 (0.0226)	0.0278 (0.0266)	0.0345 (0.0276)							0.0345 (0.0276)
palm line * positive temp deviation (2)				0.0202 (0.0414)	0.0464 (0.0403)	0.0410 (0.0471)	0.0294 (0.0492)							0.0294 (0.0492)
Observations	1,313	1,313	1,313	1,313	1,313	1,313	1,313	1,313	1,313	1,313	1,313	1,313	1,313	1,313
R-squared	0.226	0.265	0.353	0.205	0.242	0.338	0.368							0.368
District FE	YES	YES	YES	YES	YES	YES	YES							YES
Year FE	YES	YES	YES	YES	YES	YES	YES							YES
Colony linear trend	NO	YES	NO	NO	YES	NO	NO							NO
District linear trend	YES	NO	YES	YES	NO	YES	YES							YES

6 Additional robustness checks with second-six-month weather shocks

Table F1: Impact of second-six-month weather shocks on volunteer rates (Delaware data and four linear splines)

VARIABLES	(1) volunteer	(2) volunteer	(3) volunteer	(4) volunteer	(5) volunteer	(6) volunteer	(7) volunteer
negative rainfall deviation(2)	0.0130 (0.0325)	0.0026 (0.0334)	0.0035 (0.0345)				0.0014 (0.0340)
negative rainfall deviation(1)	0.0252 (0.0212)	0.0223 (0.0204)	0.0203 (0.0224)				0.0201 (0.0227)
positive rainfall deviation(1)	0.0017 (0.0217)	-0.0095 (0.0198)	-0.0070 (0.0215)				-0.0068 (0.0212)
positive rainfall deviation(2)	0.0339 (0.0299)	0.0417 (0.0258)	0.0377 (0.0284)				0.0357 (0.0278)
negative temperature deviation(2)				-0.0799*** (0.0190)	-0.0659*** (0.0180)	-0.0677*** (0.0189)	-0.0654*** (0.0191)
negative temperature deviation(1)				0.0691*** (0.0225)	0.0322 (0.0195)	0.0234 (0.0217)	0.0177 (0.0222)
positive temperature deviation(1)				-0.0188 (0.0217)	-0.0288 (0.0228)	-0.0163 (0.0237)	-0.0130 (0.0241)
positive temperature deviation(2)				-0.0271 (0.0298)	-0.0014 (0.0328)	0.0005 (0.0351)	0.0001 (0.0349)
Observations	1,460	1,460	1,460	1,460	1,460	1,460	1,460
R-squared	0.239	0.347	0.406	0.246	0.352	0.412	0.414
District FE	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES
Colony linear trend	NO	YES	NO	NO	YES	NO	NO
District linear trend	NO	NO	YES	NO	NO	YES	YES

Dependent variable is volunteering rate in a district in a given year (ranging from zero to one). "Negative rainfall deviation(2)" takes on values for standardized rainfall shocks that are smaller than minus one. "Negative rainfall deviation(1)" takes on value for standardized rainfall shocks ranging from minus one to zero. "Positive rainfall deviation(1)" takes on value for standardized rainfall shocks ranging between zero and one. "Positive rainfall deviation(2)" takes on value for standardized rainfall shocks that are larger than one. The same applies for the four temperature deviation measures. The weather deviation variables are district-specific and yearly, the construction of which is based on the monthly weather measures in a given district from July to December in a given year. Standard errors are clustered at the district level. *** p<0.01, ** p<0.05, * p<0.1.

Table F2: Impact of second-six-month weather shocks on present rates (Delaware data and four linear splines)

