The Legacy of the Slave Trade: Mistrust in Medicine and Demand for Vaccination in Sub-Saharan Africa

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THE LEGACY OF THE SLAVE TRADE: MISTRUST IN MEDICINE AND DEMAND FOR VACCINATION IN SUB-SAHARAN AFRICA*

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Abstract

There is a large body of anecdotal evidence from sub-Saharan Africa of widespread medical distrust leading to health program failures. In this paper, to isolate an exogenous variation in trust in medicine to explain contemporary health demand in sub-Saharan Africa, we rely on a widespread historical shock: the slave trade. We combine Nunn and Wantchekon's (2011) historical data on the slave trade by ethnic group with geolocated individual-level data at the district level from the 2010-2014 Demographic and Health Surveys to examine the reduced-form relationship between ancestors' exposure to the slave trade and children vaccination status against measles. Exploiting within-district variation, we find that children from mothers whose ancestors were exposed to the slave trade are less likely to be vaccinated. The effect is larger than that of standard determinants of health demand, such as education or revenue. Falsification tests, exploiting other health behaviors, show that the slave trade affects demand for vaccination only through trust in medicine. We then provide explanations for the persistent effect of the slave trade on trust in medicine. We find large treatment heterogeneity along a set of important characteristics linked to cultural transmission, in particular matrilineal lineage systems, which shows that the transmission mechanism is not necessarily monotonically increasing in the exogenous material payoffs associated to mistrust. We also point to the similarity of the environment across generations, due to colonial and contemporaneous abusive medical treatments, to explain persistence of optimal mistrusting behavior.

JEL codes: D12, I15, J15, N37, Z13

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1 Introduction

Despite improvements in health technology and access, immunization rates in sub-Saharan Africa remain very low. While we can observe significant differences across countries, none of them reaches the herd immunity level that guarantees the protection of the entire population against the spread of highly infectious diseases such as measles (World Health Organization 2018). The main explanation given by the extant literature is imperfect information on illness prevention due to both low penetration of public health communication media and low education levels (Dupas 2011b). More specifically, a series of studies using randomized field experiments confirm that providing information can have substantial impacts on health behavior.[1] They also point out that a discrepancy between actual and optimal behaviors remains even with perfect information, mainly due to the low education levels. In other words, even if the information is easily accessible, it is difficult for individuals to process it, underlying a limited cognitive-ability channel in health behavior.[2]

However, evidence cries out for the consideration of another potential ground, namely the medical distrust. In this respect, the Ebola outbreak in West Africa in 2014-2015 is highly illustrative. ABC News, on July 28th, 2014, titled: "Doctors battling Ebola are met with fear, mistrust" (Neporent 2014). The New York Times on March 13, 2015, in turn, titled: "Vaccines face same mistrust that fed Ebola" (Fink and Onishi 2015). In its July 2015 report, the World Health Organization mentions the particular case of Mohamed Soumah, 27 years old living in Guinea, the first person to receive the Ebola vaccine: "It wasn't easy. People in the village said that the injection was to kill me. I was afraid. I was the first one to be injected, the very first, here in my village on 23 March 2015" (World Health Organization 2015). However, medical mistrust is not confined to Ebola. For instance, Feldman-Savelsberg et al. (2000) report how in 1990 a

[1]For instance, Dupas (2011a), in an experiment in Kenya, finds that adolescent girls are responsive to information provided on the relative risk of contracting HIV by type of partners. An experiment in India conducted by Jalan and Somanathan (2008) shows that informing households that their drinking water is contaminated with fecal bacteria can affect their adoption of purification techniques.

[2]Dupas (2011b), building on Rosenzweig and Schultz (1989), discusses the differential complexity between passive contraceptive methods such as swallowing pills and more active rhythm methods requiring more active computation and cognitive skills.

rumour in Cameroon that public health workers were administering a vaccine to sterilize girls and women, led Cameroonian schoolgirls to "squeeze through doorways and leap from windows to flee the vaccination teams that were visiting their schools as part of a campaign to decrease neonatal tetanus".

Thus, trust comes into play in understanding demand for vaccination. There are few emerging papers that provide evidence of the importance of trust in medicine to explain demand for health. Significant contributions are from Alsan and Wanamaker (2017) who study the effect of Tuskegee syphilis experiment disclosure in 1972 on black men's contemporaneous demand for health and participation in medical experiments. In the same vein, Martinez-Bravo and Stegmann (2018) study the effect of the disclosure of the 2011 fake vaccination campaign in Pakistan as cover for CIA during the operations to locate and capture Osama Bin Laden. More related to our work is the study by Lowes and Montero (2018a), which investigates the effect of colonial medical campaigns in central Africa between 1921 and 1956 on present day trust in medicine. While they use an innovative and robust approach, these studies exploit isolated and geographically limited shocks that could not account for the global low demand for vaccination in sub-Saharan Africa that we investigate.

In this paper, to isolate an exogenous variation in trust in medicine, we rely on a more widespread shock in Africa's history: the slave trade that has occurred over five centuries, from 1400 to 1900. We build on previous work by Nunn and Wantchekon (2011), who empirically establish a causal effect of past exposure to the slave trade and a culture of mistrust, and on theoretical insights from Bowles (1998) to argue that the slave trade could have explanatory power in situations distinct from the institutional environment that accounts for its impact. To further base our argument on empirical evidence, we use individual-level data from the 2005 Afrobarometer survey, combined with Nunn and Wantchekon's (2011) data on slave exports by ethnic group. First-stage estimates show that past exposure of ancestors to the slave trade represents a relevant (weak) instrument for trust in medicine, with the former being negatively associated with descendants' current trust in health workers.

We then estimate the reduced-form relationship linking children vaccination status against measles to ancestors' exposure to the slave trade and to the other exogenous regressors. We use data from the Demographic and Health Surveys (DHS) female module, collected in the period 2010-2014. The survey respondents are geolocated at the district level, which corresponds to the primary sampling unit: village, city, municipalities. In particular, the surveys provide information on mothers' children (under five years) vaccination status. The immunization data are then combined with the historical data on the slave trade by ethnic group. We exploit variations in the exposure to the slave trade both within countries and districts. Adopting a within district estimation strategy is the best way to control for unobserved differences in health supply and quality as well as for any institutional differences between different districts in the same country, which may be correlated with the slave trade. This implies that the source of identification is the movers in the sample, that is, those who relocated from their ancestors' original ethnic homeland and who bring variation in exposure to the slave trade across ethnic groups in their new locations. While we can expect that movers may not be representative of the population, based on the literature on migrants' higher level of civicness(Casari et al. 2018), we argue that the effect of the slave trade would be downward biased. Alternatively, there may be other omitted historical events or pre-colonial cultural norms that are correlated with the slave trade and subsequent demand for vaccination. In particular, we could expect that ethnic groups that were culturally more inclined to adopt preventive measures in general were less likely to be enrolled in the slave trade, and continue to be more in favor of preventive medicine today. To rule out this possibility, we control for ethnic group initial cultural preferences for preventive behavior, using data on pre-colonial ethnic group norms from Murdock's (1967) Ethnographic Atlas database. We further include indicators on the type of ethnic groups pre-colonial political succession, whether hereditary or not, to capture parents incentives to invest in children health. We further use data from Michalopoulos and Papaioannou (2016) to include controls for colonial intervention characteristics at the ethnic group level resulted in potential health and political ethnic distance.

