AFRICAN POLYGAMY: PAST AND PRESENT

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ABSTRACT. Polygamy is common in Africa, and is blamed for negative outcomes. I use DHS data to test nine hypotheses about its prevalence and decline. First, historical inequality better predicts polygamy today than current inequality. Second, greater female involvement in agriculture reduces polygamy. Third, the slave trade predicts polygamy, but not robustly. Fourth, modern female education does not reduce polygamy. Colonial schooling does. Fifth, economic growth is weakly correlated with polygamy. Sixth and seventh, rainfall shocks and war increase polygamy, though their effects are small. Eighth, polygamy varies smoothly over borders, national bans notwithstanding. Finally, falling child mortality has reduced polygamy.

[THIS IS AN EARLY DRAFT PREPARED FOR THE LSE ECONOMIC HISTORY SEMINAR. THE DATA ARE NOT YET FULLY CLEANED. METHODS AND RESULTS MAY CHANGE.]

1. INTRODUCTION

Polygamy remains common in much of Africa.[1] In several sub-Saharan countries, more than 10% of married women are in a polygamous union (Tertilt, 2005). Between Senegal and Tanzania stretches a "polygamy belt" in which it is common to find that more than one third of married women are polygamous (Jacoby, 1995). Polygamy has been cited as a possible cause of Africa's low savings rates (Tertilt, 2005), high incidence of HIV (Brahmbhatt et al., 2002), high levels of child mortality (Strassmann, 1997), and of female depression (Adewuya et al., 2007).

This is despite a striking decline in the prevalence of polygamy in Africa over the last half century. Of the nearly half a million women included in the data for this study, roughly 40% who first married in 1970 share their husband today, while for women who married in 2005, that number is closer to 15%. In Benin, more than 60% of women in the sample who were married in 1970 were polygamists, while in 2000 this figure was under 40%. This is also true of Burkina Faso, Guinea, and Senegal. In Cameroon and the Ivory Coast, the decline has been from over 40% to under 20%. Several other countries in the data have experienced similar changes in their marriage institutions. This is an

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[1]I deal only with polygyny in this paper, ignoring polyandry. I use the term "polygamy" since it is more familiar to most readers.

evolution of marriage markets as rapid and dramatic as the rise in divorce in the United States between 1960 and 1980.

In this paper, I use data from the Demographic and Health Surveys (DHS) on women from 34 countries to test nine hypotheses about the prevalence and decline of polygamy in sub-Saharan Africa. Three of these relate to the distribution of polygamy over space. First, economists since Becker (1974) have linked polygamy to inequality between men. I am not able to find any correlation between wealth or occupational inequality recorded in the DHS and the probability that a woman is polygamous. By contrast, I find that historical indicators of inequality on the eve of colonial rule taken from the *Ethnographic Atlas* predict polygamy today. Similarly, geographic predictors of inequality that have been used in other studies also predict the existence of polygamy in the present. Second, Jacoby (1995) has linked the demand for wives in the Ivory Coast to the productivity of women in agriculture. I find, by contrast, that polygamy is least common in those parts of Africa where women have historically been most important in agriculture. Third, I confirm the result of Dalton and Leung (2011); greater slave trade exposure does predict polygamy today. My approach differs from theirs in several ways – I take women as the unit of observation rather than men, I include Angola (a low-polygamy country that was the hardest hit by the Atlantic slave trade), and I take locations rather than ethnic groups as the unit of treatment. I show, however, that the result is not robust, because identification depends on comparing Western Africa to the rest of the continent.

Five of these hypotheses relate to changes in polygamy rates over time. First, I replicate two natural experiments that have increased female education in Nigeria (Osili and Long, 2008) and Zimbabwe (Agüero and Ramachandran, 2010), and find no causal effect of schooling on polygamy. Using colonial data from Huillery (2009) and Nunn (2009), I show that schooling investments decades ago do predict lower polygamy rates today. Second, I use instrumental variables to find an effect of economic growth on the decline in polygamy, though this is not robust result and the magnitude is small. Third, I find that local economic shocks do predict polygamy; women within a survey cluster who received bad rainfall draws in their prime marriageable years are more likely to marry a polygamist. Fourth, war acts like a bad rainfall shock at the local level, increasing the prevalence of polygamy. Both of these effects, however, are small in magnitude. Fifth, I use a regression discontinuity design to test whether national bans and other policies have played any role in the decline of African polygamy. With a few notable exceptions, I find that they generally have not. Sixth, I use national-level differences in differences and a malaria eradication program in Uganda to test for an effect of falling child mortality. The magnitudes I find are large enough to explain much of the decline in polygamy across sub-Saharan Africa.

Because of this diversity of tests, I contribute to a wide range of literatures. The two most general literatures concern the economics of institutions and the economics of marriage. A global literature has confirmed the importance of institutions such

as land rights (Goldstein and Udry, 2008), slavery (Sacerdote, 2005), pre-colonial states (Michalopoulos and Papaioannou, 2011a), and colonial legal forms (La Porta et al., 1997) for development. Empirical studies have linked these institutions to biogeographical endowments, such as settler mortality (Acemoglu et al., 2001), suitability for specific crops (Engerman and Sokoloff, 1997), ecological diversity (Fenske, 2010), and population density (Acemoglu et al., 2002). By demonstrating that geographic determinants of inequality and the gender division of labor continue to predict the institution of polygamy today, I add to our understanding of how geography shapes institutions. Further, it has been suggested that institutions adapt to the needs of the market (Burness and Quirk, 1979; Greif, 1993). I show here that polygamy rates are responsive to economic shocks.

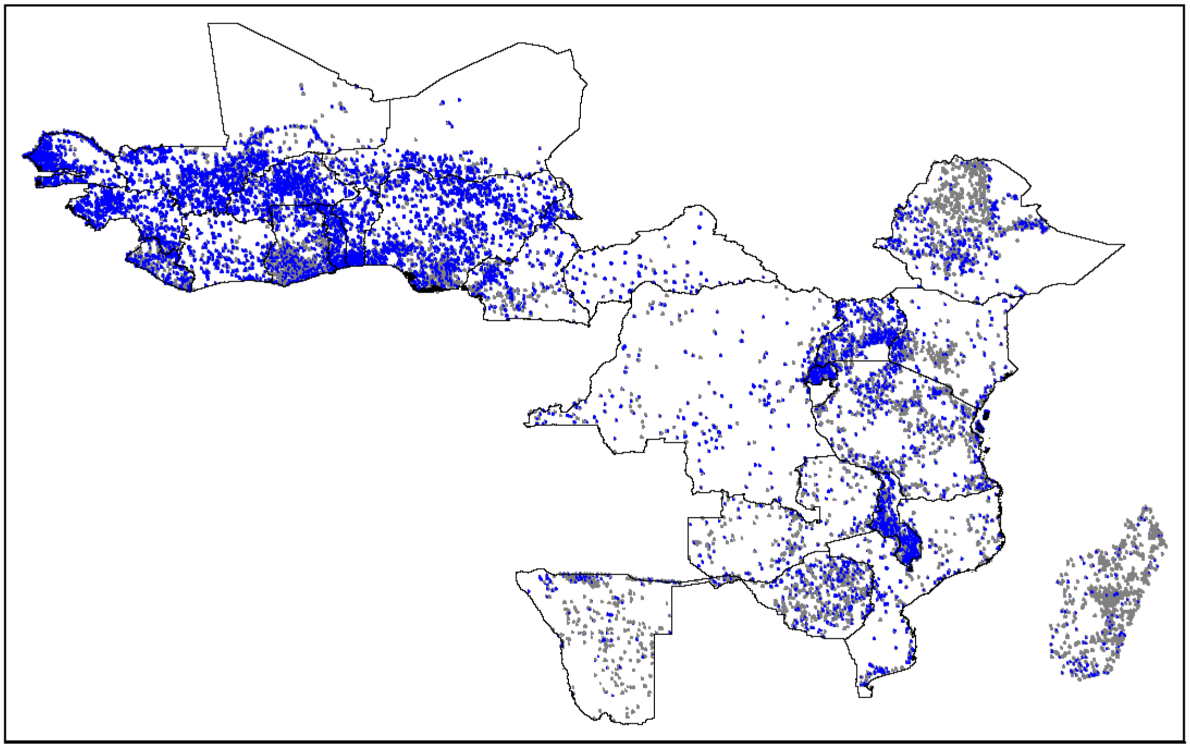
Economists since at least Becker (1973) have been interested in the operation of marriage markets. Much of this literature has focused on marital institutions in the developing world. These contributions have focused on the implications of marital arrangements for outcomes such as income smoothing (Rosenzweig and Stark, 1989), female schooling (Field and Ambrus, 2008), sex selection (Sen, 1990), and child health (Bharadwaj and Nelson, 2010). I uncover a dramatic transition in African marriage markets, and assess some of the most plausible hypotheses for this change. I also touch on a variety of other literatures, including the importance of inequality for economic development (Easterly, 2007; Putterman and Weil, 2010), the economic implications of the gender division of labor (Alesina et al., 2011; Qian, 2008), the long run impacts of the slave trade (Nunn, 2008), the microeconomic effects of war (Annan and Blattman, 2010; Blattman and Miguel, 2010), the ability of poor households to cope with economic shocks (Townsend, 1994), and the weak capacity of African states (Collier and Gunning, 1999).

I do not follow a standard outline in this paper, because I am testing several hypotheses and using multiple estimation strategies and sources of data. The base data for this study come from the DHS, and I describe these when I first use them in section 2. I explain the other sources of data briefly as I introduce them, leaving the bulk of the data description for appendix A. In section 2, I use the cross-sectional nature of the DHS data to test the three hypotheses that predict the incidence of polygyny across space. In section 3, I use the panel nature of the DHS to test the five hypotheses that explain the incidence of polygyny over time.

2. Polygamy across space

I depict the distribution of polygamy over space in Africa in Figure 1. Each point in the figure is a married woman in the DHS data for sub-Saharan Africa. Blue dots indicate polygamists. As is clear from the figure, polygamy is concentrated in West Africa, though a high-intensity belt stretches through to Tanzania. In this section, I test three theories

FIGURE 1. Polygamy in Africa



This figure plots polygamy for the 308,667 women in the sample that have latitude and longitude coordinates. A blue dot indicates polygamy, and a grey dot indicates monogamy.

that attempt to explain this distribution: inequality, female labor productivity, and the slave trade.

2.1. **Inequality.**

2.1.1. *Hypothesis.* The most familiar explanation of polygamy for economists is that it is a due to inequality between men. An early proponent of this view is Becker (1974), who argues that differences in male productivity can make polygamy efficient. Total output can be raised by giving a more productive man a second wife than by giving her to a "less able" man. Similarly, Bergstrom (1994) models polygamy as a consequence of inequality in male endowments of both wealth and of sisters that can be traded for wives. This effect is tempered, however, by the self-interest of the elite; Lagerlöf (2010) suggests that a self-interested ruler may impose monogamy to prevent his own overthrow by lesser men deprived of wives.

2.1.2. *Tests.* I use three specifications to test for the the importance of inequality for polygamy. First I use ordinary least squares (OLS) to estimate

$$polygamous_i = \beta inequality_i + x_i'\gamma + \delta_j + \epsilon_i.$$

Here, $polygamous_i$ is an indicator for whether woman i is in a polygamous marriage. $inequality_i$ is a measure of inequality, here collected at either the survey cluster (roughly village) or region level. x_i is a vector of other controls, some collected at the individual level, and some at a cluster, region or other level. x_i includes a constant. δ_j is a country-round fixed effect, which is only used in certain specifications. ϵ_i is error. Standard errors are clustered at the level at which $inequality_i$ varies. In practice, I use three measures of contemporary inequality – the coefficient of variation of household wealth, the gini coefficient of household wealth, and the ratio of partners in high-skilled occupations to those in low-skilled occupations. I compute each of these at both the cluster and region levels.

The variables that are collected differ across the 90 DHS data sets that are compiled together here, and so I use only three individual-level controls in x_i in order to conserve observations. These are: year of birth, year of birth squared, and a dummy for urban residence. I include several geographic controls in x_i, which are intended to capture other environmental determinants of polygamy that may be correlated with my variables of interest. These are: absolute latitude; suitability for wheat, maize, cereals, roots/tubers, pulses, sugar, oil, cotton, and rain-fed agriculture; suitability for malaria; ruggedness; elevation; distance to the coast, and; dummies for ecological zone (woodland, forest, mosaic, cropland, intensive cropland, wetland, desert, water/coastal fringe, or urban). The specific crops in this list are chosen by data availability. In many of the countries studied, they are economically important, accounting in the year 2000 for 83% of the value of crop production in Zambia, 91% in Namibia, and 72% in Burkina Faso, for example (faostat.fao.org). Each of these are measured at the level of the survey cluster. Because the wealth indices from the raw data that I use to measure inequality here are normalized for each country-round, country-round fixed effects are included when these are used to construct the dependent variables.