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	present	present	present	present	present	present	present
negative rainfall deviation(2)	0.0257 (0.0337)	0.0314 (0.0323)	0.0422 (0.0341)				0.0338 (0.0331)
negative rainfall deviation(1)	-0.0225 (0.0172)	-0.0206 (0.0170)	-0.0315* (0.0179)				-0.0277 (0.0182)
positive rainfall deviation(1)	0.0384*** (0.0146)	0.0364** (0.0151)	0.0414** (0.0163)				0.0427** (0.0163)
positive rainfall deviation(2)	-0.0111 (0.0198)	-0.0019 (0.0199)	0.0091 (0.0203)				0.0091 (0.0198)
negative temperature deviation(2)				-0.0022 (0.0115)	-0.0186 (0.0112)	-0.0176 (0.0125)	-0.0160 (0.0116)
negative temperature deviation(1)				-0.0379** (0.0147)	-0.0241 (0.0154)	-0.0179 (0.0161)	-0.0204 (0.0164)
positive temperature deviation(1)				-0.0154 (0.0183)	-0.0077 (0.0186)	-0.0047 (0.0199)	-0.0039 (0.0202)
positive temperature deviation(2)				0.1025** (0.0429)	0.0996** (0.0418)	0.1156*** (0.0440)	0.1154*** (0.0431)
Observations	1,457	1,457	1,457	1,457	1,457	1,457	1,457
R-squared	0.164	0.186	0.256	0.171	0.191	0.261	0.268
District FE	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES
Colony linear trend	NO	YES	NO	NO	YES	NO	NO
District linear trend	NO	NO	YES	NO	NO	YES	YES

Dependent variable is present rate in a district in a given year (ranging from zero to one). "Negative rainfall deviation (2)" takes on values for standardized rainfall shocks that are smaller than minus one. "Negative rainfall deviation(1)" takes on value for standardized rainfall shocks ranging from minus one to zero. "Positive rainfall deviation(1)" takes on value for standardized rainfall shocks ranging between zero and one. "Positive rainfall deviation(2)" takes on value for standardized rainfall shocks that are larger than one. The same applies for the four temperature deviation measures. The weather deviation variables are district-specific and yearly, the construction of which is based on the monthly weather measures in a given district from July to December in a given year. Standard errors are clustered at the district level. *** p<0.01, ** p<0.05, * p<0.1

7 Robustness checks with UEA data

7.1 "Reduced-form" and heterogeneous impacts of weather shocks on military participation (UEA data)

Table G1: Impact of weather shocks on volunteering rates UEA data

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	volunteer	volunteer	volunteer	volunteer	volunteer	volunteer	volunteer
negative temp deviation	-0.0032 (0.0171)	0.0110 (0.0159)	0.0110 (0.0159)				0.0054 (0.0171)
positive temp deviation	0.0394** (0.0172)	0.0338* (0.0177)	0.0338* (0.0177)				0.0350** (0.0169)
negative rainfall deviation				-0.0285* (0.0148)	-0.0183 (0.0124)	-0.0183 (0.0124)	-0.0203 (0.0124)
positive rainfall deviation				0.0576*** (0.0123)	0.0624*** (0.0117)	0.0624*** (0.0117)	0.0622*** (0.0116)
Observations	1,444	1,444	1,444	1,444	1,444	1,444	1,444
R-squared	0.238	0.348	0.348	0.250	0.362	0.362	0.364
District FE	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES
Colony linear trend	NO	YES	NO	NO	YES	NO	NO
District linear trend	NO	NO	YES	NO	NO	YES	YES

Dependent variable is volunteering rate in a district in a given year (ranging from zero to one). Standard errors are clustered at the district level. *** p<0.01, ** p<0.05, * p<0.1

Table G2: Impact of weather shocks on present rates UEA data

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	present	present	present	present	present	present	present
negative temp deviation	0.0149 (0.0133)	0.0104 (0.0130)	0.0104 (0.0130)				0.0111 (0.0132)
positive temp deviation	-0.0053 (0.0152)	-0.0082 (0.0155)	-0.0082 (0.0155)				-0.0065 (0.0154)
negative rainfall deviation				-0.0163 (0.0128)	-0.0175 (0.0122)	-0.0175 (0.0122)	-0.0176 (0.0121)
positive rainfall deviation				0.0056 (0.0085)	0.0039 (0.0088)	0.0039 (0.0088)	0.0032 (0.0090)
Observations	1,441	1,441	1,441	1,441	1,441	1,441	1,441
R-squared	0.160	0.181	0.181	0.160	0.182	0.182	0.183
District FE	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES
Colony linear trend	NO	YES	NO	NO	YES	NO	NO
District linear trend	NO	NO	YES	NO	NO	YES	YES

Dependent variable is present rate in a district in a given year (ranging from zero to one). Standard errors are clustered at the district level. *** p<0.01, ** p<0.05, * p<0.1