Our findings indicate a significant adverse effect of ancestors' exposure to the slave trade on descendants demand for vaccination. More specifically, a child with a mother belonging to a slave raided ethnic group is (at least) 5 percentage points less likely to be vaccinated against measles than a similar child with a mother from a slave free ethnic group. This effect offsets or even dominates the effect of standard determinants of health demand, such as income and education. Implementing a counterfactual analysis, this estimate predicts a 25% increase in the coverage rate for the ethnic group with the lowest immunization rate in the sample had they been a slave free group, leading to a 50% drop in measles incidence rate.

We further develop two falsification tests. If the slave trade affects demand for vaccination only through trust in medicine, then a negative relationship between slave trade exposure and trust-insensitive health demand outcomes should not exist. Building on Dupas (2009) that finds that malaria preventives use is sensitive only to liquidity constraint, and on Lowes and Montero (2018a) that uses blood test consent as a revealed preference measure of trust in medicine, we examine the reduced-form relationships between the slave trade and the use of malaria insecticide-treated nets (ITNs) on one side, and the consent to an anaemia blood test on the other side. As expected, we find no statistically significant relationship between the slave trade and malaria preventives use, but a statistically significant negative relationship between the slave trade and blood test consent.

Having established the adverse effect of past exposure to the slave trade on current trust in medicine and subsequent demand for vaccination, the natural question that we face, though, is how to explain the persistence of this effect. Both economics and evolutionary anthropology approaches have underlined different channels. First, we shed light on cultural transmission mechanisms by documenting heterogeneity of the slave trade effect. We find that both religious affiliations and matrilineal lineage systems are important channels of cultural transmission. More specifically, affiliation to traditional religions and belonging to ethnic groups with matrilineal lineage increase respectively twofold and fourfold the adverse effect of slave trade exposure on contemporaneous demand for vacci-

nation. Second, insights from evolutionary anthropology models predict optimal adoption of previous generations norms and traditions in the presence of similarity of environment across generations. We point to colonial and contemporaneous abusive medical treatments to explain cultural persistence of optimal mistrusting behavior inherited from the slave trade.

This paper contributes to three main streams of research. Our work complements studies documenting the long-term adverse effect of the slave trade through a mistrust channel. In particular, to the pioneer work by Nunn (2008) and Nunn and Wantchekon (2011), this paper provides evidence and explanation for the legacy of the slave trade in situations distinct from the institutional environment in which it initially occurred. Our work also speaks to the cultural transmission literature. While there is an extensive theoretical literature in several social sciences about cultural transmission, empirical analysis of cultural transmission models are scarce and do not confront the various approaches. In this paper, we show that both economic and evolutionary anthropology approaches could be useful to explain the dynamics of cultural attitudes. We also identify specific cultural transmission mechanisms that could shed light on the economic outcomes associated with some cultural traits. Finally, for the health literature, we unveil the importance of long-term historical origins to better understand contemporary demand for health.

The outline of the paper is as follows. Section 2 discusses the validity of the slave trade as an instrument for trust in medicine. In Section 3, we turn to the description of the data before reporting our reduced-form estimates and falsification tests in Section 4. In Section 5, we discuss potential explanations for the persistent effect of the slave trade on medical trust. Section 6 concludes and discusses implications for present-day health policy in sub-Saharan Africa.

2 Empirical Strategy

2.1 Conceptual Framework

The key difficulty in estimating a causal effect of trust on demand for vaccination is that it is endogenous to health supply. Hence, to identify a causal effect from trust in medicine to health behavior, one has to find some exogenous source of variation in trust in medicine. In addition, as underlined by the recent Ebola outbreaks, medical distrust is widespread in sub-Saharan Africa. As a consequence, one has to find some exogenous source of variation in trust in medicine that could explain the continent-wide medical distrust phenomenon.

We need then a theory of how current trust in medicine is determined in the sub-Saharan context. In their theoretical framework, Bisin and Verdier (2001) suggest that current trust levels are shaped by both the contemporaneous environment and the cultural traditions inherited from earlier generations. This implies that history shapes current cultural traits such as trust levels. In the same vein but through a different mechanism, cultural anthropology highlights that current norms of trust are determined by the persistent optimality of previous norms of trust. In particular, when the historical environment is such that norms of mistrust towards others were likely more beneficial than norms of trust, optimal mistrusting behavior would have become more prevalent over time if the environment stays similar.

In the sub-Saharan context, the pioneer work by Nunn and Wantchekon (2011) investigates the historical origins of current differences in interpersonal trust across ethnic groups and conclude to a negative causal impact of the slave trade. More specifically, they find that ancestors' historical exposure to the slave trade has an adverse effect on their descendants' trust in relatives, neighbors, co-ethnics, and locally elected people. Building on African historiography, the authors explain this effect through the peculiar institutional characteristics of the slave trade. While early in the slave trade, nearly all slaves were taken in large-scale conflicts or raids, as the trade progressed, individuals began to turn on others close to them, including neighbors, friends, and even family members, through trickery and local kidnappings, to protect themselves (Nunn and Wantchekon 2011). They

also uncover that most of the impact of the slave trade channels through internal factors to the individual, such as cultural norms and beliefs, rather than through external factors, such as institutions.

The natural question we face, though, is why we expect that the slave trade affects trust in medicine, in other words, why the resulting culture of mistrust could also affect the medical sector. We know from Bowles (1998), echoing a rich literature in psychology, that preferences learned under one set of circumstances become generalized reasons for behavior (see Nisbett and Ross [1991] for a review). We could then expect that the slave trade had imposed more general characteristic patterns of interaction on the people whose ancestors were raided during the slave trade; that it had influenced their process of human development, affecting their personality, habits, commitments, identities, and values. This, in turn, implies that the slave trade has explanatory power in situations distinct from the institutional environment in which it initially prevailed. Thus, we hypothesize that the slave trade has an impact also on current medical mistrust. Importantly, the slave trade occurred over five centuries, from 1400 to 1900, and has transported tens of millions of enslaved Africans. As a consequence, it has the feature of a widespread shock in Africa's history.

2.2 Slave Trade and Contemporaneous Mistrust in Medicine

To further base our argument on empirical evidence, we follow the baseline estimation strategy in Nunn and Wantchekon (2011) to investigate the impact of the slave trade on current trust in medicine. More specifically, we combine their data on slave exports by ethnic group with individual-level data from the 2005 Afrobarometer survey related to the following questions about respondents' perception of health workers' trustworthiness: "How many of the following people do you think are involved in corruption, or haven't you heard enough about them to say: Health workers?"[3], as well as "Have you encountered any problems of lack of attention or respect from staff in your local public clinic or hospital during the past 12 months ?"[4]

[3]With effective response going from 0=None, 1=Some of them, 2=Most of them, 3=All of them.
[4]With effective response going from 0=Never, 1=Once or twice, 2=A few times, 3=Often.

We include all the relevant controls following Nunn and Wantchekon's (2011) baseline estimation. The results are reported in Table I below. They show that historical exposure of the ancestors to the slave trade has a negative impact on descendants' trust in public health workers. In particular, respondents of the round 3 of the Afrobarometer that are descendants from slave-raided ethnic groups are today significantly more likely to perceive health workers as being corrupt and to have encountered problems of lack of attention or respect when they last visited their public health facility. The size of the effect is smaller than the one found by Nunn and Wantchekon (2011) on different interpersonal trust dimensions. However, this is in line with the fact that our outcome variable is much more confined.

[Table I about here.]