Each of the measures of contemporary inequality may be correlated with ϵ_i. I take two approaches for dealing with this. First, I replace $inequality_l$ with historical measures describing a woman's ethnic group on the eve of colonial rule. These are: historic class stratification, historic slavery, and historic access to trade routes. Second, I replace $inequality_l$ with geographic variables that have been used in other studies as predictors of inequality. These are the log ratio of wheat to sugar suitability (Easterly, 2007) and unequal agricultural endowments (Michalopoulos et al., 2010). I have attempted to use these geographic measures as instruments for the contemporary and historical inequality measures, but the first stage F statistics are generally too weak to permit this.[2]

[2] I have also tested whether a quadratic function of historic population density matters, following Baker et al. (2008), where inequality is highest at intermediate population densities. There does appear to be a statistically significant inverse-U pattern (not reported). I do not interpret this as inequality, however, and so exclude it from the analysis. This measure can also be interpreted in light of the "land abundance" view

Other approaches to predicting inequality, such as unequal landholding (Dutt and Mitra, 2008) or inequality in immigrants' home countries (Putterman and Weil, 2010), cannot be applied to these data. None of these measures are perfect, as each one might be correlated with other determinants of polygamy. A cleaner identification strategy would be to use changes over time in relative prices of "plantation" and "smallholder" crops (Galor et al., 2009). The distinction between these crops, however, is not the same in Africa as in the Americas. Many of the crops for which I have suitability data are not typically exported. Thus, I can only offer a guarded interpretation of the results – I find that historical patterns of inequality *or the unobservable factors associated with them* predict polygamy today. History matters.

2.1.3. *Data.* Each of these data sources are described in more detail in appendix A. Polygamy is taken by using the "individual recode" section from 90 DHS surveys conducted between 1986 and 2009, collected from 34 sub-Saharan countries. 494,157 observations are available in which a woman's polygamy status, year of birth, and urban residence are known. Of these, data are available on the latitude and longitude of the woman's survey cluster for 308,667 respondents. Absolute latitude is computed from these data. Distance to the coast is also computed directly using these coordinates.

Two other variables from the DHS data are used to measure inequality. The first is the wealth index. This is a factor score computed separately for every survey round, based on ownership of durable goods. I compute both coefficients of variation and gini coefficients from these data. The second variable used is the respondent's partner's occupation. I classified the responses from the raw into fourteen categories. Of these fourteen, I classified agricultural laborer, farmer, unskilled manual, household, and domestic as low skilled, army, clerical, sales, services, skilled manual, student and applicant as medium-skilled, and professional, technical and managerial as high-skilled. Not working, unknown, and other (X% of the sample for which this question is asked) were left unclassified.

Geographic data are joined to these coordinates using raster data collected from several sources. Each survey cluster is assigned the value of the nearest raster point. Variables taken from the FAO-GAEZ project are suitability for specific crops, suitability for rain-fed agriculture, and ecological zone. The suitability measures are all scores between 0 and 7. The measure of elevation is an index that ranges from 0 to 255, taken from the NACIS. Suitability for malaria is taken from the Malaria Atlas Project, and ranges

of African history (Austin, 2008; Hopkins, 1973; Iliffe, 1995). This view, as stated by Goody (1976), holds that polygyny exists where allocating land to additional wives is less costly but their labor is valuable. For this exercise, "historic population density" is population density in 1960, reported by the United Nations Environment Programme. Following (Baker et al., 2008), I include the log of one plus this density and its square as regressors. The result is consistent with an amended land abundance view of African history, in which some population density is a prerequisite for polygamy, but in which high densities increase the value of land relative to wives.

TABLE 1. Inequality and polygamy

[Table 1 here]

from 0 to 1. The ruggedness data are the Terrain Ruggedness Index used by Nunn and Puga (2011), which range from 0 to 1,368,318 in the data here.

Historic class stratification and historic slavery are taken from the *Ethnographic Atlas*. This database records institutions at the ethnicity level for 1,267 societies from around the world at the time of European contact. These are joined to the DHS data using the name of the respondent's ethnic group. Ethnicity is only reported for a sub-sample of the data, some of which contain uninformative responses such as "other" or "African." Not all ethnic groups in Africa have entries in the *Ethnographic Atlas*. Slightly more than half the sample could be joined by this method. Historic class stratification is a score between 1 and 5 describing the degree to which class differences were present before colonial rule. Slavery, similarly, is an index between 1 and 4 measuring the pre-colonial use of slaves. Historic access to trade routes is distance from the survey cluster to a trade route existing in 600 AD, as mapped by Brice and Kennedy (2001) and used previously by Michalopoulos et al. (2010). This variable is included because taxation of trade was a major source of income for elites in pre-colonial Africa (e.g. Bates (1987)).

There are two predictors of inequality used. The log ratio of wheat to sugar suitability is computed directly from the FAO data, described above. Unequal agricultural endowments are measured in two ways – the coefficient of variation of suitability for rain-fed agriculture (described above) for the survey clusters within each region, and the coefficient of variation of constraints on rain-fed agriculture, for the survey clusters within each region. The constraints variable is, like the FAO suitability measures, an index between 1 and 7. It measures the combined soil, climate, and terrain slope constraints on rain-fed agriculture.

2.1.4. *Results.* Results of these tests are reported in Table 1. It is clear that there is no positive relationship between any of the measures of present-day inequality and the probability that a woman is polygamous, except when the cluster-level coefficient of variation of wealth is introduced without other controls. Even in this case, the point estimate is very small. The estimated coefficients for the ratio of high-skilled to low-skilled occupations also run counter to the inequality hypothesis, as these coefficients are usually negative. This robust negative correlation at the cluster level survives inclusion of both country-round and region-round fixed effects (not reported).

What of historic inequality? Here, the results are quite different. Historic class stratification, historic slavery, and historic access to trade routes all strongly predict the presence of polygamy today. Binary indicators of class stratification and slavery give similar results. The class stratification results are robust to including country-round or region-round fixed effects (not reported). The slavery and trade route results are significant with region-round fixed effects, but not country-round fixed effects (not reported).

Because the effect of historical trade routes may not work through the wealth of elites, but instead through the influence of Islam, I re-estimate this specification, with controls, a) including an indicator for whether the woman is Muslim, b) excluding country-rounds where more than 25% of the population is Muslim, and c) excluding country-rounds where more than 10% of the sample is Muslim. Though this diminishes the coefficient (and the sample), it remains significant. This should not be too surprising: Muslims and followers of traditional African religions have similar levels of polygamy in the data – polygamy is not an Islamic import.

What of the determinants of inequality? Here too, the results suggest that the very long-term determinants of inequality matter. The Easterly (2007) instrument, in which a greater wheat-sugar ratio should reduce inequality, predicts lower levels of polygamy. Similarly, greater regional differences in land quality predict higher levels of polygamy. Each of these results are robust to the inclusion of country-round fixed effects, though the log wheat sugar ratio is insignificant with region-round fixed effects (not shown).

The magnitudes of the significant historical effects vary. The coefficient magnitudes imply that a one standard deviation change in historical class stratification would reduce polygamy by a bit more than 1 percentage point. For slavery and historic trade routes, the comparable effects are roughly 8 points and 7 points, respectively. Each of these are a sizable effect, but none is large enough to explain a substantial fraction of the variance in polygamy. A one standard deviation movements in the log wheat-sugar ratio is associated with a more than 7 percentage point reduction in polygamy rates, while the comparable effect for variation in land quality is a bit larger than 1 percentage point. Again, these are non-trivial changes relative to the mean rate of polygamy in the sample (28%), but they do little to explain the total variance.

2.2. **Female productivity.**

2.2.1. *Hypothesis.* That polygamy might be a consequence of female productivity in agriculture is also a familiar hypothesis. Jacoby (1995), for example, shows that the demand for wives is highest in those parts of the Ivory Coast where female productivity in agriculture is highest. In particular, he finds positive effects of cluster-level cultivation of yams/sweet potatoes, rice, plantains/bananas, and peanuts on female labor productivity. He finds a negative effect for maize, and insignificant effects of coffee, cassava, cotton, vegetables, and “other.” He finds that female labor productivity predicted by these crops increases the demand for wives. He takes inspiration from Boserup (1970), who links polygamy to the sexual division of labor in hoe agriculture; women in a bush fallow system play a greater role in agriculture than elsewhere.

2.2.2. *Tests.* Unlike Jacoby (1995), I have a data-set that spans most of sub-Saharan Africa, and exogenous measures of the suitability of the land for cultivating specific crops. In addition, I have a measure of the historic importance of women in agriculture.

TABLE 2. Female productivity and polygamy

[Table 2 here]

I estimate three specifications to test for the importance of female productivity. Before testing whether the suitability for any particular crop matters, I use OLS to estimate

$$\textit{polygamous}_i = \beta \textit{land quality}_i + x_i'\gamma + \epsilon_i.$$

Here, *land quality*$_i$ is one of two proxies for land quality. The first is the direct measure of suitability for rain-fed agriculture described in section 2.1. The second is the measure of agricultural constraints, also described in that section. The dependent variable and controls are as they were in section 2.1, except that suitability for rain-fed agriculture is no longer in x_i, but instead reported directly. This specification does not test for female productivity in particular, but rather for the importance of overall agricultural productivity.

Second, I use OLS to estimate:

$$\textit{polygamous}_i = \sum_{c=1}^{C} \beta_c \textit{suitability for crop c}_i + x_i'\gamma + \epsilon_i.$$

The suitability measures for each crop are the measures described in section 2.1, and are available for wheat, maize, cereals, roots/tubers, pulses, sugar, oil crops, and cotton. I will contrast the coefficients on these with the findings of Jacoby (1995). The other variables are unchanged, except that these suitability measures are no longer in x_i, but instead reported directly.

Third, I use both OLS and IV to estimate:

$$\textit{polygamous}_i = \beta \textit{historic female agriculture}_i + x_i'\gamma + \epsilon_i.$$

The measure of historic female agriculture is described below. The excluded instruments I use are the suitability measures for the specific crops. The other controls are unchanged.

2.2.3. *Data.* The data used here have already been outlined in section 2.1, with one exception. *Historic female agriculture* is taken from the taken from the *Ethnographic Atlas*, and like the class stratification and slavery variables described in that section, it is merged to the DHS data using the name of the respondent's ethnic group. This variable assigns each ethnic group a score between 1 and 5 indicating the degree to which female labor was dominant relative to male labor in agriculture, roughly at the time of European contact.

2.2.4. *Results.* The results, in Table 2, are inconsistent with those of Jacoby (1995). While the constraints measure of land quality suggests that polygamy exists where agriculture in general is more productive, the measure of suitability for rain-fed agriculture does

not give the same result. More directly, the variables that predict female productivity in his sample do not predict polygamy here. Roots and tubers (the equivalent of yams and sweet potatoes) have a negative and non-robust coefficient. His negative coefficient on maize is not found in these data. Cotton has a positive and significant, rather than insignificant effect.

Critically, the historical importance of women in agriculture is negatively correlated with polygamy. A cursory glance at Figure 1 suggests that this should not be a surprise. Polygamy is concentrated in the sahel and the soudan, where women have been less important in agriculture than in the more tropical parts of Africa. This is a moderately large effect: a one standard deviation increase in female importance predicts a more than 5 percentage point reduction in polygamy. This result also survives the use of instrumental variables. An over-identification test suggests that the full vector of suitability controls cannot be excluded from the polygamy equation, and so only the suitability for wheat (the strongest predictor) is used as an instrument. The OLS results are robust to the inclusion of country-round or region-round fixed effects, but the IV results are not (not reported). Despite this, the general pattern here is unmistakeable – the hypothesis that female productivity in agriculture determines polygamy cannot explain why polygamy is most prevalent in those parts of Africa where female labor in agriculture has historically been least important.

2.3. **The slave trade.**

2.3.1. *Hypothesis.* That the slave trade may have increased polygamy in Africa is an old argument – see Thornton (1983). This may have operated through several mechanisms. First, the Atlantic slave trade removed more men than women from the affected areas of the continent. Second, the slave trade increased inequality between those who profited from the trade and those who suffered from it. Third, by creating movable wealth in the form of slaves and imported monies, the slave trade may have facilitated a transition from matrilocal to patrilocal marriage, allowing for non-sororal polygamy (Schneider, 1981). Whatley and Gillezeau (2010) have shown that there is a correlation between slaves taken from points along the coast and the degree of polygamy among coastal groups recorded in the *Ethnographic Atlas*. Recently, Dalton and Leung (2011) have used DHS data to find a correlation that is robust to the instrumental variables strategy used by Nunn (2008) – predicting slave exports using distance from new world ports. I confirm their result using different methods. They use a man's number of wives as a dependent variable, while I take women as the unit of observation. They match DHS data to the ethnicity-level slave trade estimates in Nunn and Wantchekon (2011) using respondents' ethnic groups. I do this *and* use geographic coordinates to make an alternative matching to these slave estimates. Critically, neither the individual nor male recodes of the DHS data provide polygamy data for Angola. Angola exported more slaves than any

TABLE 3. The slave trade and polygamy

[Table 3 here]

other African country, but has low polygamy rates today. Using the household recode data to add Angola to the analysis does not change the result.

2.3.2. *Tests.* Using the DHS individual recodes, I use OLS and IV to estimate:

$$polygamous_i = \beta Slave\ trade\ exposure_i + x_i'\gamma + \epsilon_i.$$

The variable *polygamous* and the controls in x_i are unchanged from section 2.1. I use two estimates of *Slave trade exposure*$_i$. First, I match the women in the sample to the ethnicity-level slave trade estimates in Nunn and Wantchekon (2011) using self-reported ethnicities. Second, because the estimates in Nunn and Wantchekon (2011) are reported in a map of ethnic groups, I use respondents' geographic coordinates to join them to these measures of slave trade intensity over space. Following Dalton and Leung (2011), I use the log of (one plus) Atlantic slave trade exports normalized by area to measure slave trade exposure. Standard errors are clustered at the ethnic-group level. I also instrument for slave exports using distance of the survey cluster from the closest slave port in the Americas. To demonstrate that the significant effects found below are contingent on a comparison of West Africa and the rest of the continent, I also include longitude in x_i and re-estimate this regression on the sub-sample of West African countries.[3]

Because my main data source and that of Dalton and Leung (2011) both exclude Angola (since the polygamy question was not asked), I assemble an alternative data series using the "household recode" portion of the DHS survey. Here, the unit of observation is the household, and I code each household as polygamous if there is more than one woman listed in the household roster who is stated to be the wife of the household head. I discard households with no wives. These data do not include information on year of birth, urban status, or ethnicity, and so I am only able to estimate the main equation with geographic controls. Standard errors are again clustered at the ethnic group level, matched by geographic coordinates.