Table G3: Heterogeneous impacts of weather shocks on volunteering rates UEA data

VARIABLES	(1)		(2)		(3)		(4)		(5)		(6)		(7)	
	volunteer	volunteer	volunteer	volunteer	volunteer	volunteer	volunteer	volunteer	volunteer	volunteer	volunteer	volunteer	volunteer	volunteer
negative temp deviation	-0.0345*	-0.0194	-0.0194	-0.0194	-0.0194	-0.0194	-0.0129	-0.0129	-0.0129	-0.0129	-0.0129	-0.0129	-0.0129	-0.0126
	(0.0200)	(0.0179)	(0.0179)	(0.0179)	(0.0179)	(0.0179)	(0.0164)	(0.0164)	(0.0164)	(0.0164)	(0.0164)	(0.0164)	(0.0164)	(0.0182)
palm line * negative temp deviation	0.0702***	0.0646***	0.0646***	0.0646***	0.0646***	0.0646***	-0.0153	-0.0153	-0.0153	-0.0153	-0.0153	-0.0153	-0.0153	0.0505***
	(0.0166)	(0.0155)	(0.0155)	(0.0155)	(0.0155)	(0.0155)	(0.0245)	(0.0245)	(0.0245)	(0.0245)	(0.0245)	(0.0245)	(0.0245)	(0.0158)
positive temp deviation	0.0706***	0.0567***	0.0567***	0.0567***	0.0567***	0.0567***	0.0153	0.0153	0.0153	0.0153	0.0153	0.0153	0.0153	0.0426**
	(0.0193)	(0.0193)	(0.0193)	(0.0193)	(0.0193)	(0.0193)	(0.0130)	(0.0130)	(0.0130)	(0.0130)	(0.0130)	(0.0130)	(0.0130)	(0.0173)
palm line * positive temp deviation	-0.0835***	-0.0547***	-0.0547***	-0.0547***	-0.0547***	-0.0547***	0.1090***	0.1090***	0.1090***	0.1090***	0.1090***	0.1090***	0.1090***	-0.0400*
	(0.0183)	(0.0203)	(0.0203)	(0.0203)	(0.0203)	(0.0203)	(0.0225)	(0.0225)	(0.0225)	(0.0225)	(0.0225)	(0.0225)	(0.0225)	(0.0210)
negative rainfall deviation							-0.0329*	-0.0329*	-0.0329*	-0.0329*	-0.0329*	-0.0329*	-0.0329*	-0.0173
							(0.0194)	(0.0194)	(0.0194)	(0.0194)	(0.0194)	(0.0194)	(0.0194)	(0.0169)
palm line * negative rainfall deviation							0.0094	0.0094	0.0094	0.0094	0.0094	0.0094	0.0094	0.0004
							(0.0265)	(0.0265)	(0.0265)	(0.0265)	(0.0265)	(0.0265)	(0.0265)	(0.0235)
positive rainfall deviation							0.0183	0.0183	0.0183	0.0183	0.0183	0.0183	0.0183	0.0155
							(0.0143)	(0.0143)	(0.0143)	(0.0143)	(0.0143)	(0.0143)	(0.0143)	(0.0126)
palm line * positive rainfall deviation							0.0891***	0.0891***	0.0891***	0.0891***	0.0891***	0.0891***	0.0891***	0.0978***
							(0.0225)	(0.0225)	(0.0225)	(0.0225)	(0.0225)	(0.0225)	(0.0225)	(0.0215)
Observations	1,444	1,444	1,444	1,444	1,444	1,444	1,444	1,444	1,444	1,444	1,444	1,444	1,444	1,444
R-squared	0.248	0.355	0.355	0.355	0.355	0.355	0.265	0.265	0.265	0.265	0.265	0.265	0.265	0.385
District FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Colony linear trend	NO	YES	YES	YES	NO	NO	NO	NO	NO	YES	YES	NO	NO	NO
District linear trend	NO	NO	NO	NO	YES	YES	NO	NO	NO	NO	NO	YES	YES	YES

Dependent variable is volunteering rate in a district in a given year (ranging from zero to one). Standard errors are clustered at the district level. *** p<0.01, ** p<0.05, * p<0.1