To investigate whether the estimated negative effect of the slave trade on current trust in health workers is not biased by differences in health supply in terms of price, quantity and quality, we use the answers given by the same respondents related to such dimensions.[5] The results are reported in Table II. We find no significant relationship between historical experience of the slave trade and current perception of health supply dimensions. Overall, first-stage estimates confirm that historical exposure of ancestors to the slave trade represents a relevant instrument for contemporaneous trust in medicine.

[Table II about here.]

2.3 Identification

The p-value for the instrument is not below 0.0016 (p-value = 0.012), suggesting that the slave trade is a weak instrument. In the presence of weak instruments, we know that hypothesis tests based on IV estimates are not correct. Instead, estimating the reduced

[5]The questions are formulated in the following way: "Have you encountered any of these problems with your local public clinic or hospital during the past 12 months?" Then respondents had to answer on different items: Too expensive; Lack of medicines/supplies; Absent doctors; Long waiting time; Dirty facilities, with effective responses: 0=Never, 1=Once or twice, 2=A few times, 3=Often.

form linking current demand for vaccination to the slave trade, and to the other exogenous regressors, will provide better estimates (see Chernozhukov and Hansen (2008))[6].

However, for the slave trade to impact current demand for vaccination only through mistrust in medicine, it needs to have no direct effect on current demand for vaccination, or any effect running through omitted variables. This restriction could be justified if controls for contemporaneous health supply and medical institutions are included. We know that the slave trade has differently affected regions within countries (Nunn 2008). It means that the slave trade could have a lasting effect on the sectoral composition of the current employment or public infrastructure endowments within countries, and this could affect regional health supply and institutions (even though our first stage estimates do not provide evidence for that). In addition, history of exposure to epidemics might vary across locations. We could then expect that areas that were more prone to epidemics, and hence more prone to preventive behavior, were less likely to be affected by the slave trade, and continue to be more in favor of preventive medicine today. To rule out these potential biases, we exploit variation in slave trade exposure across ethnic groups both within countries and districts.

Table A.3 in the Appendix Section A.1 presents summary statistics at the district level. The sample of interest includes 9726 districts (primary localities) from the 18 sub-Saharan African countries. There is an average of 1.70 ethnic groups by district with a standard deviation of 0.87. More than 25% of the districts have more than two ethnic groups, reaching a maximum of 7 different ethnic groups in some districts. There is an average of 16 children under age five and of more than 11 respondent mothers by locality. The average measles vaccination rate is 66% with a standard deviation of 25 percentage points. The share of children from slave raided ethnic groups within districts is 80% with a standard deviation of 0.37.

The within-district estimation strategy implies that the source of identification is the movers in the sample (i.e., those who relocate from their ancestor's original ethnic homeland), who bring variation in the exposure to the slave trade across ethnic groups within

[6]In addition, the DHS does not collect any survey measures of trust in medicine, and it is not possible to match the data from the DHS with data on trust in medicine from the Afrobarometer.

districts. While we can expect that movers may not be representative of the population, we build on Casari et al. (2018) to argue that if our estimates are biased, they are downward biased. In particular, Casari et al. (2018) provide empirical evidence and a theoretical explanation for self-selection into migration by more trusting individuals according to the origin and destination characteristics. They find that more trusting individuals are more likely to emigrate when the local fraction of trusting peers is low and the destination characteristics make migration more attractive for the trusting. In our sample, 71% of the movers are from slave-raided ethnic groups, implying that their original ethnic homeland is a slave-raided area. We know from Nunn and Wantchekon (2011) that slave-trade exposure is associated with more suspicious, less trusting, behaviors. We can then infer that the local fraction of trusting peers in their place of origin is low for these slave-raided movers and that they probably relocate in slave-free locations characterized by better enforcement of civic behavior. This converges towards the selection of more trusting individuals in our within-district estimation strategy, leading to a downward bias of our estimates for the impact of the slave trade.

Alternatively, there may be unobservable historical events, cultural and social norms that are correlated with selection into the slave trade and subsequent demand for vaccination. We hence include important ethnicity-level controls as additional regressors, related to pre-colonial characteristics associated with initial cultural preferences for preventive behavior and child investment, and to colonial characteristics associated with ethnic distance.

We further perform two falsification tests. If the slave trade affects demand for vaccination only through trust in medicine, then a negative relationship between slave trade exposure and trust-insensitive health demand outcomes should not exist. Thus, we examine the reduced-form relationships between the slave trade and health outcomes that exhibit sharp different degrees of trust sensitivity: the use of malaria insecticide-treated nets on one side, and the consent to up-take a free anemia blood test on the other side.

3 Data Sources and Description

In this section, we present the variables used in the analysis. The details about the exact measures, summary statistics, and sources of all data are presented in Table A.1 in the Appendix Section A.1.

3.1 Individual-level data

3.1.1 Slave Export Data

The historical data on slave exports by ethnic group comes from Nunn (2008). The author combined data from various historical records that report the ethnic identities of slaves exported from Africa with data on the number of slaves shipped from each African port or region during the transatlantic and the Indian Ocean slave trades. The primary data sources for slaves exports are from the Transatlantic Slave Trade Database constructed by Eltis et al. (1999) and from Austen (1979, 1988, 1992) for the Indian Ocean trades. Nunn (2008) could then match a total of 80,656 slaves to 229 identified ethnic groups for the transatlantic slave trade and 21,048 slaves to 80 distinct ethnic groups for the Indian Ocean slave trade. In a final step, Nunn and Wantchekon (2011) match the ethnic identity recorded in the slave trade databases to the ethnic identity reported by respondents of the Afrobarometer surveys, based on the historical classification by Murdock (1959).

We follow the same procedure for the ethnic designation reported by the respondents in the DHS survey that we match when necessary to Murdock (1959) classification, allowing a simple merge to Nunn and Wantchekon (2011) ethnic groups slave exporting data. The matching goes from relatively simple correspondence (e.g., in the case of Uganda, BaGanda or BaSoga ethnic group from DHS corresponds to GANDA and SOGA in the Murdock classification) to slightly less straightforward correspondence (e.g., in the case of Senegal, where PULAAR ethnic group in the DHS is related to FUTATORO in Murdock ancient classification). In our study, we end up with a final sample of 98 ethnic groups with 68 (69%) groups recorded as exporting slaves and 30 as slave-free. Each ethnic group represents a minimal share of 5% of its country population.

3.1.2 Vaccination Data

We combine the historical data on slave exports with DHS data from the most recent compatible surveys (collected between 2010 and 2014, except for Central Africa, Niger and Ethiopia collected respectively in 1994, 1998 and 2003), and in particular the female modules questionnaires containing information on the immunization status of their children born in the last 5 years. We restrict our interest to countries where geolocated survey data exist and where the respondent's ethnic group identity is reported. The baseline sample in our study consists of 157,405 children born to 101,866 adult mothers from 98 ethnic groups with a minimal size of 5% of each country population, covering 18 sub-Saharan African countries.

We focus on a particular infectious and vaccine-preventable disease that is measles, which remains one of the world-leading cause of children under-five mortality and morbidity. In 2015, there were 134,200 measles deaths in the world, which amounts to about 367 deaths every day or 15 deaths every hour, with developing countries concentrating more than 95% of these deaths (World Health Organization 2018). Even when it does not lead to death, child infections might result in lifelong disability such as blindness, deathless, or severe respiratory infections, undermining the child's future education and economic prospect. In addition, by focusing on a traditionally one-shot vaccine, we avoid the complexity and sequentiality involved in other vaccines requiring multiple shots and hence, more active computation, memory, and reasoning. Despite the vaccine effectiveness and free provision by public health facilities, measles was the lowest-performing vaccine in terms of coverage rate across sub-Saharan Africa in 2016, with an average country coverage of 75% in 2016, and with no countries reaching the 95% herd immunity level.