2.3.3. *Data.* All variables used here have been previously described except for exposure to the slave trade, which has been outlined above.

2.3.4. *Results.* Results are in Table 3. I find a positive correlation between the slave trade and polygamy rates today in the OLS and IV estimates, using both individual-level and household-level data and matching respondents to treatment by location. In the individual-level OLS, a one standard deviation change in slave exports predicts a roughly 2 percentage point increase in polygamy; in the IV results the effect is more

[3]Benin, Burkina Faso, Cameroon, Ghana, Guinea, Ivory Coast, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, and Togo.

than 15 times as large. Matches by ethnicity give positive but insignificant coefficients. The IV coefficients are much larger than the OLS, which is consistent with more severe measurement error in slave exports than in geographic location. However, this result depends on the broad comparison of West Africa with the rest of the continent. Country fixed effects, controlling for longitude, and separately estimating the effects using only the West African sub-sample do not yield statistically significant results (latter two not reported).

2.4. **Summary.** So far, then, I have found no evidence that modern-day inequality predicts polygamy, but I have shown that modern day polygamy is strongly correlated with both historic inequality and with geographic variables that predict it. I have shown that, notwithstanding the results of Jacoby (1995), the distribution of polygamy across sub-Saharan Africa is not consistent with the claim that it is determined by the importance or productivity of women in agriculture. I have confirmed the results of Dalton and Leung (2011), that the distribution of slavery in Africa is correlated with the impact of the transatlantic slave trade, but I have also shown that this result is more robust when treatment is measured spatially, rather than by ethnic group, and is dependent on a comparison of West Africa with the rest of the continent.

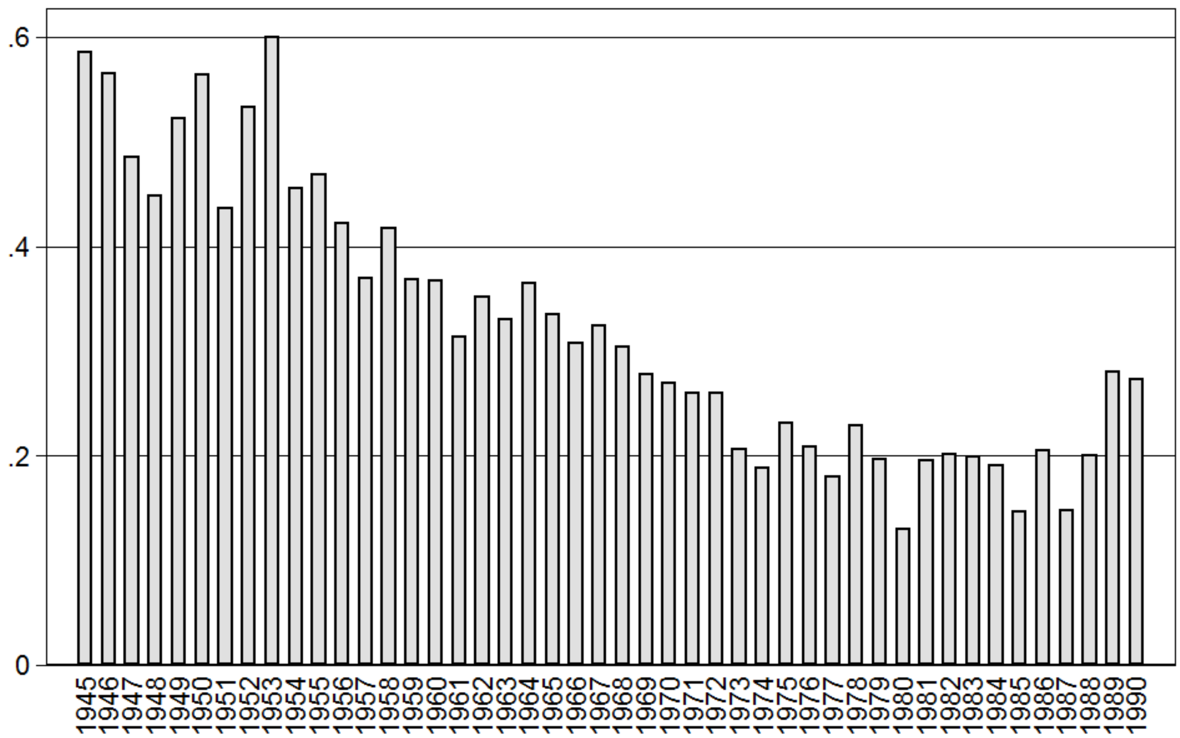
3. Polygamy over time

The decline in polygamy rates in Africa over the past few decades is striking. Figure 2 captures one example, plotting the fraction of women in the sample who are polygamous against their year of birth for the Ivory Coast. Women born in the 1980s were much less likely to marry into a polygamist union than women born in the 1940s or 1950s. In appendix B, I present similar graphs for all the countries in the sample. It is clear from these pictures that the decline has not been confined to one region of Africa, to high polygamy countries, to more urban countries, or to those that have been more successful at achieving growth and stability. Madagascar and South Africa are the only countries in the sample where there has not been a clear decline since 1970. In this section, I address six possible explanations of these changes over time – women's education, economic growth, economic shocks, war, national laws, and child mortality.

3.1. **Female education.**

3.1.1. *Hypothesis.* It is intuitive that empowering women through education may encourage them to avoid polygamous marriage. Over and above this effect, Gould et al. (2008) suggest that the quantity-quality tradeoff links female education to polygamy. If child quality matters, a rich man may prefer to spend his money on purchasing one educated wife, rather than several uneducated ones. The expansion of female schooling from independence until the 1980s was dramatic across much of Africa (Schultz, 1999). Has this played a role in the decline of polygamy?

FIGURE 2. Polygamy in the Ivory Coast by year of birth



This figure plots the average polygamy status of Ivoirian women in the sample against their year of birth.

3.1.2. *Tests.* I begin by using OLS to estimate:

$$\textit{polygamous}_i = \beta \textit{years of schooling}_i + x_i'\gamma + \delta_j + \epsilon_i.$$

x_i contains the standard individual and geographic controls outlined in section 2.1. Depending on the specification, δ_j denotes country-round, region-round, or cluster-round fixed effects. This regression does not test for an impact of a woman's years of schooling on polygamy, but only confirms there is a strong correlation in the data worth investigating further. To test for a causal impact of educating women, I replicate two natural experiments and two historical exercises.

First, I replicate the Nigerian natural experiment of Osili and Long (2008) as closely as possible. From 1976 to 1981, the Nigerian government engaged in a school-building program that only affected certain states. Osili and Long (2008) use this to test whether female schooling reduces fertility. I follow their approach, and use OLS to estimate:

$$\begin{aligned}\textit{years of education}_i = {} & \beta \textit{Born 1970-75 X Intensity}_i \\ & + \alpha \textit{Intensity}_i + \lambda \textit{Born 1970-75} + x_i'\gamma + \epsilon_i\end{aligned}$$

The controls in x_i are year of birth, and dummies for the three largest Nigerian ethnic groups (Yoruba, Hausa, Igbo), and the major religions (Muslim, Catholic, Protestant, other Christian, and traditional). The sample includes only women born between 1956-61 and 1970-75. This tests whether the school-building program had a differential effect on the women young enough to exposed to it as children in the affected states. The treatment effect is the coefficient β. Since the three measures of $\textit{Intensity}_i$ (described below) differ only at the level of states in 1976, standard errors are also clustered at this level. I then estimate the same equation with polygamy as an outcome.

Second, I replicate the Zimbabwean natural experiment of Agüero and Ramachandran (2010) as closely as possible. On independence, Zimbabwe dramatically increased access to secondary schooling. There was a discontinuous increase in educational attainment for students who were 14 years old in 1980. Agüero and Ramachandran (2010) use this break to test for intergenerational effects of this education shock. Following their approach, I use OLS to estimate:

$$\begin{aligned} \textit{years of education}_i &= \beta \textit{Age 14 or below in 1980}_i + \alpha \textit{Age in 1980}_i \\ &\quad + \lambda \textit{(14-Age in 1980) X (Age 14 or below in 1980)} + \epsilon_i \end{aligned}$$

There are no additional controls and, following Agüero and Ramachandran (2010), robust standard errors are used. The "full" sample includes women aged 6 to 22 in 1980, and the "short" sample includes women aged 10 to 20. Here β measures the program's discontinuous effect on women aged 14 in 1980. I then estimate this equation with OLS using polygamy as an outcome.

Third, I replicate the historical approach of Huillery (2009) as closely as possible. In particular, I use OLS to estimate:

$$\textit{polygamy}_i = \beta \textit{Teachers per capita, 1910-1928}_i + x_i'\gamma + \epsilon_i$$

Here, *Teachers per capita, 1910-1928* measures the average number of teachers per capita at the district (cercle) level in colonial French West Africa. Because population is not available every year, the denominator is always population in 1925. x_i always contains the respondent's year of birth, year squared, and an urban dummy. Following Huillery (2009), I include measures of the attractiveness the district to the French, conditions of its conquest, pre-colonial conditions, and geographic variables in x_i, though not all at once. Standard errors are clustered by 1925 district.

Fourth, I follow an exercise similar to Nunn (2010), and test whether the presence of a colonial mission lowers polygamy rates today. I use OLS to estimate:

$$\textit{polygamy}_i = \beta \textit{Distance from a mission in 1924}_i + x_i'\gamma + \delta_j + \epsilon_i$$

TABLE 4. Female schooling and polygamy

[Table 4 here]

Here *Distance from a mission in 1924*$_i$ measures distance from a catholic or protestant mission in 1924. Since most colonial education was conducted through missions, this will capture the combined effects of schooling and religious evangelism. Depending in the specification, δ_j indicates country-round or region-round fixed effects.

Instruments are not available for either teachers in colonial French West Africa, or missions in Africa as a whole. It is not possible, then, to interpret these estimates as strictly causal; it may be that colonial-era schooling does not matter, but rather the unobservable characteristics of certain places determined both outcomes. Despite this weakness, the significant estimates reported below are consistent with the importance of long-run factors in contemporary polygamy.

3.1.3. *Data.* The variable *years of schooling*$_i$ is readily available in the raw DHS data. For the replication of Osili and Long (2008), three measures of program intensity are taken directly from the text of their paper – a dummy variable for a "high intensity" state, school-building funds in 1976 divided by the 1953 census population estimates, and school-building funds normalized by 1976 population projections based on the (unreliable) 1963 census. Survey clusters were matched to the old states using their latitude and longitude coordinates. Since the 1999 DHS data for Nigeria do not have geographic data, this wave of the DHS is not used. The age variables needed to replicate Agüero and Ramachandran (2010) are easily computed from the DHS.

The data used to replicate Huillery (2009) are taken from her website. The only control for attractiveness of the district to the French is trade taxes per capita in 1914. Conditions of conquest are year of conquest, duration of resistance and its square, and indemnities charged. Pre-colonial controls are a dummy for a centralized political power, a European trade counter and 1910 population density. Geographic controls are latitude, longitude, altitude, dummies for the river and coast, and average rainfall from 1915 to 1975. The data on missions, used by Nunn (2010), are originally contained in Roome (1924). Distance to these missions is measured from the respondent's survey cluster.

3.1.4. *Results.* The hypothesis is well motivated. There is a strong negative correlation between polygamy and a woman's years of education. This holds conditional on controls, country-round fixed effects, region-round fixed effects, and cluster-round fixed effects. It is of a reasonable magnitude, suggesting that an extra year of schooling, in the most conservative specification, is correlated with a slightly less than 1 percentage point reduction in the probability of polygamy. Were this to be taken as a causal elasticity, it could not, however, explain a substantial portion of the decline in polygamy. African women in the sample have gained less than half a year of schooling per decade, while polygamy rates in the sample have been falling at more than 5 percentage points every

ten years.[4] While I am able to find program effects on female schooling that were uncovered by Osili and Long (2008) and Agüero and Ramachandran (2010), neither of these predict a discontinuous drop in polygamy rates. In Nigeria, the coefficient estimate is positive, while in Zimbabwe it is both small and insignificant.

Contrary to this, I do find a negative effect of schooling in colonial French West Africa on polygamy today. Though pre-colonial controls make this effect insignificant, the fact that the coefficient grows larger suggests this is the result of multi-collinearity. The magnitude suggests that a one standard deviation change in colonial education reduces polygamy by roughly 1 percentage point. Like Nunn (2010), I do find that distance from either a Catholic or a Protestant mission reduces access to education, even in the present. Interestingly, while I find that proximity to a Catholic mission reduces polygamy today, the similar effect of distance from a protestant mission disappears once country-round or region-round fixed effects are added. Adding a control for wether the respondent is Muslim dramatically reduces the estimated coefficients before country-round or region-round fixed effects are added; once these are included, controlling for whether the respondent is Muslim has almost no effect on the estimated impact of missions (not reported). A one standard deviation change in access to a Catholic mission reduces polygamy by roughly 3 percentage points. This is consistent with the findings in Nunn (2009) that Catholic missions imparted not only education, but also ideological views about the appropriate role for women in African society. Together, these results suggest that education of women only appears to reduce polygamy rates over the very long term, and in conjunction with other interventions.

3.2. **Economic growth.**

3.2.1. *Hypothesis.* The decline of polygamy in Africa has coincided with a period of fitful economic growth. Are the two related?