Table G4: Heterogeneous impacts of weather shocks on present rates UEA data

VARIABLES	(1)		(2)		(3)		(4)		(5)		(6)		(7)	
	present		present		present		present		present		present		present	
negative temp deviation	0.0230 (0.0178)		0.0202 (0.0173)		0.0202 (0.0173)		0.0202 (0.0173)		0.0202 (0.0173)		0.0202 (0.0173)		0.0202 (0.0173)	
palm line * negative temp deviation	-0.0206 (0.0163)		-0.0209 (0.0162)		-0.0209 (0.0162)		-0.0209 (0.0162)		-0.0209 (0.0162)		-0.0209 (0.0162)		-0.0209 (0.0162)	
positive temp deviation	-0.0211 (0.0147)		-0.0161 (0.0157)		-0.0161 (0.0157)		-0.0161 (0.0157)		-0.0161 (0.0157)		-0.0161 (0.0157)		-0.0161 (0.0157)	
palm line * positive temp deviation	0.0489*** (0.0155)		0.0193 (0.0186)		0.0193 (0.0186)		0.0193 (0.0186)		0.0193 (0.0186)		0.0193 (0.0186)		0.0193 (0.0186)	
negative rainfall deviation														
palm line * negative rainfall deviation														
positive rainfall deviation														
palm line * positive rainfall deviation														
Observations	1,441		1,441		1,441		1,441		1,441		1,441		1,441	
R-squared	0.164		0.182		0.182		0.170		0.192		0.192		0.194	
District FE	YES		YES		YES		YES		YES		YES		YES	
Year FE	YES		YES		YES		YES		YES		YES		YES	
Colony linear trend	NO		YES		NO		NO		YES		NO		NO	
District linear trend	NO		NO		YES		NO		NO		YES		YES	

Dependent variable is present rate in a district in a given year (ranging from zero to one). Standard errors are clustered at the district level. *** p<0.01, ** p<0.05, * p<0.1

7.2 "Reduced-form" impacts with four linear splines (UEA data)

Table G5: Impacts of weather shocks on volunteer rates (four linear splines UEA data)

VARIABLES	(1) volunteer	(2) volunteer	(3) volunteer	(4) volunteer	(5) volunteer	(6) volunteer	(7) volunteer
negative rainfall deviation (2)	-0.0002 (0.0242)	0.0037 (0.0235)	0.0090 (0.0253)				0.0086 (0.0247)
negative rainfall deviation (1)	-0.0701* (0.0360)	-0.0533* (0.0319)	-0.0506 (0.0335)				-0.0492 (0.0340)
positive rainfall deviation (1)	0.0544** (0.0250)	0.0614*** (0.0221)	0.0634*** (0.0226)				0.0632*** (0.0224)
positive rainfall deviation (2)	0.0651*** (0.0197)	0.0672*** (0.0206)	0.0677*** (0.0217)				0.0679*** (0.0214)
negative temp deviation (2)				-0.0170 (0.0223)	-0.0223 (0.0207)	-0.0241 (0.0226)	-0.0352 (0.0233)
negative temp deviation (1)				0.0106 (0.0378)	0.0630* (0.0345)	0.0648* (0.0389)	0.0781** (0.0392)
positive temp deviation (1)				0.1025** (0.0516)	0.1151** (0.0521)	0.1112* (0.0563)	0.0906 (0.0557)
positive temp deviation (2)				-0.0019 (0.0289)	-0.0386 (0.0393)	-0.0455 (0.0421)	-0.0337 (0.0392)
Observations	1,444	1,444	1,444	1,444	1,444	1,444	1,444
R-squared	0.251	0.363	0.422	0.240	0.353	0.412	0.429
District FE	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES
Colony linear trend	NO	YES	NO	NO	YES	NO	NO
District linear trend	NO	NO	YES	NO	NO	YES	YES

Dependent variable is volunteering rate in a district in a given year (ranging from zero to one). Standard errors are clustered at the district level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table G6: Impacts of weather shocks on present rates (four linear splines UEA data)