A brief narrative description illustrates the ethnic group variations in immunization rates that we will further investigate. In Burkina Faso and Uganda, for instance, there are variations in coverage rate between ethnic groups according to the historical slave-trade exposure. In Burkina Faso, the slave-free group Senufo scores 70% in measles coverage compared to slave-raided groups like Fulani or related Gourmatche that score 60% and 64% respectively. In Uganda, the difference increases to 14 percentage points between the

slave-raided Baganda and the slave-free Ngakarama.

3.1.3 Child, Mother and Household Data

The DHS also provides a rich set of questions we build upon to control for the child-specific characteristics that might influence mother's vaccination decisions, such as the gender, the child's birth-order, and an indicator for whether the child was delivered at home or within a health facility.

We also have information about mother education, literacy status, employment status, religion, age. We further include variables capturing mother's level of information related to public health issues, using answers to the questions of whether she watches TV or listens to radio. We add a variable capturing the subjective assessment of access to health facility using the mother answer to the question of whether distance to the health facility was a problem or not. As mother's fertility preferences have been shown to affect the investment in child health and protection, we include the mother's total births as well as mother's number of births during the last five years to control for close pregnancies. Importantly, we also include the mother's report of the ideal number of children and of unwanted last birth as proxies for her adoption of contraceptives and hence her preferences regarding the use of preventive health techniques in general. By introducing such controls, we expect to take into account mothers' specific characteristics associated with child investment and preferences for adopting preventive health behavior and technology.

We also take into account the household's socio-demographic characteristics, capturing intra-household resources allocation and bargaining dimensions. In particular, we control for father employment status, the household wealth index, the gender of the household head and of the head for health decisions.

3.2 Ethnicity-level Data

3.2.1 Pre-colonial Cultural Norms of Preventive behavior and Child Investment

As there may be unobservable historical events, cultural and social norms that are correlated with selection into the slave trade and subsequent vaccination decisions, it is important to introduce important controls at the ethnic group level. In particular, we could expect that ethnic groups that were culturally more inclined to adopt preventive measures in general, and for children in particular, were less likely to be enrolled in the slave trade, and continue to be more in favor of preventive medicine today. To rule out this possibility, we control for ethnic group initial cultural norms of preventive behavior, using data on pre-colonial ethnic group norms from Murdock's (1967) Ethnographic Atlas database. More specifically, in the African context, data on sexual norms, in particular on girls premarital sexual behavior norms as well as on post-partum sexual norms, allow to control for initial propensity to adopt preventive behavior. The former captures the insistence on early female marriage or on virginity to prevent early pregnancy outside marriage (by contrast to norms of promiscuous and freely permitted sexual behavior). The latter captures the insistence on absence of post-partum sexual activity to prevent repeated parturitions.

We further include indicators on the type of prevailing political succession, whether hereditary or not. The rationale of this proxy is to capture parents incentives to invest in their children health, knowing that hereditary lineage makes children be perceived as future source of old-age insurance, labor and land income, and source of political power. We also consider ethnic groups pre-colonial political centralization to capture ethnic groups attitudes towards public authorities.

3.2.2 Colonial Controls for Ethnic Distance

We use data from Michalopoulos and Papaioannou (2016) to include dummies for colonial intervention characteristics resulted in ethnic groups split across country borders as well as in current minority or majority status in contemporaneous national borders. Split ethnic

groups have been shown to be more prone to conflicts and to have lower national identity. Thus, including this variable allows us to control for potential identity distance. In addition, including minority status allows to control for potential ethnic distance between mother's group and the one of the health worker or officers in charge of immunization, that might lead to ethnic grievance or discrimination during health seeking interactions. It allows also to control for the ethnic distance between mother's ethnic group and the ethnic group mainly represented by the local or central political power.

4 Estimating the Effect of Trust in Medicine on Demand for Vaccination

4.1 Reduced-form Estimates

As already highlighted in Section 2.3, our goal is to estimate the reduced form linking contemporary demand for vaccination to ancestors' exposure to the slave trade. As the slave trade is correlated with trust in medicine, which in turn influences demand for vaccination, we ought to find a significant effect of the slave trade on demand for vaccination, after controlling for the other determinants of demand for vaccination. Thus, we estimate the following equation:

$$Vaccin_{i,m,e,l,c} = \alpha_{lt} + \beta\, Slave_e + \mathbf{X'_{i,m,e,l,c}}\, \boldsymbol{\Gamma} + \mathbf{X'_{m,e,l,c}}\, \boldsymbol{\Omega} + \mathbf{X'_{e}}\, \boldsymbol{\Phi} + \epsilon_{i,m,e,l,c} \tag{1}$$

where $Vaccin_{i,m,e,l,c,t}$ is a binary indicator variable equal to one if child i born to mother m from ethnic group e within locality l and country c is vaccinated against measles, and zero otherwise. α_{lt} denotes a vector of location-(survey) year interacted fixed effects. $Slave_e$ is a binary indicator variable equal to one if the mother's ethnic group e has been slave-raided, and zero otherwise. $\mathbf{X'}_{i,m,e,l,c}$ is a set of child individual controls, while $\mathbf{X'}_{m,e,l,c}$ is a set of mother/household controls. $\mathbf{X'}_{e}$ includes ethnic-group level controls

for pre-colonial cultural preferences for preventive behavior and child investment, and for colonial characteristics associated with ethnic distance. The standard errors are clustered at the ethnic group level. We estimate a linear probability model for ease of interpretation of the results.[7]

4.2 Results

Results are reported in Table 3. The estimates in Column 1 only reflect within-country-year variations and are adjusted for individual, mother, district[8], and ethnicity-level main characteristics, with standard errors clustered both at the ethnic group level, and at the ethnic group and district levels. The estimates in Column 2 reflect our baseline estimation, including district-year fixed effects.

The slave trade variable has a negative and significant estimated coefficient, as expected. More specifically, we find, in our most conservative specification associated with a downward bias of the slave trade effect (see discussion in Section 2.3), that a child born from a mother belonging to a slave raided ethnic group is around 5 percentage points less likely to be vaccinated against measles than a child whose mother is from a slave-free ethnic group. To assess the magnitude of the slave export coefficient, we compare its explanatory power against standard determinants of demand for vaccination (see Table A.4 in the Appendix Section A.2). We find that the adverse effect of the slave trade is as important as the positive effect of belonging to the highest quintile of the income distribution, as important as the positive effect of employed mothers, and dominates the positive effect of literate mothers. Implementing a counterfactual analysis, we find that the estimate predicts a 25% increase (from 20 to 25%) in coverage rate for Hausa in Northern Nigeria — the ethnic group with the lowest immunization rate in our sample — had they been a slave-free, leading to 50% drop in measles incidence rate, that is, 10,625

[7]Logit estimates produce similar results. See in the Appendix Section A.2 (Table A.6).

[8]We introduce a rich set of controls for the locality current economic development (density, luminosity at night), the geography (elevation, distance to water, to the sea, and to capital city), the existence of natural resources (diamond mines, petroleum plants). We also include controls for the recent experience of conflicts, violence and riots from Armed Conflict Location and Event Data Project, as well as controls for the district disease environment using the malaria stability index constructed by Kiszewski et al. (2004). These controls are retrieved from Michalopoulos and Papaioannou (2016) and are spatially matched to our DHS sample localities.

cases of infection avoided over two years between 2011 and 2014[9].