3.2.2. *Tests.* To test this hypothesis, I use OLS and IV to estimate:

$$\textit{polygamy}_i = \beta \textit{GDP per capita before marriage}_i + x_i'\gamma + \delta_j + \eta_t + \epsilon_i$$

Polygamy and the set of controls are as in section 2.1, except that I now include country (δ_j) and year (η_t) fixed effects in x_i. I use two measures of *GDP per capita before marriage* – log GDP per capita in the year a woman is married, and log GDP per capita averaged over her early adolescence, i.e. the years she is aged 12 to 16. Standard errors are clustered by country $\times$ year of marriage in the first specification, and country $\times$ year of birth in the second. Because year of marriage may be endogenous, and measuring GDP during early adolescence is a crude attempt to deal with this, I also reshape the data into an artificial panel. Here, each woman is observed between the ages of 12 and

[4]These are the coefficients of (unreported) bivariate regressions for the pooled sample.

TABLE 5. GDP per capita and polygamy

[Table 5 here]

25, and exits on marriage or on turning 26. I estimate the same equation as above, except that the dependent variable is now an indicator for having married polygamously in a given year. I include fixed effects for age, country, and year, excluding other controls. Standard errors are now clustered by country × year.

To test for a causal relationship, I instrument for country-level GDP per capita using the country-level FAO rainfall estimates used by Miguel et al. (2004), both in the panel and cross section. These are taken by year, or averaged over early adolescence as appropriate. I do not seek to interpret this correlation, even if it is causal; GDP is too coarse an indicator to explain any underlying mechanism by which economic growth eroded polygamy.

3.2.3. *Data.* The only new data introduced here cover GDP per capita and rainfall. GDP per capita is taken from the World Development Indicators. Rainfall data used to instrument national level GDP are taken from the Miguel et al. (2004) data set. These capture average rainfall, recorded by the FAO, over the geographic points in the entire country during that year. FAO estimates are used because these extend the furthest back in time of any of the three data series used in that paper.

3.2.4. *Results.* The results, given in Table 5, are mixed. While greater GDP per capita in the year a woman is married predicts a lower probability that she marries a polygamist, the results are less robust when GDP per capita is averaged over her early adolescence. The results here do not survive the inclusion of year and country fixed effects alongside controls, though this insignificance is marginal. The instrument has no power to predict GDP in this specification. Without controls but with fixed effects (not reported), the results remain significant. Similarly, the results in the artificial panels do not survive the inclusion of age, year and country fixed effects. though the estimated coefficient grows more negative in the IV results. The results for year of marriage, then, are suggestive of only a weak link between GDP per capita and polygamy. Further, the estimated coefficients are very small; in the log specification, a 100% increase in GDP per capita would reduce polygamy by roughly 2 percentage points in the unconditional OLS specifications. While economic growth over the past few decades has been cyclical and uneven across the continent, most countries in the sample have seen a steady, uninterrupted decline in polygamy.

3.3. **Economic shocks.**

3.3.1. *Hypothesis.* The previous section tested for a relationship between country-level economic growth and polygamy. Here, I test for a more local relationship, investigating whether rainfall shocks at the survey cluster level predict whether a woman will marry

TABLE 6. Rainfall shocks and polygamy

[Table 6 here]

polygamously. These shocks operate on both the supply and demand side of the marriage markets. Since many African societies pay bride price rather than dowry, a bad rainfall shock may encourage a girl's parents to marry her to a worse man than they otherwise would, in order to smooth consumption. Further, since polygamist men tend be wealthier, they are better able to buy a wife in a bad year.

3.3.2. *Tests.* To test this hypothesis, I use OLS to estimate:

$$\textit{polygamy}_i = \beta \textit{Rainfall shock before marriage}_i + x_i'\gamma + \delta_j + \eta_t + \epsilon_i$$

Polygamy and the set of controls are defined as in section 2.1, except that I now include cluster (δ_j) and year-of-marriage (η_t) or year-of-birth fixed effects in x_i. The rainfall shock for cluster j is measured as rainfall in year t over average rainfall for that cluster in the whole panel, i.e. $Rainfall_{jt}/\overline{Rainfall_j}$. I use two measures of *Rainfall shock before marriage* – the rainfall shock in the year a woman is married, and the shock averaged over her early adolescence, i.e. the years she is aged 12 to 16. Standard errors are clustered by cluster $\times$ year of marriage in the first specification, and cluster $\times$ year of birth in the second. As with the tests for GDP growth, year of marriage may be endogenous and measuring shocks during early adolescence is a crude solution. I reshape the data into an artificial panel where each woman is observed between the ages of 12 and 25, and exits on marriage or on turning 26. The dependent variable is now an indicator for having married polygamously in a given year. I add fixed effects for age, cluster, and year to x_i, excluding other controls (which are completely collinear with these fixed effects). Standard errors are now clustered by cluster $\times$ year.

3.3.3. *Data.* The only new data introduced here are those on rainfall shocks. These are the standard University of Delaware data series. Each cluster is joined to the nearest grid-point in these data.

3.3.4. *Results.* The results in Table 6 are clear. Across all specifications, a positive rainfall shock in a woman's prime marriageable years predicts that she is less likely to marry polygamously. Though robust, these effects are small. Raising rainfall by, for example, 100% over its normal value would only have a less than 3 percentage point effect on the probability a woman marries polygamously. Local economic shocks matter, but they cannot explain the decline in overall polygamy.

3.4. **War.**

3.4.1. *Hypothesis.* Warfare might increase polygamy through several mechanisms. The most obvious is the sex ratio. Becker (1974) gives, as an example, a nineteenth-century war that killed most of the male population of Paraguay and was followed by a rise in

TABLE 7. War and polygamy

[Table 7 here]

polygamy. The BBC has suggested that polygamy is a coping strategy for war widows in Iraq,[5] while the OECD has made similar claims about Angola.[6] In addition to war's effect on the gender ratio, conflict is expected to act like a negative rainfall shock, encouraging families to marry their daughters to polygamists for cash and protection. Has the falling incidence of war in Africa (e.g. Blattman and Miguel (2010)) reduced polygamy?

3.4.2. *Tests.* To test this hypothesis, I use OLS to estimate:

$$\textit{polygamy}_i = \beta \textit{Battle deaths before marriage}_i + x_i'\gamma + \delta_j + \eta_t + \epsilon_i$$

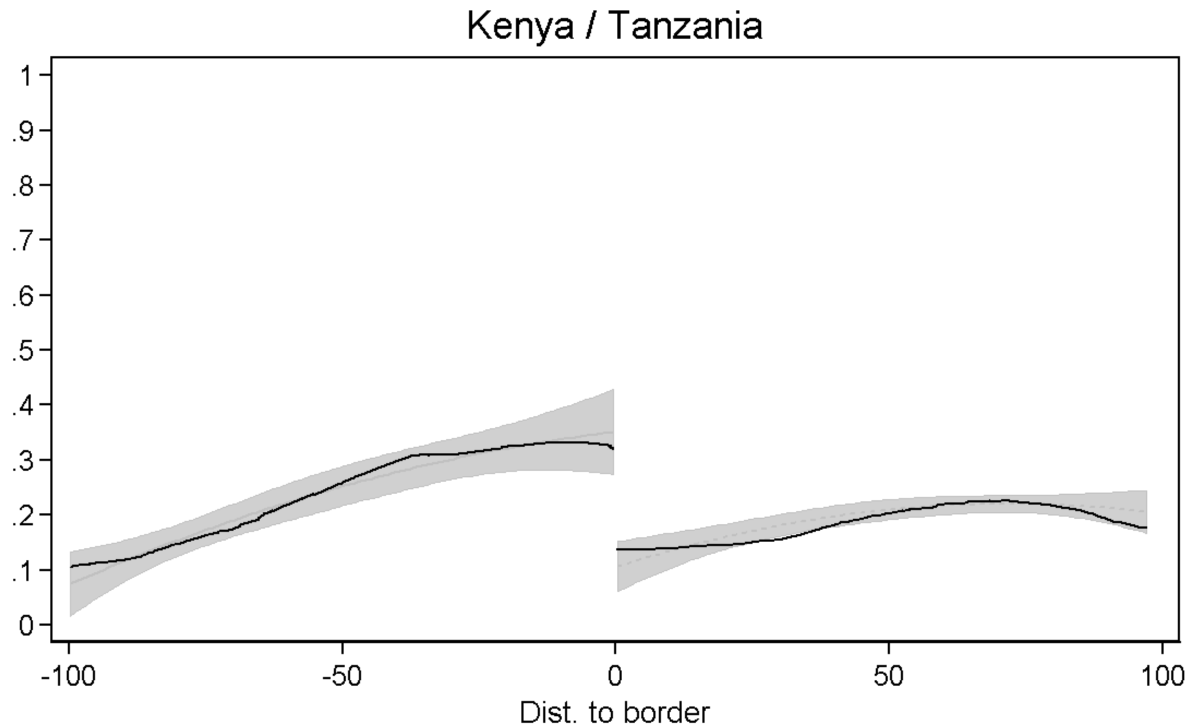
Polygamy and the set of controls are defined as in section 2.1, except that I now include cluster (δ_j) and year-of-marriage (η_t) or year-of-birth fixed effects in x_i. My measure of the intensity of conflict is the number of battle-related deaths in a conflict whose spatial extent includes her survey cluster. I use two measures of *Battle deaths before marriage* – the number of deaths in the year a woman is married, and the number of deaths averaged over her early adolescence, i.e. the years she is aged 12 to 16. Standard errors are clustered by cluster $\times$ year of marriage in the first specification, and cluster $\times$ year of birth in the second. As before, year of marriage may be endogenous, and so I reshape the data into an artificial panel as in previous sections. Here, each woman is observed between the ages of 12 and 25, and exits on marriage or on turning 26. I estimate the same equation as above, except that the dependent variable is now an indicator for having married polygamously in a given year. I add fixed effects for age, cluster, and year to x_i, excluding other controls (which are perfectly collinear with the fixed effects). Standard errors are now clustered by cluster $\times$ year.

3.4.3. *Data.* The only new data introduced here are the data on battle deaths. These have been used previously by Michalopoulos and Papaioannou (2011b). These data are originally from the Uppsala Conflict Data Program (UCDP)/International Peace Research Institute, Oslo (PRIO) Armed Conflict Dataset. Each conflict in the data is given a latitude-longitude coordinate, a radius, and a best estimate of the number of battle deaths in each year of fighting. If the spatial extent of a war overlaps a woman's survey cluster in her year of marriage (or early adolescence), she is "treated" by the number of battle deaths in that war. These are measured in millions of deaths.

3.4.4. *Results.* The results in Table 7 mirror those for rainfall shocks: war increases the probability that a woman marries polygamously. This is only apparent from the fixed effects specification. Otherwise, the fact that many war-prone regions of Africa have low polygamy rates dominates. Although I take war as a random shock, I am unable

[5] http://www.bbc.co.uk/news/world-middle-east-12266986
[6] http://genderindex.org/country/angola

FIGURE 3. Polygamy across the Kenya-Tanzania border



This figure plots the average polygamy status of women on either side of the Kenya-Tanzania border as a function of their distance from that border in kilometers. The solid line is a locally weighted regression fit, and the grey shaded region is the 95% confidence interval on a quadratic fit.

to rule out the alternative view that war is correlated with local unobservable factors such as environmental degradation. These results are, however, robust to the inclusion of local rainfall shocks (not reported). Interpreting the magnitudes here is not obvious, because of both the units and the range of parameter estimates. A war that kills one million people would, depending on the specification, raise a woman's probability of marrying polygamously by 60 to 550 percentage points. On average, a woman receives a much smaller shock closer to 1,000 battle deaths in her year of marriage or per year during her early adolescence. These suggest, as with rainfall shocks, a more modest effect that cannot explain the overall decline in polygamy.

3.5. **National borders.**

3.5.1. *Hypothesis.* Polygamy was banned by law in the Ivory Coast in 1964. From Figure 2 it is clear that polygamy continued to exist into the present. Small sample sizes in the early years make it impossible to test for a discontinuous break around the year of the law. A similar ban in Benin in 2004 does not appear to have precipitated a decline in polygamy rates in 2005 and 2006 (the last years available). Despite the failure of these

TABLE 8. National borders and polygamy

[Table 8 here]

bans, it is possible that national-level policies have affected polygamy on the ground. In this section, I use a regression discontinuity design to test whether polygamy rates break at the borders in my sample. Other border studies for Africa (Berger, 2009; Bubb, 2009; Cogneau et al., 2010; Cogneau and Moradi, 2011) have found that government investments such as education and health have effects that change discontinuously across national borders. Similarly, imported institutions such as local government can have long-lasting border effects. By contrast, indigenous institutions such as the sale and rental of land tend to vary continuously across national borders.

3.5.2. *Tests.* For each neighboring set of countries in the data, I pick clusters within 100 km of the border and estimate:

$$\textit{polygamy}_i = \beta_0 + \beta_1 \textit{Country}_i + f(\textit{Distance}_i) + \textit{Country}_i \times f(\textit{Distance}_i) + x_i'\gamma + \epsilon_i$$

I adopt the convention that $Country_c$ is a dummy for the alphabetically later country. In practice, $f(\textit{Distance}_i)$ is a cubic in distance from the border. x_i includes year of birth and its square. Standard errors are clustered at the survey cluster level.

3.5.3. *Data.* The only new source of data introduced here is the distance from a national border. Distance from the border was computed by converting country borders into a finely-spaced set of points and calculating the minimum distance from these points to the survey cluster.