VARIABLES	(1)		(2)		(3)		(4)		(5)		(6)		(7)	
	present	present	present	present	present	present	present	present	present	present	present	present	present	present
negative rainfall deviation (2)	-0.0240 (0.0239)	-0.0296 (0.0222)	-0.0294 (0.0239)											-0.0308 (0.0224)
negative rainfall deviation (1)	-0.0047 (0.0274)	-0.0025 (0.0285)	-0.0009 (0.0314)											0.0055 (0.0289)
positive rainfall deviation (1)	-0.0057 (0.0217)	-0.0048 (0.0215)	0.0048 (0.0232)											0.0111 (0.0231)
positive rainfall deviation (2)	0.0102 (0.0151)	0.0057 (0.0156)	0.0017 (0.0161)											0.0048 (0.0163)
negative temp deviation (2)							-0.0785*** (0.0179)		-0.0767*** (0.0179)					-0.0823*** (0.0193)
negative temp deviation (1)							0.2556*** (0.0389)		0.2375*** (0.0381)					0.2447*** (0.0398)
positive temp deviation (1)							-0.1550*** (0.0347)		-0.1466*** (0.0364)					-0.1244*** (0.0394)
positive temp deviation (2)							0.0168 (0.0251)		0.0137 (0.0269)					0.0113 (0.0289)
Observations	1,441	1,441	1,441				1,441		1,441					1,441
R-squared	0.161	0.182	0.251				0.198		0.214					0.285
District FE	YES	YES	YES				YES		YES					YES
Year FE	YES	YES	YES				YES		YES					YES
Colony linear trend	NO	YES	NO				NO		YES					NO
District linear trend	NO	NO	YES				NO		NO					YES

Dependent variable is present rate in a district in a given year (ranging from zero to one). Standard errors are clustered at the district level. *** p<0.01, ** p<0.05, * p<0.1

7.3 Weather shock impacts with linearly interpolated tax controls (UEA data)

Table G7: Weather shock impacts on volunteering rates with linearly interpolated tax controls (UEA data)

VARIABLES	(1)		(2)		(3)		(4)		(5)		(6)		(7)	
	volunteer	volunteer	volunteer	volunteer	volunteer	volunteer	volunteer	volunteer	volunteer	volunteer	volunteer	volunteer	volunteer	volunteer
negative rainfall deviation (2)	-0.0233 (0.0211)	-0.0136 (0.0220)	-0.0131 (0.0250)	-0.0136 (0.0220)	-0.0131 (0.0250)	-0.0131 (0.0250)	-0.0131 (0.0250)	-0.0131 (0.0250)	-0.0131 (0.0250)	-0.0131 (0.0250)	-0.0131 (0.0250)	-0.0131 (0.0250)	-0.0131 (0.0250)	-0.0131 (0.0250)
negative rainfall deviation (1)	-0.0552* (0.0315)	-0.0500 (0.0313)	-0.0420 (0.0333)	-0.0500 (0.0313)	-0.0420 (0.0333)	-0.0420 (0.0333)	-0.0420 (0.0333)	-0.0420 (0.0333)	-0.0420 (0.0333)	-0.0420 (0.0333)	-0.0420 (0.0333)	-0.0420 (0.0333)	-0.0420 (0.0333)	-0.0420 (0.0333)
positive rainfall deviation (1)	0.0800*** (0.0270)	0.0770*** (0.0266)	0.0773*** (0.0274)	0.0770*** (0.0266)	0.0773*** (0.0274)	0.0773*** (0.0274)	0.0773*** (0.0274)	0.0773*** (0.0274)	0.0773*** (0.0274)	0.0773*** (0.0274)	0.0773*** (0.0274)	0.0773*** (0.0274)	0.0773*** (0.0274)	0.0773*** (0.0274)
positive rainfall deviation (2)	0.0713*** (0.0214)	0.0732*** (0.0223)	0.0869*** (0.0235)	0.0732*** (0.0223)	0.0869*** (0.0235)	0.0869*** (0.0235)	0.0869*** (0.0235)	0.0869*** (0.0235)	0.0869*** (0.0235)	0.0869*** (0.0235)	0.0869*** (0.0235)	0.0869*** (0.0235)	0.0869*** (0.0235)	0.0869*** (0.0235)
log head tax	-0.2892*** (0.0460)	-0.2325*** (0.0428)	-0.2759*** (0.0528)	-0.2325*** (0.0428)	-0.2759*** (0.0528)	-0.2759*** (0.0528)	-0.2486*** (0.0517)	-0.2486*** (0.0517)	-0.1769*** (0.0455)	-0.1769*** (0.0455)	-0.2278*** (0.0539)	-0.2278*** (0.0539)	-0.2278*** (0.0539)	-0.2638*** (0.0546)
negative temp deviation (2)							-0.0089 (0.0172)	-0.0089 (0.0172)	-0.0045 (0.0179)	-0.0045 (0.0179)	-0.0158 (0.0189)	-0.0158 (0.0189)	-0.0316 (0.0192)	-0.0316 (0.0192)
negative temp deviation (1)							0.0467 (0.0325)	0.0467 (0.0325)	0.0776** (0.0311)	0.0776** (0.0311)	0.0742** (0.0325)	0.0742** (0.0325)	0.0830** (0.0335)	0.0830** (0.0335)
positive temp deviation (1)							0.1018* (0.0554)	0.1018* (0.0554)	0.0904 (0.0563)	0.0904 (0.0563)	0.0838 (0.0593)	0.0838 (0.0593)	0.0598 (0.0573)	0.0598 (0.0573)
positive temp deviation (2)							0.0056 (0.0290)	0.0056 (0.0290)	0.0059 (0.0286)	0.0059 (0.0286)	-0.0103 (0.0305)	-0.0103 (0.0305)	-0.0007 (0.0293)	-0.0007 (0.0293)
Observations	1,297	1,297	1,297	1,297	1,297	1,297	1,297	1,297	1,297	1,297	1,297	1,297	1,297	1,297
R-squared	0.345	0.373	0.443	0.373	0.443	0.443	0.325	0.325	0.355	0.355	0.418	0.418	0.449	0.449
District FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Colony linear trend	NO	YES	NO	YES	NO	NO	NO	NO	YES	YES	NO	NO	NO	NO
District linear trend	NO	NO	YES	NO	YES	YES	NO	NO	NO	NO	YES	YES	YES	YES