[Table III about here.]

Regarding the impact of the other regressors, as expected, we find that initial cultural preferences for preventive behavior and child investments (captured respectively by sexual norms and child heredity variable) have a positive and significant effect on current demand for vaccination (see Table A.4 in the Appendix Section A.2). Interestingly, the size of the effect is constant across the three variables. Identity and ethnic distances, captured by the minority and split ethnic group variables, do not seem to have a significant impact on demand for vaccination. Ethnic groups pre-colonial political centralization is negatively associated with vaccines uptake.

4.3 Causal Mechanism: Falsification Tests

When we examine the reduced form, we find a strong negative relationship between ancestors exposure to the slave trade and their descendants demand for vaccination today. This result is consistent with the first-stage estimates reported in Table I: ethnic groups that were exposed to the slave trade have descendants that have a lower trust in medicine today, and hence a lower demand for vaccination. Our strategy rests on the assumption that mistrust in medicine is the only channel through which the slave trade affects current demand for vaccination. If this assumption is correct, then a negative relationship between slave trade exposure and trust-insensitive health demand outcomes should not exist.

To assess the validity of the causal mechanism, we undertake the following falsification test that investigates the reduced-form relationships between the slave trade and health demand outcomes that involve sharp differences in terms of trust sensitivity: the use of malaria insecticide-treated nets (ITNs) on one side, and the consent to an anemia blood test on the other side.

[9]Hall and Jolley (2011) predict that a 1% increase in the MCV1 coverage rate is associated with a 2% decrease in the disease incidence in the same year and the following year.

The expectation that malaria preventives use does not imply any trust component is in line with Dupas's (2009) results. Using experimental variation in prices interacted with experimental variation in framing and targeting strategies in Western Kenya, she finds that liquidity constraint is the only barrier to the resort to ITNs. In addition, as for measles, malaria is one of the deadliest infectious child diseases in sub-Saharan Africa, and ITNs use does not imply any computation skills either. Nevertheless, it differs from a vaccine injection by the technology that is used since there is no prick and injection involved.

As for the free blood test consent, Lowes and Montero (2018a) use it as a proxy for trust in medicine, underlining that it has the benefit of being a revealed preference measure of trust rather than a self-reported measure. As the other two health demand outcomes, it does not imply any computation skills. In terms of technology, it is more similar to vaccine injection as it involves, even though non-invasive, a blood prick. However, it is not related to any infectious disease.

We use the DHS female modules surveys that also provide information on mothers' consent to a blood test and on their use of ITNs. Results are reported in Table IV. The first column reports the reduced-form estimate of the relationship between mothers' ancestors exposure to the slave trade and their use of ITN today. Column 2 reports the same reduced-form estimate with the blood test consent as outcome variable. The findings are in line with our predictions. We estimate a statistically insignificant relationship between slave trade historical exposure and contemporaneous use of malaria preventive ITN, with a point estimate close to zero, but a statistically significant and sizeable negative relationship between slave trade historical exposure and today blood test consent.

[Table IV about here.]

5 How to Explain the Persistent Effect of the Slave Trade?

In this paper, we have established the adverse effect of past exposure to the slave trade on current trust in medicine and subsequent demand for vaccination. The natural question that we face, though, is how to explain the persistence of this effect. The persistence of preferences, beliefs and norms of behavior is an object of study of several social sciences, among which economics and evolutionary anthropology. Both approaches have underlined different mechanisms that we discuss, and test when possible, in this Section.

5.1 Understanding Cultural Transmission Mechanisms Inside the Family

In the economic literature, cultural transmission is formalized as the result of decisions made inside the family (corresponding to the vertical channel of cultural transmission, from parents to children) (Bisin and Verdier 2001, 2011). A fundamental assumption in these economic models, called "imperfect empathy", implies that parents, while altruistic, tend to prefer children with their own cultural traits. Therefore, as the intergenerational transmission of cultural traits involves economic decisions of rational agents (the cultural parents), an important implication of these models is that the transmission mechanism is not necessarily monotonically increasing in the exogenous material payoffs associated to cultural traits. Thus, according to Bisin and Verdier's (2001) theoretical model, both parents' preferences and value of their children welfare are likely to explain vertical intergenerational transmission of cultural values.

In particular, we expect cultural transmission of traditional norms to be more important when individuals consistently lay more emphasis on traditions. Among our mother-level variables, religious affiliation, and more specifically, affiliation to traditional African pre-colonial religions (after centuries of monotheist religions (Islam and Christianity) spread across Africa) might capture higher preferences for traditional values and norms, and hence a higher persistence of norms of behavior inherited from historical

shocks. Table V, Panel A, shows the heterogeneous impact of past exposure to the slave trade across religious affiliations. When our main explanatory variable is interacted with the dummy variable traditional religion (column (1)), we find that the negative effect of slave trade exposure more than double. By contrast, when our main explanatory variable is interacted with the other religious affiliation dummy variables, we find that the coefficient of the interaction term is not significantly different from 0, even though the results show that cultural transmission is more important through Catholic than Protestant and Islam religious affiliation (column (2), (3) and (4)). This finding is consistent with Bisin et al.'s (2004) result with respect to asymmetric 'relative intolerance' parameters across religious traits.

Cultural transmission is also expected to be more important when parents value more their children's welfare. Therefore, we interact our main explanatory variable with the ethnicity-level dummy variable with respect to pre-colonial type of political succession, whether hereditary or not (Table V, Panel B, column (1)). The coefficient of the interaction term is highly insignificant. We further investigate whether the type of hereditary succession – matrilineal or patrilineal – plays a role in cultural transmission. As a matter of fact, in matrilineal lineage systems, by definition, women are key for determining descent. This implies that in these systems children represent part of women's outside option, as their kin group has an interest in the well-being of the children[10]. As a consequence, women value more their children's welfare in matrilineal lineage systems[11]. This in turn could lead to higher cultural transmission relative to patrilineal lineage systems, as it is consistently women that are in charge of children education in the sub-Saharan African context. Therefore, we expect the slave trade adverse effect on current trust in medicine to be more important for slave-raided ethnic groups with matrilineal lineage. When our main explanatory variable is interacted with the dummy variable matrilineal

[10]This is the reason why a large literature in anthropology suggests that matrilineal systems reduce spousal cooperation (Radcliffe-Brown 1950; Gluckman 1963; Richards 1950; Douglas 1969).

[11]Note that consistent with this theory, we expect that matrilineal systems lead to better children health outcomes. Our results confirm this hypothesis: the coefficient of matrilineal dummy itself is positive and highly significant. More specifically, a child born from a mother belonging to a matrilineal ethnic group is 18 percentage points more likely to be vaccinated against measles than a child whose mother is from a patrilineal ethnic group. Lowes and Montero (2018b) find similar results.

lineage, we find that the negative effect of slave trade exposure is multiplied by four (Panel B, column (2)). This considerable effect is highly significant.

[Table V about here.]

5.2 Understanding the Persistent Optimality of Mistrust in Medicine

In the evolutionary anthropology literature, as highlighted by Giuliano and Nunn (2019), a class of models predicts that cultural persistence is determined by the similarity of the environment across generations. More specifically, within these models, when the environment is similar across generations, the traits that have evolved up to the previous generation are likely to be also optimal for the current generation.