3.5.4. *Results.* I report the results of this exercise in Table 8. Visual representations of the results, mimicking Figure 3, are included in appendix C. It is immediately apparent that most of the borders do not indicate significant discontinuous changes in polygamy rates. Of the nine exceptions, a quick inspection of appendix C shows that three should obviously be discarded as invalid. No clusters were surveyed near the Benin/Burkina Faso border, and so there is a gap of nearly 20 kilometers on either side of it. A similar gap exists for the DRC and Tanzania, since much of the border is made up of Lake Tanganyika. There are too few clusters in the DRC near the CAR border for a regression polynomial to be estimated with any precision there. Two other discontinuities are spurious: the two pairs of Guinea/Mali and Niger/Nigeria are both driven by outliers near the border that inflect the polynomial very close to the border. The estimated discontinuity for these two pairs is no longer significant if the regression discontinuity is estimated as a linear or a quadratic function of distance. By contrast, visual inspection of the Ghana/Ivory Coast, Kenya/Tanzania, Malawi/Tanzania, and Malawi/Zambia discontinuities suggests that these may indeed be legitimate discontinuities. All four of

these remain significant when estimated with linear or quadratic regression polynomials, excepting Malawi/Zambia, which is not significant in the linear form.

The four effects that exist are large. The Ghana/Ivory Coast break is comparable in size to the polygamy rate in Ghana, or half the polygamy rate in the Ivory coast. Similarly, polygamy nearly doubles at the Malawi-Tanzania and Kenya-Tanzania borders. The break between Malawi and Zambia is more modest, but is still high relative to a mean rate of less than 20% in Zambia.

What explains the exceptions? While Bubb (2009) find border discontinuities indicating higher levels of education and numeracy in Ghana, Cogneau et al. (2010) find instead that several indicators of material well-being break at the border in favor of the Ivory Coast. Education, then, emerges as a candidate explanation. For each of the four "legitimate" discontinuities, I perform two checks. First, replacing $\textit{polygamy}_i$ with $\textit{years of schooling}_i$ as an outcome variable, I test whether levels of female schooling also break discontinuously across these borders. Second, I add $\textit{years of schooling}_i$ as a control in the regression equation, and test whether it can explain away the border effect on polygamy. I find significant breaks in years of schooling, favoring Ghana over the Ivory Coast by a bit more than 4 years and Tanzania over Malawi by roughly two and a half years (not reported). I find insignificant breaks in favor of Kenya over Tanzania, and Zambia over Malawi (not reported). Despite these breaks, controlling for education does not do away with the discontinuity in polygamy in any of the four cases, and has only a modest effect on the magnitudes (not reported).

3.6. **Child mortality.**

3.6.1. *Hypothesis.* Hypothetically, a man's completed fertility is limited only by his number of wives, each of whom can only give birth a certain number of times in her lifetime. If polygamy is a mechanism for men to increase their fertility (e.g. Iliffe (1995); Tertilt (2005)) a reduction in the probability that any one child will die reduces number of wives needed to achieve a target level of surviving children. Though this effect is offset by the fact that each wife is now more effective at producing children, the net effect can be observed by testing responses to changes in the environment for child mortality.

3.6.2. *Tests.* To test this hypothesis, I use OLS and IV to estimate:

$$\textit{polygamy}_i = \beta \textit{Child mortality before marriage}_i + x_i'\gamma + \delta_j + \eta_t + \epsilon_i$$

Polygamy and the set of controls are as in section 2.1, except that I now include country (δ_j) and year (η_t) fixed effects in x_i. I use two measures of *Child mortality before marriage* – under-5 country-level child mortality in the year a woman is married, and country-level child mortality averaged over her early adolescence, i.e. the years she is aged 12 to 16. Standard errors are clustered by country $\times$ year of marriage in the first specification, and country $\times$ year of birth in the second. This is the same specification

used to assess the role of economic growth. I have also implemented similar tests for rising life expectancy and urbanization, but I have found no impact of either conditional on year fixed effects. Polygamy is less prevalent in urban, long-surviving countries, but it is not falling faster in countries that are urbanizing more rapidly, or in which life expectancy is rising most quickly.

For the same reasons as with GDP per capita, I also reshape the data into an artificial panel. Each woman is observed between the ages of 12 and 25, and exits on marriage or on turning 26. I estimate the same equation as above, except that the dependent variable is now an indicator for having married polygamously in a given year. I include fixed effects for age, country, and year, excluding other controls. Standard errors are now clustered by country × year.

There exists, however, a literature suggesting that polygamy may cause greater child mortality (Strassmann, 1997). Similarly, if polygamy became more costly, men might respond by investing more in the survival of their children. The reverse causation that would explain the results, however, is more subtle than this, since child mortality is measured at the time these women are married, and so this will usually precede their fertility. To test for a causal relationship, I instrument for country-level child mortality using the country-level DPT vaccination rates, both in the panel and cross section.

I also replicate a natural experiment from Uganda. In 1960, a joint program between the WHO and the Government of Uganda eradicated malaria in the country's Kigezi region. Following Barofsky et al. (2011), I estimate the effect of this program with the regression:

$$\textit{polygamy}_i = \beta \textit{Post}_i \times \textit{Kigezi}_i + \alpha \textit{Kigezi}_i + \lambda \textit{Post}_i + x_i'\gamma + \delta_j + \eta_t + \epsilon_i$$

Here, $\textit{Post}_i$ measures whether the respondent was born in 1960 or later, $\textit{Kigezi}_i$ is a dummy for the treated region, x_i is as above, δ_j is a district fixed effect, and η_t is a year-of-birth fixed effect. Standard errors are clustered by district. There are two difficulties with this approach. First, none of the women in the sample are old enough for treatment to be measured relative to their year of marriage, rather than their year of birth. Second, malaria may have had other effects over and above a reduction in the mortality of a woman's potential children; Barofsky et al. (2011), for example, use the experiment to test for educational effects. This results can only provide indirect support of the effect of a reduction in child mortality.

3.6.3. *Data.* The only new data introduced here cover child mortality and DPT vaccination rates. Both are taken from the World Development Indicators. Because child mortality is only reported every five years, it is interpolated linearly for the other years. For Uganda, "Kigezi" is a dummy for whether the respondent's survey cluster is in one of the four present-day districts of Kabale, Kanungu, Kisoro or Rukungiri. In addition to the DHS sample, I also use the 1991 Ugandan census, available through IPUMS. Because a woman's polygamous status is not directly reported in these data, I limit my sample to

TABLE 9. Child mortality and polygamy

[Table 9 here]

wives of household heads in these data, and record them as polygamous if the household head is listed as a polygamist. In these data, I follow Barofsky et al. (2011) by also including indicators for religion, urban status, and ethnicity.

3.6.4. *Results.* The results, given in Table 9, are strong. In both cross-sectional approaches and in the IV, excepting the final result in the artificial panel, the elasticity of polygamy with respect to child mortality is sizable. This is robust to the inclusion of region-round and cluster-round fixed effects in both cross-sectional approaches (not reported), for which the magnitudes are similar. The decline in child mortality in Africa since the 1960s has been large in magnitude. Women in the sample have seen child mortality at their age in marriage fall on average 2 percentage points each decade, while polygamy has fallen at roughly 6 percentage points a decade. At an elasticity of 0.7 (one of the conservative estimates), declining child mortality explains roughly one fifth of the decline in polygamy. Critically, the addition of year and country fixed effects shows that polygamy is declining most rapidly where child mortality is falling fastest, a fact that is not true for either life expectancy or urbanization.

The results for Uganda are not as robust. The DHS data suggest that women born after the malaria eradication program were roughly 5 to 8 percentage points less likely to marry polygamously than those born in other parts of Uganda, relative to women born in these areas before the treatment. The IPUMS data, however, give more modest effects, less than 1 percentage point. The significance of these results, however, is sensitive to the clustering used and controls added. Using the IPUMS data tests based on a woman's exposure during her prime marriage years rather than at birth. These data support the view that child mortality matters, but malaria eradication might have reduced polygamy through several channels, and so they are not dispositive.

3.7. **Summary.** Beneficial economic shocks and peace both erode polygamy, while the evidence for economic growth is weak. By contrast, female education in the present does not seem to matter, at least not in the short run. I fail to find any positive effect of two natural experiments in school provision on polygamy rates, gains in schooling have not been sufficient for the raw correlations to explain much of the decline in polygamy, and discontinuities in female education cannot explain the discontinuously high rates of polygamy in the Ivory Coast, Kenya, and Malawi relative to their neighbors. Despite this, years of schooling is strongly correlated with polygamy, while colonial teachers and Catholic missions both predict lower polygamy rates. Generally, national policies do not appear to have had an impact on polygamy which, with the above exceptions, does not differ across national borders. Child mortality, by contrast, can explain a fifth of the decline in recent decades.

4. Conclusion

I have tested three influential theories about the existence of polygamy, and none have passed cleanly. Polygamy rates in the present are more related to inequality and female education in the past than they are to these variables today. The relative distribution of polygamy in Africa cannot be explained by the traditional gender division of labor. The slave trade remains a plausible explanation of the high prevalence of slavery in West Africa, and this result survives the inclusion of Angola. However, the slave trade cannot explain the relative distribution of polygamy within West Africa, and is indistinguishable from the simple fact that polygamy rates decline smoothly moving West to East.

The widespread decline in African polygamy since independence has continued mostly unhindered by the fits and starts of economic growth. Economic shocks and violence in a woman's prime years of marriage increase the probability she will marry polygamously, but the magnitudes of these effects are small. The decline has passed smoothly over national laws and most national borders. The education of women in Africa has also advanced in Africa in recent decades, often independent of economic growth. I do not find any evidence, however, that post-independence natural experiments in schooling have had any measurable effect on polygamy. The magnitudes even in the non-experimental data are not plausible: the educational attainment of women in Africa has been proceeding too slowly. Countries that have lagged in female schooling, such as Guinea or the DRC, have seen remarkable declines in polygamy. By contrast, schooling in the past that appears to have had a noticeable effect. Polygamy has fallen within both rural and urban areas, for women who self-declare as "Muslim" or as "Traditional", and among those who cannot read. Declining child mortality appears to have played a substantial role, but still leaves the bulk of the decline unexplained. Existing theories cannot explain the bulk of the decline of African polygamy, nor can most of the causal links uncovered here.

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Appendix A. Data appendix

A.1. **Principal DHS data.** The principal data source for this study is the Demographic and Health Survey (DHS) data, downloaded from `http://www.measuredhs.com/`. The main data are the "individual recodes, " which are data on a nationally representative sample of married women between the ages of 15 and 64 for each country.

I use 90 of these datasets for the analysis:

BFIR21FL, BFIR31FL, BFIR43FL, BJIR31FL, BJIR41FL, BJIR51FL, BUIR01FL, CFIR31FL, CGIR51FL, CIIR35FL, CIIR3AFL, CIIR50FL, CMIR22FL, CMIR31FL, CMIR44FL, ETIR41FL, ETIR51FL, GAIR41FL, GHIR02FL, GHIR31FL, GHIR41FL, GHIR4AFL, GHIR5HFL, GNIR41FL, KEIR03FL, KEIR33FL, KEIR3AFL, KEIR41FL, KEIR51FL, KMIR32FL, LBIR01FL, LBIR51FL, MDIR21FL, MDIR31FL, MDIR41FL, MDIR51FL, MLIR01FL, MLIR32FL, MLIR41FL, MLIR52FL, MWIR22FL, MWIR41FL, MWIR4CFL, MZIR31FL, MZIR41FL, MZIR51FL, NGIR21FL, NGIR41FL, NGIR4BFL, NGIR51FL, NIIR22FL, NIIR31FL, NIIR51FL, NMIR21FL, NMIR41FL, OSIR01FL, RWIR21FL, RWIR41FL, RWIR53FL, SDIR02FL, SLIR51FL, SNIR02FL, SNIR21FL, SNIR32FL, SNIR4HFL, TDIR31FL, TDIR41FL, TGIR01FL, TGIR31FL, TZIR21FL, TZIR3AFL, TZIR4IFL, TZIR51FL, UGIR01FL, UGIR33FL, UGIR41FL, UGIR51FL, ZAIR31FL, ZMIR21FL, ZMIR31FL, ZMIR42FL, ZMIR51FL, ZWIR31FL, ZWIR42FL, ZWIR51FL, cdir50fl, gnir52fl, nmir51fl, szir51fl, and tzir4afl.

These include data from 34 countries:

Benin, Burkina Faso, Burundi, CAR, Cameroon, Chad, Comoros, Congo-Brazzaville, DRC, Ethiopia, Gabon, Ghana, Guinea, Ivory Coast, Kenya, Liberia, Madagascar, Malawi, Mali, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, South Africa, Sudan, Swaziland, Tanzania, Togo, Uganda, Zambia, and Zimbabwe.

The data include 494,157 observations for which data on polygamy are non-missing. Of these observations, latitude/longitude coordinates are available for 308,667 in separate files similarly downloaded from the DHS website. These coordinates are used to join the data to the other variables listed below. Variables used from the DHS data are:

Respondent's year of birth is the difference between the survey year (v007) and the respondent's age (v012). The survey year required cleaning: adding 1900 if it was less than 100, recoding 1900 as 2000, 1901 as 2001, 1992 as 2000 for Ethiopia, and 1997 as 2000 for Ethiopia.

Urban is an indicator for whether v025 is "urban." If v025 was not asked, v102 was used.

Polygamous is an indicator for whether v505 is greater than 0 if v505 is not missing and is not 98.

Wealth index is variable v191. To compute the gini coefficient, I re-scaled the index to be everywhere positive by adding the minimum to all observations (a uniform rightward shift). Gini coefficients were computed using the *fastgini* command in Stata.

Respondent's partner's occupation is variable v705.

Years of schooling is variable v133.