Dependent variable is present rate in a district in a given year (ranging from zero to one). Standard errors are clustered at the district level. *** p<0.01, ** p<0.05, * p<0.1

Table G8: Weather shock impacts on present rates with linearly interpolated tax controls (UEA data)

VARIABLES	(1)		(2)		(3)		(4)		(5)		(6)		(7)	
	present	present	present	present	present	present	present	present	present	present	present	present	present	present
negative rainfall deviation (2)	0.0007 (0.0247)	-0.0142 (0.0224)	-0.0075 (0.0239)											-0.0094 (0.0233)
negative rainfall deviation (1)	-0.0132 (0.0292)	-0.0010 (0.0301)	0.0003 (0.0331)											0.0031 (0.0307)
positive rainfall deviation (1)	0.0002 (0.0223)	-0.0044 (0.0226)	0.0065 (0.0246)											0.0121 (0.0244)
positive rainfall deviation (2)	0.0104 (0.0160)	0.0090 (0.0163)	0.0040 (0.0167)											0.0035 (0.0171)
log head tax	-0.0381 (0.0480)	-0.0695 (0.0548)	-0.0851 (0.0706)				-0.0522 (0.0503)		-0.0702 (0.0558)			-0.0857 (0.0715)		-0.0919 (0.0706)
negative temp deviation (2)							-0.0657***		-0.0662***			-0.0681***		-0.0702***
negative temp deviation (1)							0.0187 (0.0187)		0.0182 (0.0182)			0.0189 (0.0189)		0.0192 (0.0192)
positive temp deviation (1)							0.2497***		0.2290***			0.2335***		0.2351***
positive temp deviation (2)							-0.1399***		-0.1165***			-0.0947**		-0.0983**
							0.0395 (0.0395)		0.0406 (0.0406)			0.0439 (0.0439)		0.0442 (0.0442)
							0.0243 (0.0264)		0.0137 (0.0244)			0.0089 (0.0259)		0.0095 (0.0257)
Observations	1,297	1,297	1,297				1,297		1,297			1,297		1,297
R-squared	0.197	0.231	0.317				0.229		0.258			0.344		0.345
District FE	YES	YES	YES				YES		YES			YES		YES
Year FE	YES	YES	YES				YES		YES			YES		YES
Colony linear trend	NO	YES	NO				NO		YES			NO		NO
District linear trend	NO	NO	YES				NO		NO			YES		YES

Dependent variable is present rate in a district in a given year (ranging from zero to one). Standard errors are clustered at the district level. *** p<0.01, ** p<0.05, * p<0.1