For the object of our study, this perspective implies that the persistent effect of the slave trade on trust in medicine is explained by the similarity of the environment across generations. It is now acknowledged that the colonial period was associated with abusive medical treatments. French, British, and Belgian colonial governments implemented a wide variety of medical campaigns beginning in the early 20th century in order to eradicate several diseases, mainly sleeping sickness but also yaws, malaria, leprosy, and yellow fever (Headrick 1994; Pepin 2011; Headrick 2014). In order to achieve a good coverage during these campaigns, the military used to force villagers to participate and used medications with considerable side effects[12].

Furthermore, there is also a large body of anecdotal evidence from Africa of more contemporaneous abusive clinical trials. Katz et al. (1972), Fost (1998), Meier (2002), and Washington (2007a, 2007b) provides telling examples of medical misbehavior in different countries and contexts: Dr. Basson involved in the murder, by poisoning, of hundreds of blacks in South Africa and Namibia from 1979 to 1987; patients murder by lethal medical injections in Zimbabwe and Zambia during the 1980s and 1990s; AZT treatments testing in Africa in 1994; thalidomide treatment for leprosy in Africa in the 1990's; unethical medical experiments on black breast-cancer patients in South Africa in 2000, among others

[12]Lowes and Montero (2018a) document the peculiar case of Central Africa.

instances. A testimony of the importance of these mistreatments is the film release in 2005 "The Constant Gardener", by Fernando Meirelles, based on the real-life meningococcal meningitis abusive testing in Kano, Nigeria, in 1996.

The fact that Africans have become the subjects of dangerous therapeutics is explained by the increasing strictness of rules that apply in the West. Washington (2007a) mentions this quote from Robert F. Murray, M.D., chief of the Division of Medical Genetics at Howard University, who warned in 1994: "People are going overseas trying to do research in Africa. They are saying, 'We don't have to go through all that IRB[13] stuff to study AIDS, sickle cell and other diseases. This sort of questionable research is now going on in Africa and Third World countries because there are plentiful patients and the scientists are not subject to the same restrictions they are now subjected to here." (Washington 2007a, p. 390). The African public-health vacuum might also be endogenous to corrupt central governments or leaders that try to get money from international donors.

6 Conclusion

This article seeks to better understand the global phenomenon of contemporaneous medical distrust in sub-Saharan Africa resulting in major health program failures. One of the contributions of this paper is to provide theoretical explanation and empirical evidence that the slave trade emerges as an important determinant of current trust in medicine. We have then pointed out that it is a valid instrument for trust in medicine in the reduced-form relationship between ancestors' exposure to the slave trade and current demand for vaccination, holding constant any unobserved local variable and including a rich set of relevant ethnicity-level controls for pre-colonial and colonial characteristics. Leading to the second and main contribution of this study: The slave trade is an important determinant of current demand for vaccination, more important than the standard socio-economic factors. The next natural step is to try to understand the persistent effect of the slave trade on trust in medicine. We provide explanations that are consistent with both economic and evolutionary anthropology approaches. We identify religious affiliations and

[13]Stands for Institutional Review Board for protection of human subjects in research.

matrilineal lineage systems as specific important cultural transmission mechanisms, and we point to the similarity of the environment across generations due to colonial and contemporaneous abusive medical treatments to explain persistence of optimal mistrusting behavior inherited from the slave trade.

The implications for present-day health policy in sub-Saharan Africa are twofold. First, one way to alleviate the persistent culture of mistrust is to increase the environmental mismatch by reducing contemporaneous medical misbehavior in Africa. This implies strengthening the institutional and legal frameworks and improving the regulation of all actors in the health sector. The second important implication of our results is that there is no one-size-fits-all health policy. In particular, given that different levels of trust and hence propensity to adopt preventive technologies exist between ethnic groups, health intervention design could be improved by leveraging cooperation from early adopters. Such strategy might be useful to generate the early benefits of externalities in preventive health.*

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A Appendices

A.1 Data Description

[Table A.1 about here.]

[Table A.2 about here.]

[Table A.3 about here.]

A.2 Complementary Results

[Table A.4 about here.]

[Table A.5 about here.]

[Table A.6 about here.]

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Table I: OLS Estimates of the Determinants of Trust in Health Workers

	Corrupt health workers	Lack of attention/respect
	(1)	(2)
ln (1 + exports/area)	0.0506**	0.0611**
	(0.0201)	(0.0280)
Individual controls	Yes	Yes
Districts controls	Yes	Yes
Ethnicity-level colonial controls	Yes	Yes
Colonial population density	Yes	Yes
Country FE	Yes	Yes
Number of observations	17829	16701
Number of ethnicity clusters	187	187
Number of district clusters	1292	1292
R-Squared	0.057	0.097

The table reports OLS estimates. The unit of analysis is the individual respondent in the 3rd round of the Afrobarometer survey. Standard errors are adjusted for two-way clustering at the ethnicity and district levels. The slave export variable ln(1+exports/area) is the natural log of one plus slave exports normalized by land area. The individual controls follow Nunn and Wantchekon (2011) full controls. They include the respondent age, age squared, five living conditions fixed effects, ten education fixed effects, 18 religion fixed effects, 25 occupation fixed effects, and an indicator for whether the respondent lives in an urban location. The district controls include ethnic fractionalization in the district and the share of the district's population that is the same ethnicity as the respondent. Ethnicity-level colonial controls include the prevalence of malaria, a 1400 urbanization indicator variable, eight fixed effects for the sophistication of precolonial settlement, the number of jurisdictional political hierarchies beyond the local community in the precolonial period, an indicator for integration with the colonial rail network, an indicator for contact with pre-colonial European explorers, and the number of missions per square kilometer during colonial rule. Colonial population density is the natural log of an ethnicity's population density during the colonial period. *$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.

Table II: OLS Estimates of the Determinants of Health Supply Perception (Price, Quantity and Quality)

	Costs	Medicine supplies	Absence of doctors	Waiting-time	Dirty clinic
	(1)	(2)	(3)	(4)	(5)
ln (1 + exports/area)	0.0262	-0.0142	0.0201	-0.0101	0.0307
	(0.0336)	(0.0273)	(0.0231)	(0.0261)	(0.0267)
Individual controls	Yes	Yes	Yes	Yes	Yes
Districts controls	Yes	Yes	Yes	Yes	Yes
Ethnicity-level colonial controls	Yes	Yes	Yes	Yes	Yes
Colonial population density	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes
Number of observations	16823	16706	16497	16713	16476
Number of ethnicity clusters	187	187	187	187	187
Number of district clusters	1292	1292	1292	1292	1292
R-Squared	0.199	0.172	0.121	0.111	0.082

The table reports OLS estimates. The unit of analysis is the individual respondent in the 3rd round of the Afrobarometer survey. Standard errors are adjusted for two-way clustering at the ethnicity and district levels. The slave export variable ln(1+exports/area) is the natural log of one plus slave exports normalized by land area. The individual controls follow Nunn and Wantchekon (2011) full controls. They include the respondent age, age squared, five living conditions fixed effects, ten education fixed effects, 18 religion fixed effects, 25 occupation fixed effects, and an indicator for whether the respondent lives in an urban location. The district controls include ethnic fractionalization in the district and the share of the district's population that is the same ethnicity as the respondent. Ethnicity-level colonial controls include the prevalence of malaria, a 1400 urbanization indicator variable, eight fixed effects for the sophistication of precolonial settlement, the number of jurisdictional political hierarchies beyond the local community in the precolonial period, an indicator for integration with the colonial rail network, an indicator for contact with pre-colonial European explorers, and the number of missions per square kilometer during colonial rule. Colonial population density is the natural log of an ethnicity's population density during the colonial period. *$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.