Ethnicity is variable v131. This was matched to the ethnic groups in the *Ethnographic Atlas* with the help of alternative names on www.ethnologue.com

Religion is variable v130.

A.2. **Supplementary DHS data.** I use additional DHS data to assess the impact of the slave trade. The data here are the "household recodes, " which are household rosters associated with each of the surveys. In particular, I use 92 of these datasets for the analysis:

BFHR21FL, BFHR31FL, BFHR43FL, BJHR41FL, BJHR51FL, cdhr50FL, CFHR31FL, CGHR51FL, CGHR5HFL, CIHR35FL, CIHR50FL, CMHR22FL, CMHR31FL,CMHR44FL, ETHR41FL, ETHR51FL, GAHR41FL, GHHR31FL, GHHR41FL, GHHR5HFL, GNHR41FL, gnhr52FL, KEHR33FL, KEHR3AFL,KEHR41FL, KEHR51FL, KMHR32FL, LBHR5HFL, LSHR41FL, LSHR60FL, MDHR21FL, MDHR31FL, MDHR41FL, MDHR51FL, MLHR32FL,MLHR41FL, MLHR52FL, MLHR60FL, MWHR22FL, MWHR41FL, MWHR4CFL, MZHR31FL, MZHR41FL, MZHR51FL, NGHR21FL, NGHR41FL, NGHR4BFL,NGHR51FL, NIHR22FL, NIHR31FL, NIHR51FL, NMHR21FL, NMHR41FL, nmhr51FL, RWHR21FL, RWHR41FL, RWHR53FL, RWHR5AFL,SLHR51FL, SNHR21FL, SNHR32FL, SNHR4HFL, SNHR50FL, SNHR5HFL, STHR50FL, szhr51FL, TDHR31FL, TDHR41FL, TGHR31FL, TZHR21FL, TZHR3AFL, TZHR41FL, tzhr4aFL, TZHR4IFL, TZHR51FL, TZHR60FL, UGHR33FL, UGHR41FL, UGHR51FL, UGHR5HFL, ZAHR31FL, ZMHR21FL, ZMHR31FL, ZMHR42FL, ZMHR51FL, ZWHR31FL, ZWHR42FL, ZWHR51FL, BJHR31FL, CIHR3AFL, GHHR41FL, and LBHR51FL.

From these, I use the variables $hv101_1$ through $hv101_95$ to measure polygamy. I create an indicator for polygamy if the household has more than one member listed as a spouse of the household head, for the sub-sample of households in which there is at least one spouse.

A.3. **FAO-GAEZ data.** All of these data are downloaded from http://www.iiasa.ac.at/Research/LUC/GAEZ/index.htm. The variables that I create are.

Suitability for wheat, maize, cereals, roots/tubers, pulses, sugar, oil, and cotton are average suitability for the chosen rain-fed crop, according to plates 29 through 36 of the FAO's GAEZ project. This is re-scaled so that larger values indicate greater suitability, and is (like the other controls) converted to a standard normal variable for the regressions.

Suitability for rain-fed agriculture is plate 46 from the FAO GAEZ data, and measures the suitability for rain-fed agriculture of any type. *Constraints on rain-fed agriculture* is

plate 28 from the FAO GAEZ data, and measures the sum of soil terrain, slope, and climate constraints on rain-fed agriculture. *Ecological zone dummies* are computed from plate 55 of the FAO GAEZ data.

A.4. **Other geographic controls.** *Elevation* is average elevation for the ethnic group. Raster data are provided by the NACIS, downloaded from `http://www.naturalearthdata.com/`.

Ruggedness is a measure of terrain ruggedness used by Nunn and Puga (2011). This measures the elevation distance between a raster cell and its neighbors at a fine level. The data are downloaded from `http://diegopuga.org/data/`.

Malaria is suitability for malaria, according to the Malaria Atlas Project, downloaded from `http://www.map.ox.ac.uk/data/`.

Historic trade routes are those existing in 600 AD, according to Brice and Kennedy (2001). I measure distance from these in thousands of kilometers.

Historic population density is made available by the UNEP, at `http://na.unep.net/siouxfalls/datasets/datalist.php`. This is measured per square kilometer.

Cluster-level rainfall shocks are made available by the University of Delaware for the period 1950-1999, at `http://climate.geog.udel.edu/~climate/html_pages/archive.html`.

Country-level rainfall shocks are the average of all FAO estimates for grid points within a country in a given year, computed by Miguel et al. (2004). These are made available on Edward Miguel's website, at `http://elsa.berkeley.edu/~emiguel/data.shtml`.

Country borders are downloaded from `http://www.diva-gis.org/`.

Cluster-level battle deaths are computed from two data sets, described in considerable detail by Michalopoulos and Papaioannou (2011b). These are all downloaded from `http://www.prio.no/CSCW/Datasets/Armed-Conflict/`. The first, ConflictSite 4 2006 v2, contains latitude and longitude coordinates and a radius of conflict (in km, divisible by 50) for all of the wars in the data. Four African wars were missing these, and so I manually coded them as: Uganda/Tanzania (-1,31.5,150), the Kivu Conflict (-2.5,28,150), the Tuareg Rebelion (18,6,150) and the Djibouti-Eritrea Border Conflict (12.71,43,13,50). The second data set, PRIO bd 3.0, contains high, low, and "best" estimates of the number of battle deaths. Where these were missing for the intermediate years of a specific conflict, I imputed missing values using lags. Where no best estimate was available, I used the midpoint between the high and low estimates.

Slave trade exposure is computed using the "Murdock ethnic groups" shapefile made available by Nathan Nunn at `http://www.economics.harvard.edu/faculty/nunn/data_nunn`. This data source contains his estimates for ethnicity-level slave exports, as well as a map of these ethnic groups and the area of each ethnic group's territory.

Distance to Protestant/Catholic mission is computed using the mission locations and affiliations recorded by Roome (1924).

Distance from the nearest new world slave port is the minimum distance to Virginia, Havana, Haiti, Kingston, Dominica, Martinique, Guyana, Salvador, or Rio.

A.5. **Ethnographic.** This can be downloaded from `http://eclectic.ss.uci.edu/drwhite/worldcul/EthnographicAtlasWCRevisedByWorldCultures.sav`.

Historic class stratification is variable V66, if V66 is not zero or missing. The categories are: 1, absence among freemen, 2, wealth distinctions, 3, elite, 4, dual, and 5, complex.

Historic slavery is variable V70, if V70 is not zero or missing. The categories are 1, absence or near absence, 2, incipient or nonhereditary, 3, reported but type not identified, and 4, hereditary and socially significant.

Historic female agriculture is computed from V54, where I code "males only" as 1, "males appreciably more" as 2, "differentiated but equal participation" as 3, "equal participation" as 3, "female appreciably more" as 4, and "females only" as 5. This is missing if agriculture is absent or unimportant.

A.6. **Data taken from other papers.** Three measures of program intensity are taken directly from the text of Osili and Long (2008) – a dummy variable for a "high intensity" state, school-building funds in 1976 divided by the 1953 census population estimates, and school-building funds normalized by 1976 population projections based on the (unreliable) 1963 census.

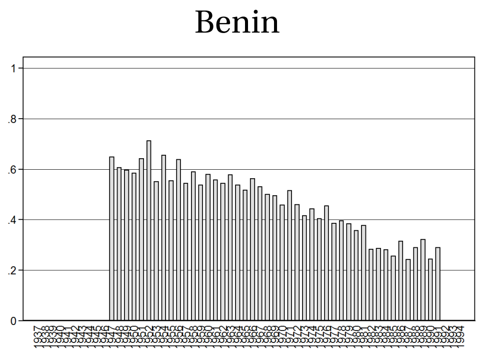
These variables used to replicate Huillery (2009) are downloaded from `http://econ.sciences-po.fr/elise-huillery`.

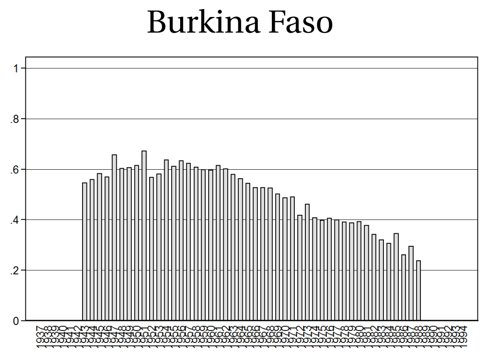
A.7. **Other variables.** *Log GDP per capita*: These data are taken from the World Development Indicators and are downloaded from `data.worldbank.org/data-catalog/world-development-indicators`.

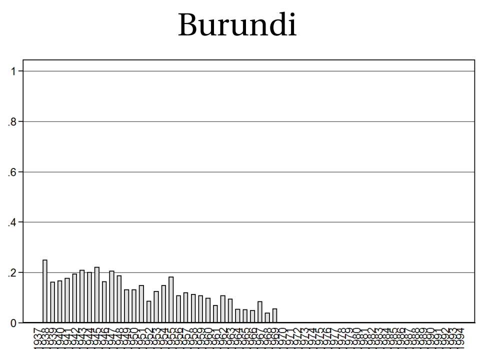
Under-5 child mortality: These data are taken from the World Development Indicators.

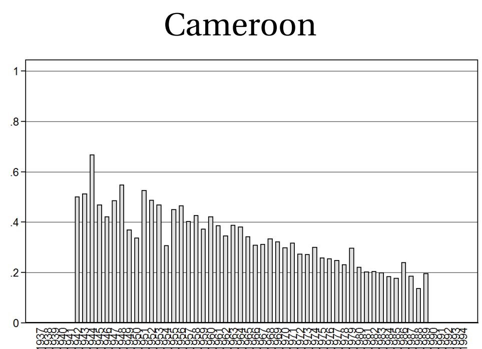
DPT vaccination rates: These data are taken from the World Development Indicators.

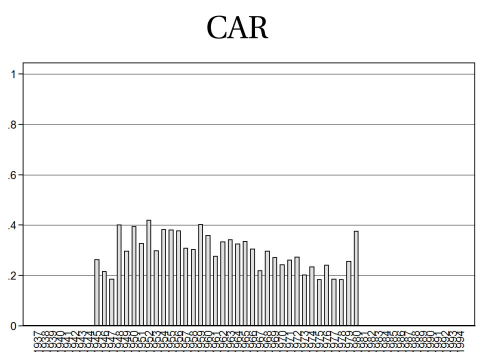
APPENDIX B. POLYGAMY RATES OVER TIME

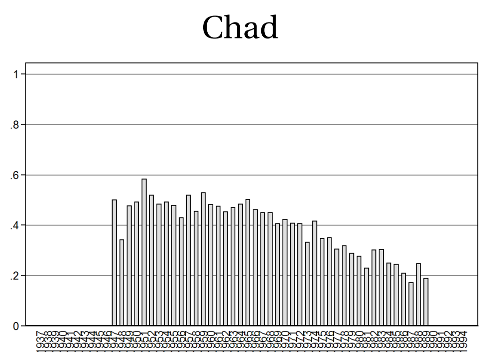


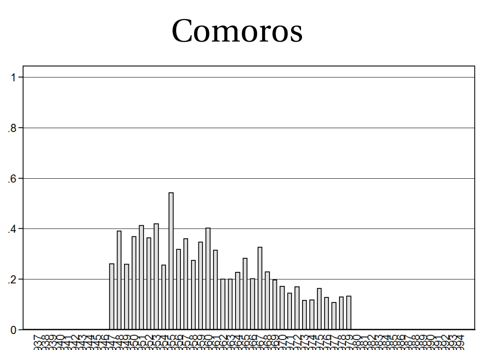


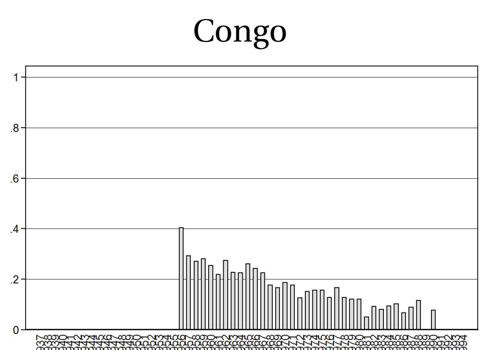












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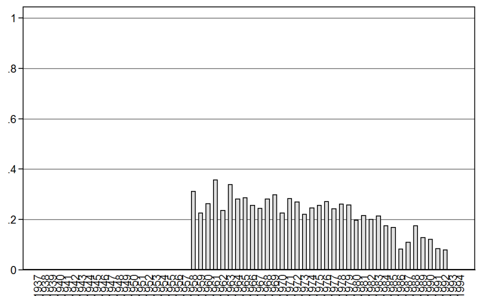

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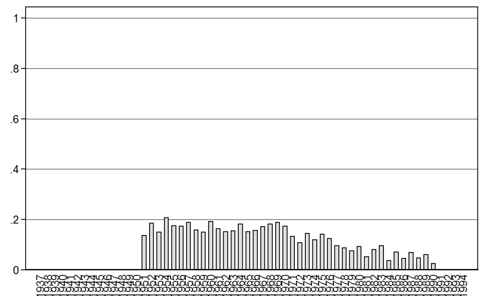

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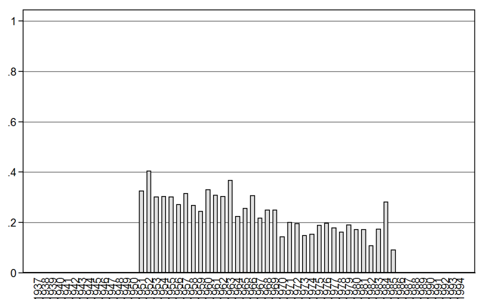

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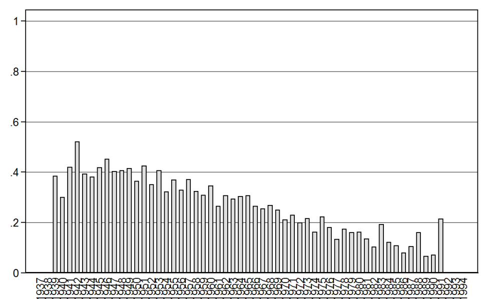

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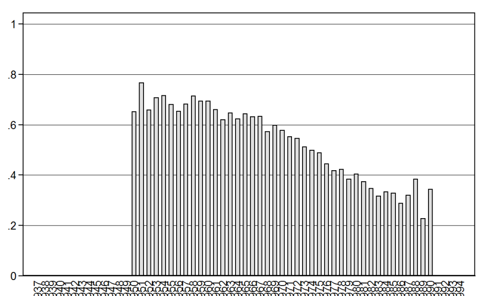

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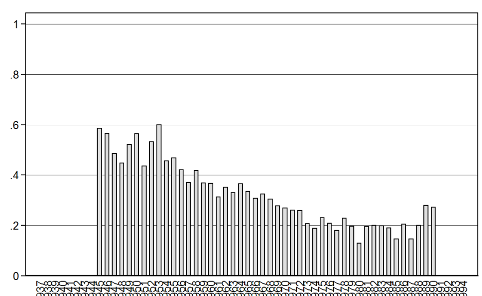

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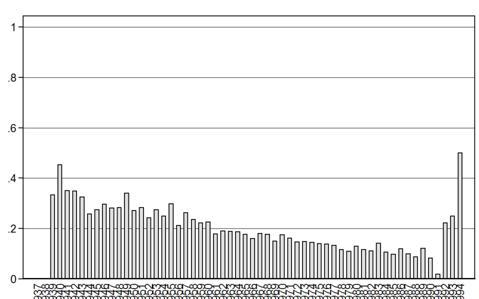

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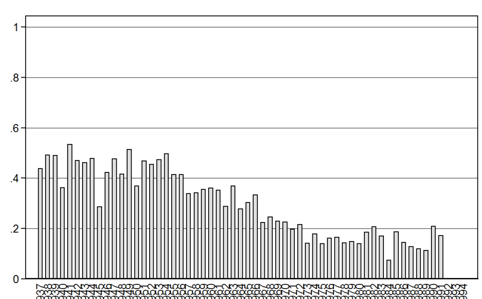

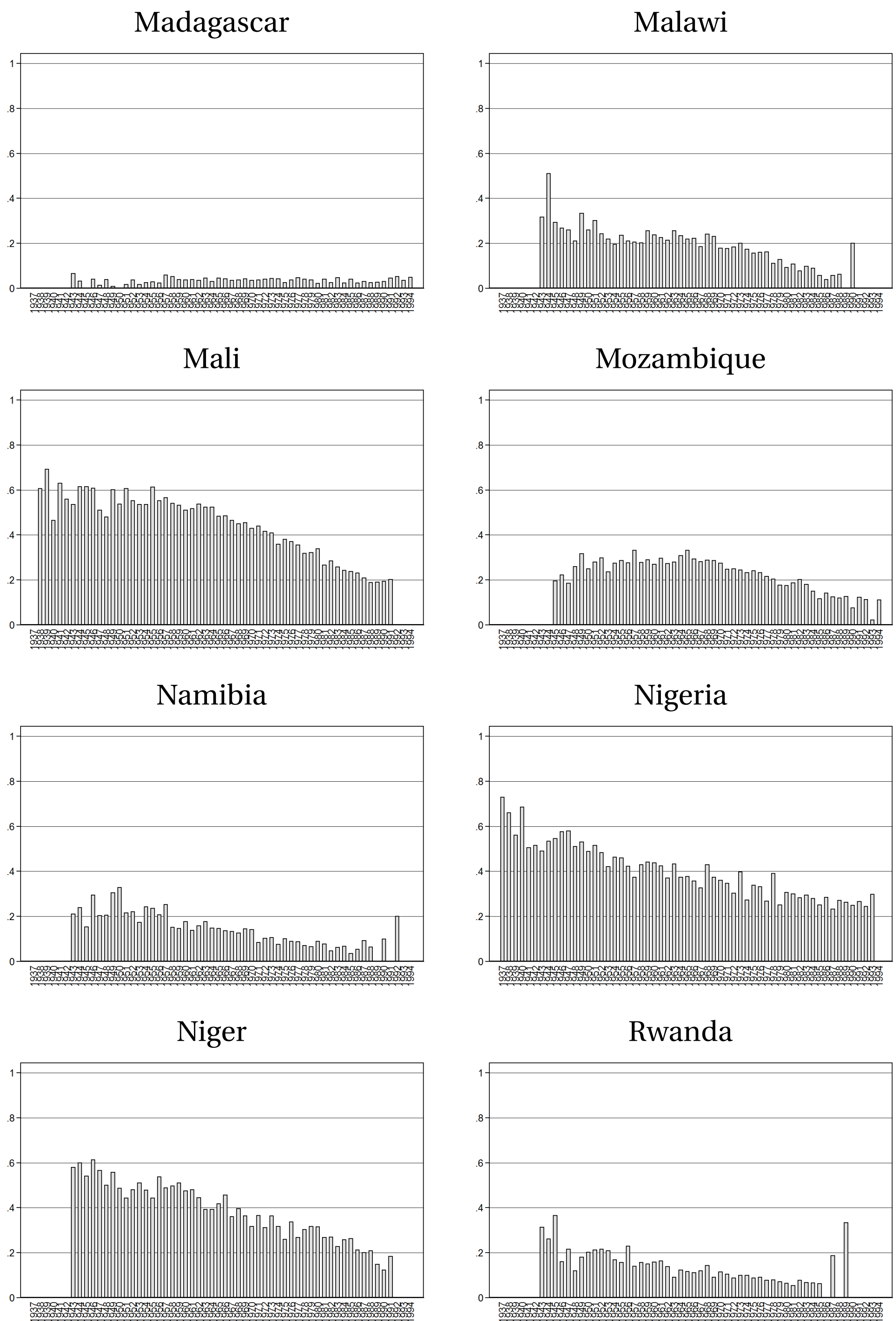
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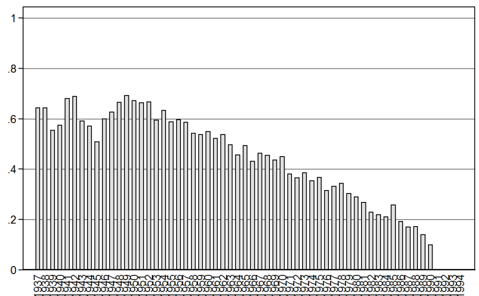
Nigeria
Niger
Rwanda

Senegal



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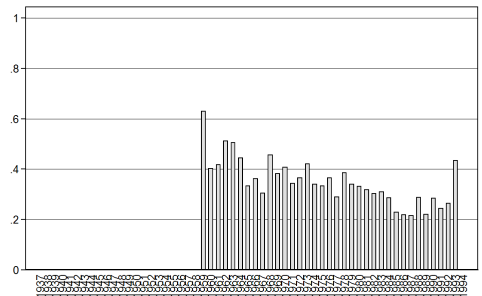

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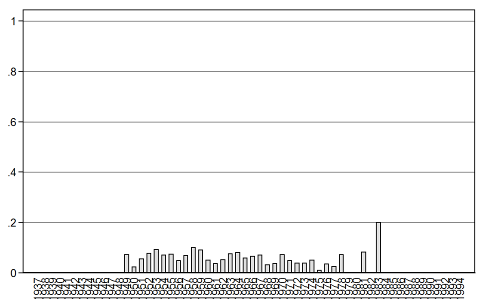

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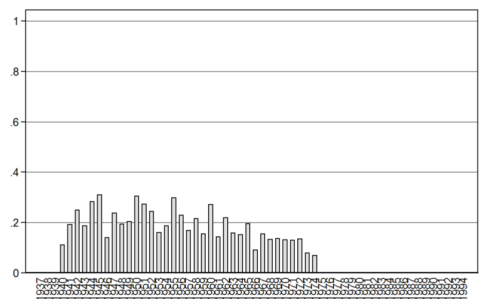

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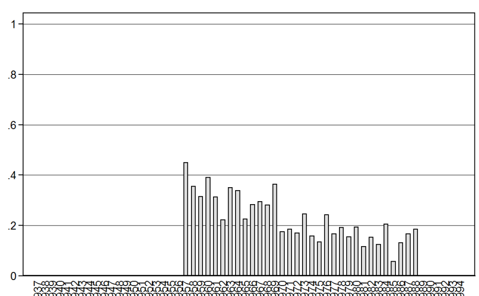

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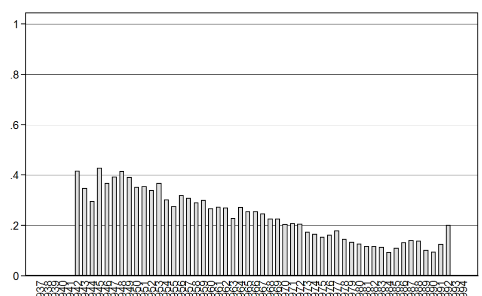

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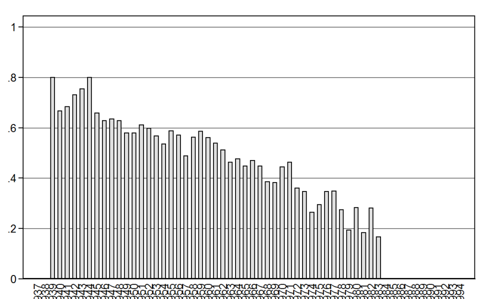
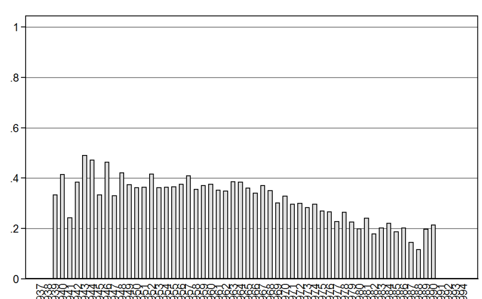
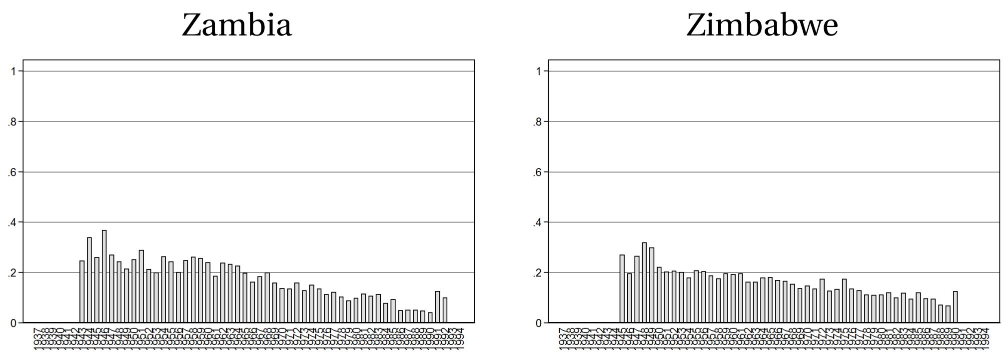