Table III: LPM Estimates of the Determinants of Measles Vaccination

	Measles Vaccine	
	(1)	(2)
Group exports slaves (=1)	-0.0902***	-0.0457**
	(0.0251)	(0.0206)
	[0.0250]	
Child controls	Yes	Yes
Mother controls	Yes	Yes
Household controls	Yes	Yes
Ethnic pre-colonial controls	Yes	Yes
Ethnic colonial controls	Yes	Yes
District controls	Yes	No
Country x Survey-Year FE	Yes	No
District x Survey-Year FE	No	Yes
Adj. R-Squared	0.154	0.210
N observations	80088	81280
N mothers	101866	55257
Number of ethnicity clusters	98	64
Number of district clusters	9726	7325

The table reports LPM estimates. Below the coefficients, two standard errors are reported: in parentheses are standard errors adjusted for clustering within ethnic groups, in square brackets are standard errors adjusted for two-way clustering within ethnic groups and districts. Child controls include: sex of the child, the order of birth, a dummy for home delivery. Mother controls: education, literacy status, employment status, religion, age, access to health facility, total children, birth interval, ideal number of children, unwanted births, watch TV, listen to radio. Household controls: father employment status, the gender of the houshold head, the household wealth index, mother makes health decision. Ethnic pre-colonial controls include dummies for norms of: child heredity, postpartum sex taboo, rigidity of girls premarital sexual behavioral norms, past-political centralization. Ethnic colonial controls: split across country borders, current minority status. District controls: density, luminosity at night, elevation, distance to water, to the sea, and to capital city, existence of natural resources (diamond mines, petroleum plants), recent experience of conflicts, violence and riots, disease environment using the malaria stability index. *$*p < 0.10$, **$**p < 0.05$, ***$**p < 0.01$.*

Table IV: LPM Estimates of the Determinants of ITN Use and Anemia Hemoglobin Test Consent

	Use Malaria ITN Net	Accept Anemia Test
	(1)	(2)
Group exports slaves (=1)	-0.0019	-0.0250***
	(0.0142)	(0.0083)
Child controls	Yes	Yes
Mother controls	Yes	Yes
Household controls	Yes	Yes
Ethnic pre-colonial controls	Yes	Yes
Ethnic colonial controls	Yes	Yes
District x Survey-Year FE	Yes	Yes
Adj. R-Squared	0.338	0.204
N observations	82199	31471
N mothers	53216	20711
Number of ethnicity clusters	59	45
Number of district clusters	6884	4326

The table reports LPM estimates. Standard errors are adjusted for clustering within ethnic groups. Child controls include: sex of the child, the order of birth, a dummy for home delivery. Mother controls: education, literacy status, employment status, religion, age, access to health facility, total children, birth interval, ideal number of children, unwanted births, watch TV, listen to radio. Household controls: father employment status, the gender of the houshold head, the household wealth index, mother makes health decision. Ethnic pre-colonial controls include dummies for norms of: child heredity, postpartum sex taboo, rigidity of girls premarital sexual behavioral norms, past-political centralization. Ethnic colonial controls: split across country borders, current minority status. *$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.

Table V: The Effect of Historical Slave Trade Exposure on Today Demand for Vaccination, Depending on Cultural Transmission Preferences

Dep.Var:	Measles Vaccine			
	(1)	(2)	(3)	(4)
Panel A: Preferences for traditions				
Group exports slaves (=1)	-0.0457**	-0.0595***	-0.0427**	-0.0444*
	(0.0206)	(0.0213)	(0.0205)	(0.0227)
Group exports slaves (=1) X Traditionnal religion (=1)	-0.0708**			
	(0.0334)			
Group exports slaves (=1) X Muslim (=1)		0.0312		
		(0.0201)		
Group exports slaves (=1) X Catholics (=1)			-0.0208	
			(0.0133)	
Group exports slaves (=1) X Protestants (=1)				-0.0033
				(0.0131)
Baseline controls	Yes	Yes	Yes	Yes
District x Survey-Year FE	Yes	Yes	Yes	Yes
Observations	81280	81280	81280	81280
Adj. R-squared	0.210	0.210	0.210	0.210
Panel B: Values of children's welfare				
Group exports slaves(=1)	-0.0398**	-0.0349*		
	(0.0183)	(0.0189)		
Group exports slaves(=1) X Child heredity (=1)	-0.0141			
	(0.0351)			
Group exports slaves(=1) X Matriarchy (=1)		-0.1700***		
		(0.0514)		
Baesline controls	Yes	Yes		
District x Survey-Year FE	Yes	Yes		
Observations	81280	81280		
Adj.R-squared	0.210	0.210		

The table reports LPM estimates. Standard errors are reported in parentheses and adjusted for clustering within ethnic groups. Panel A and Panel B are estimated as in our baseline controls where child controls include: sex of the child, the order of birth, a dummy for home delivery. Mother controls: education, literacy status, employment status, religion, age, access to health facility, total children, birth interval, ideal number of children, unwanted births, watch TV, listen to radio. Household controls: father employment status, the gender of the houshold head, the household wealth index, mother makes health decision. Ethnic pre-colonial controls include dummies for norms of: child heredity, postpartum sex taboo, rigidity of girls premarital sexual behavioral norms, past-political centralization. Ethnic colonial controls: split across country borders, current minority status. *$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.

Table A.1: Variable description and data source

Variables	**Description**	**Source**
Group exports slaves	Dummy variable for ethnic group exporting	Nunn and Wantchekon (2011)
Employment	Dummy variables for parents' employment	Demographic Health Survey
Mother age	Reported age of the mother	Demographic Health Survey
Mother education	Reported number of education years	Demographic Health Survey
Literacy	Categorical variable for effective ability to read during survey	Demographic Health Survey
Female household head	Dummy variable for households headed by females	Demographic Health Survey
Mother makes health decisions	Dummy for child health decisions made by the mother	Demographic Health Survey
Wealth Index	Categorical variable for the household level of income	Demographic Health Survey
Listen to radio	Frequency of listening to radio	Demographic Health Survey
Watch TV	Frequency of watching TV	Demographic Health Survey
Religion	Categorical variable for the reported religion	Demographic Health Survey
Total births	Categorical variable for the mother's life time birth records	Demographic Health Survey
Close pregnancies (last 5 years)	Number of births during the last five years	Demographic Health Survey
Ideal number of children	Mothers reported ideal number of children	Demographic Health Survey
Not wanted last child	Dummy variable for undesired last child	Demographic Health Survey
Distance to health facility	Dummy variable for distance to health facility is a problem	Demographic Health Survey
Child birth order	Categorical variable for the child birth order	Demographic Health Survey
Sex of child	Dummy variable for female child	Demographic Health Survey
Home delivery	Dummy variable for a child delivery at home instead of medical facility	Demographic Health Survey
Ethnic Centralization	Dummy for ethnic group pre-colonial political centralization	Murdock Ethnographic Atlas (1959)
Split ethnic group	Ethnic group split during colonial period	Michalopoulos and Papaioannou (2016)
Ethnic minority status	Dummy variable coded for groups outside majority	Demographic Health Survey
Child Hereditary Succession	Dummy variable coded from indicator on type of political hereditary succession	Murdock Ethnographic Atlas (1959)
Matriarchy	Dummy variable for child matrilineal political succession	Murdock Ethnographic Atlas (1959)
Postpartum sex-taboos	Dummy variable coded from indicator on historical norms of postpartum sex-taboos	Murdock Ethnographic Atlas (1959)
Rigidity of sexual norms	Dummy variable coded from indicator on historical norms of premarital sexual behavior of girls	Murdock Ethnographic Atlas (1959)

Table A.2: Summary statistics

	Obs.	Mean	S.d.	Min.	Max.
Panel A: Child variables					
Sex of child	157405	0.49	0.50	0	1
Birth order (Age < 5 years)	157405	2.12	0.72	1	3
Child home delivery	156610	0.43	0.50	0	1
Measles	144375	0.62	0.49	0	1
Panel B: Mother and household variables					
Female household head	101866	0.20	0.40	0	1
Mother Age	101866	28	7.19	15	49
Mother employed	97589	0.67	0.47	0	1
Mother education years	101866	4	1.59	0	8
Mother literacy	95390	0.41	0.49	0	1
Health decisions female	80016	0.48	0.50	0	1
Problem distant health services	134258	0.46	0.50	0	1
Accept hemoglobin test	35019	0.97	0.17	0	1
Adult sleep under net	90474	0.49	0.50	0	1
Total births last 5 years	101866	1.49	0.62	1	5
Ideal number of children	90919	5.59	2.75	0	40
Non desired last child	97461	0.26	0.44	0	1
Total children	101866	3.81	2.48	1	17
Father employed	91558	0.99	0.10	0	1
Wealth Index	95891	2.79	1.41	1	5
Listen to radio	95784	0.65	0.48	0	1
Watch TV	95756	0.39	0.49	0	1
Muslim	101722	0.43	0.49	0	1
Catholics	101722	0.19	0.39	0	1
Protestants	101722	0.33	0.47	0	1
Traditionnal religion	101722	0.03	0.17	0	1
Panel C: Ethnic group variables					
Ethnic group exports slaves	101866	0.80	0.40	0	1
Ethnic centralization	82367	0.66	0.48	0	1
Ethnic child heredity	101866	0.44	0.50	0	1
Ethnic matriarcat	84366	0.17	0.38	0	1
Ethnic post-partum sex taboo	101866	0.30	0.46	0	1
Ethnic rigidity of sexual norms	101866	0.22	0.42	0	1
Ethnic colonial Split	101866	0.52	0.50	0	1
Ethnic minority	101866	0.61	0.49	0	1

Table A.3: Summary statistics at the district level

	Obs.	Mean	S.d.	Min.	Max.
Number of ethnic groups	9726	1.70	0.87	1	7
Number of children	9726	16.18	11.92	1	91
Number of mothers	9726	11.08	7.42	1	54
Measles vacc. rate	9707	0.66	0.25	0	1
Group exports slaves	9726	0.80	0.37	0	1

Table A.4: LPM Estimates of the Determinants of Measles Vaccination

	Measles
Ethnic group exports slave	-0.0457**
	(0.0206)
Ethnic group Pre-colonial centralization	-0.0257**
	(0.0105)
Split ethnic group during colonial period	-0.0127
	(0.0087)
Minority group	0.0217*
	(0.0110)
Pre-colonial Cultural Norms of Child Investment: Type of Hereditary Succession	
Child Heredity	0.0326**
	(0.0140)
Pre-colonial Cultural Norms of Preventive behavior	
Postpartum sex taboo	0.0312***
	(0.0081)
Insistence on early female marriage or on girls virginity	0.0348***
	(0.0123)
Household socio-demographics:	
Father employed (=1)	0.0174
	(0.0170)
Mother employed (=1)	0.0465***
	(0.0062)
Mother Age	0.0629***
	(0.0060)
Mother education (years)	0.0009
	(0.0015)
Literacy (Ref:Not able to read)	
Read partially	0.0202***
	(0.0068)
Read adequately	0.0376***
	(0.0055)
Distance to health facility is a problem(=1)	-0.0154**
	(0.0063)
Female household head	-0.0137**
	(0.0062)
Mother makes health decisions	0.0100***
	(0.0037)
Listen to radio	0.0061**
	(0.0023)
Watch Tv	0.0072
	(0.0043)
continued in Table X	

Table A.5: LPM Estimates of the Determinants of Measles Vaccination (continued)

Wealth Index Quantile (Ref:poorest)	
2nd quantile	0.0085
	(0.0053)
3rd quantile	0.0193***
	(0.0062)
4th quantile	0.0355***
	(0.0097)
5th quantile	0.0504***
	(0.0127)
Religion (ref:Muslim)	
Catholic	0.0176
	(0.0110)
Protestant	0.0062
	(0.0091)
Traditional	-0.0296*
	(0.0152)
Others	-0.0238
	(0.0147)
Mother Births History(Ref: ≤2)	
Life time total births (3/4)	0.0805***
	(0.0069)
Life time total births (≥5)	0.2133***
	(0.0131)
Close Births (last 5 years)	-0.0510***
	(0.0045)
Mother fertility preferences	
Ideal number of children (N)	0.0023**
	(0.0011)
Not wanted last children	0.0011
	(0.0050)
Child birth order (Ref: ≤2)	
Birth order (2/4)	-0.1172***
	(0.0105)
Birth order (5/18)	-0.3088***
	(0.0225)
Sex of child (female=1)	0.0088***
	(0.0033)
Home delivery (=1)	-0.0289**
	(0.0143)
Location x Survey-Year FE	Yes
Adj. R-Squared	0.210
N Observations	81280

The table reports LPM estimates of the remaining explanatory variables in the baseline estimation in column (2) of Table 3. Standard errors are reported in parentheses and adjusted for clustering within ethnic groups as in our baseline specification in column (2) of Table 3. Child controls include: sex of the child, the order of birth, a dummy for home delivery. Mother controls: education, literacy status, employment status, religion, age, access to health facility, total children, birth interval, ideal number of children, unwanted births, watch TV, listen to radio. Household controls: father employment status, the gender of the household head, the household wealth index, mother makes health decision. Ethnic precolonial controls include dummies for norms of: child heredity, postpartum sex taboo, rigidity of girls premarital sexual behavioral norms, past-political centralization. Ethnic colonial controls: split across country borders, current minority status. *$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.

Table A.6: Logit Estimates of the Determinants of Measles Vaccination

	Measles	Use Malaria ITN Net	Accept Anemia Test
	(1)	(2)	(3)
Group exports slaves (=1)	-0.2291***	0.0017	-0.9253***
	(0.0818)	(0.0983)	(0.3436)
Child controls	Yes	Yes	Yes
Mother controls	Yes	Yes	Yes
Household controls	Yes	Yes	Yes
Ethnic pre-colonial controls	Yes	Yes	Yes
Ethnic colonial controls	Yes	Yes	Yes
District x Survey-Year FE	Yes	Yes	Yes
Log likelihood	-33166.94	-30914.29	-1343.96
N observations	73893	68063	4213
Number of districts	5439	4395	4213

The table reports logit survey-year fixed-effects estimates as specified in the baseline specification in column (2) of Table 3. Child controls include: sex of the child, the order of birth, a dummy for home delivery. Mother controls: education, literacy status, employment status, religion, age, access to health facility, total children, birth interval, ideal number of children, unwanted births, watch TV, listen to radio. Household controls: father employment status, the gender of the household head, the household wealth index, mother makes health decision. Ethnic pre-colonial controls include dummies for norms of: child heredity, postpartum sex taboo, rigidity of girls premarital sexual behavioral norms, past-political centralization. Ethnic colonial controls: split across country borders, current minority status. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$