Uganda




Zambia
Zimbabwe
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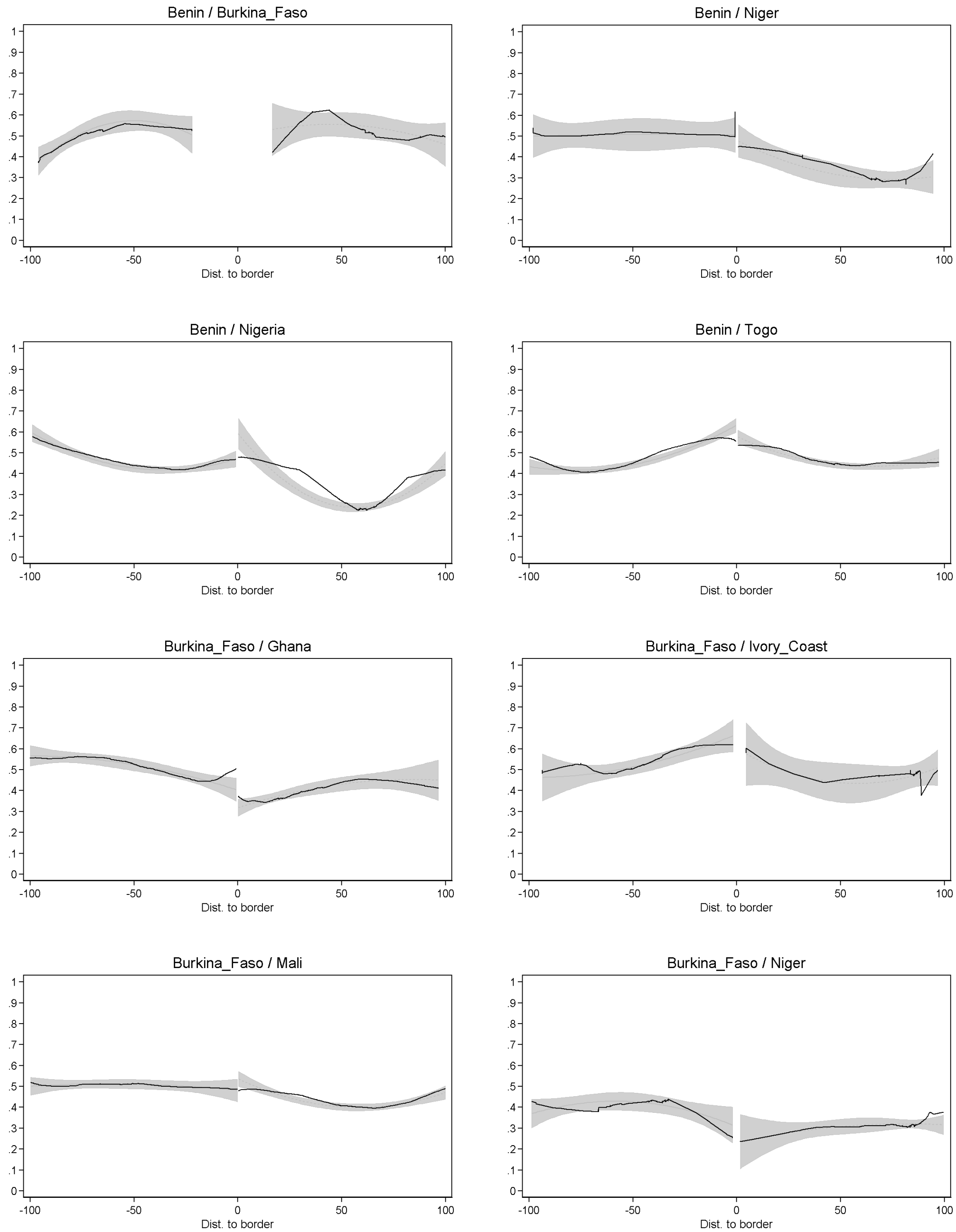
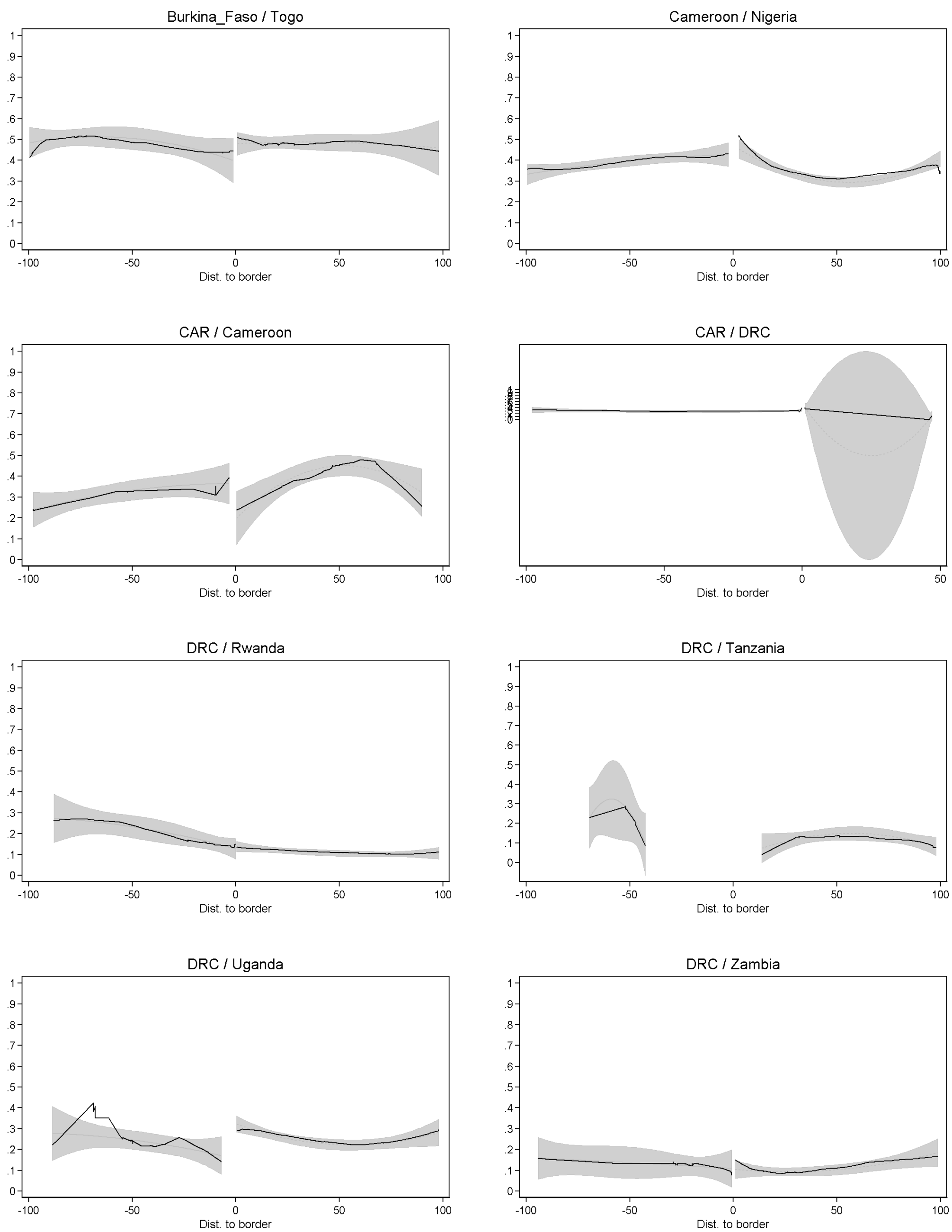
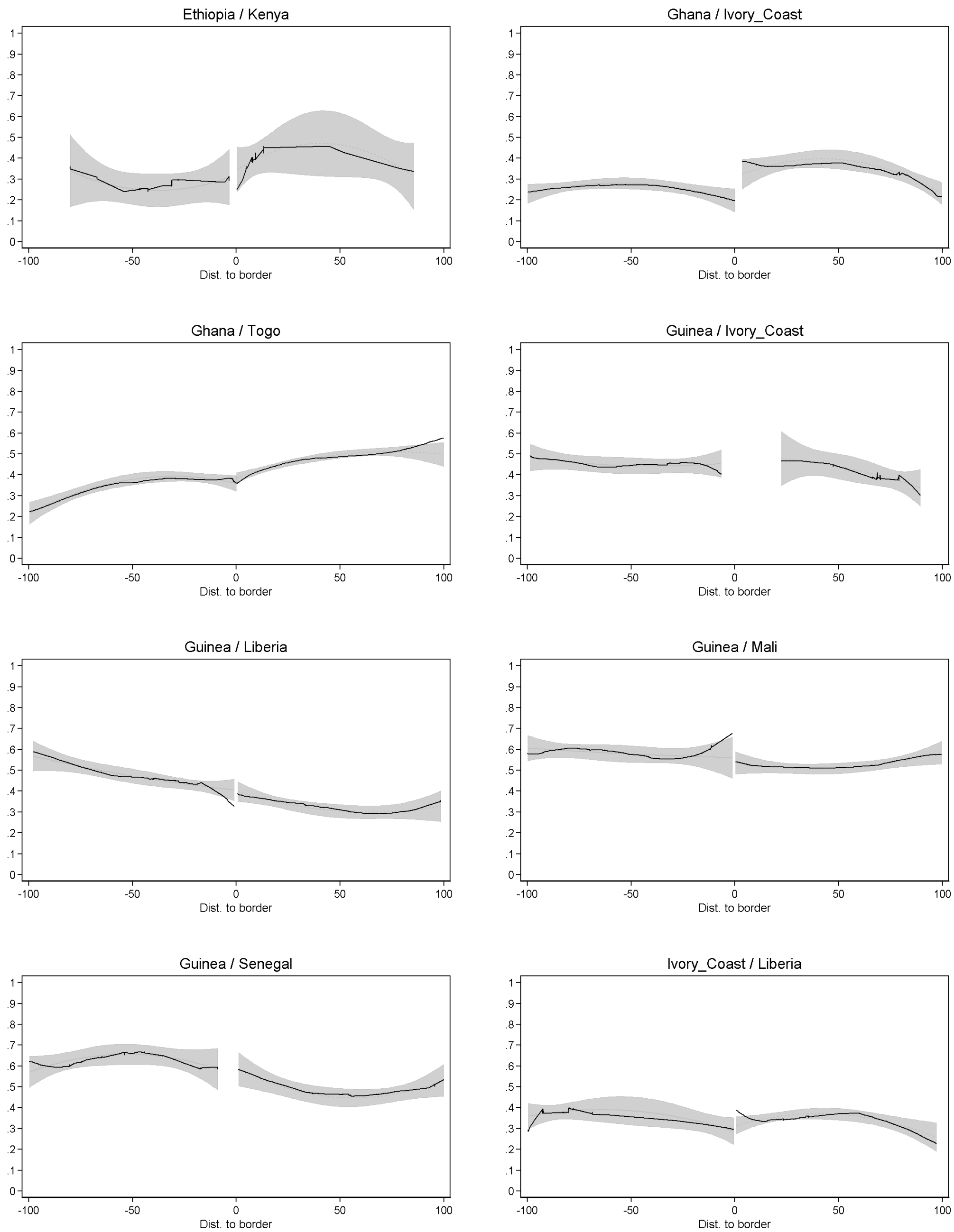
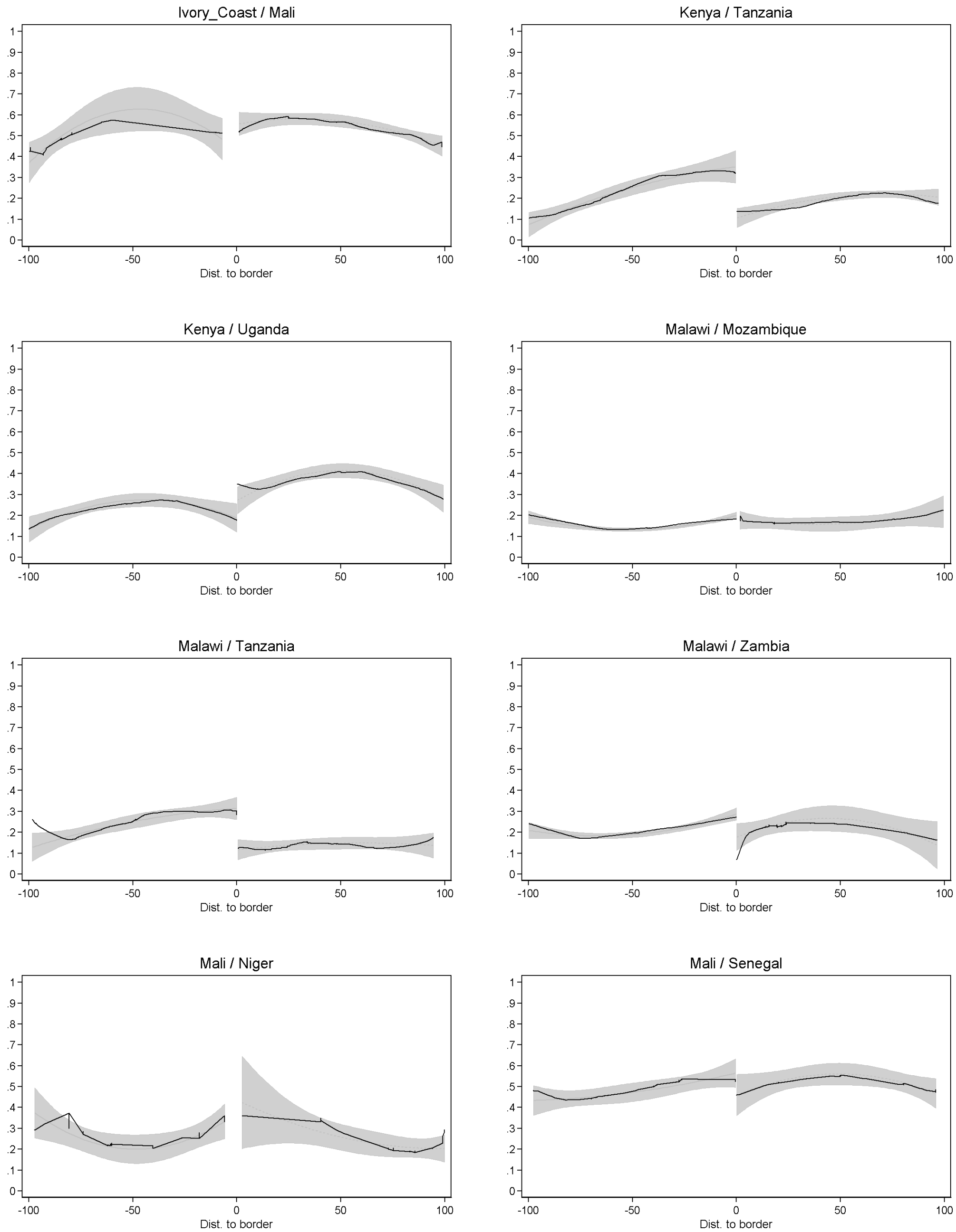
.8
.6
.4
.2
0

APPENDIX C. DISCONTINUITY RESULTS




Burkina_Faso / Togo
Cameroon / Nigeria
CAR / Cameroon
CAR / DRC
DRC / Rwanda
DRC / Tanzania
DRC / Uganda
DRC / Zambia
Dist. to border


Ethiopia / Kenya
Ghana / Ivory_Coast
Ghana / Togo
Guinea / Ivory_Coast
Guinea / Liberia
Guinea / Mali
Guinea / Senegal
Ivory_Coast / Liberia
Dist. to border
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
1
-100
-50
0
50
100


Ivory_Coast / Mali
Kenya / Tanzania
Kenya / Uganda
Malawi / Mozambique
Malawi / Tanzania
Malawi / Zambia
Mali / Niger
Mali / Senegal
Dist. to border
0
.1
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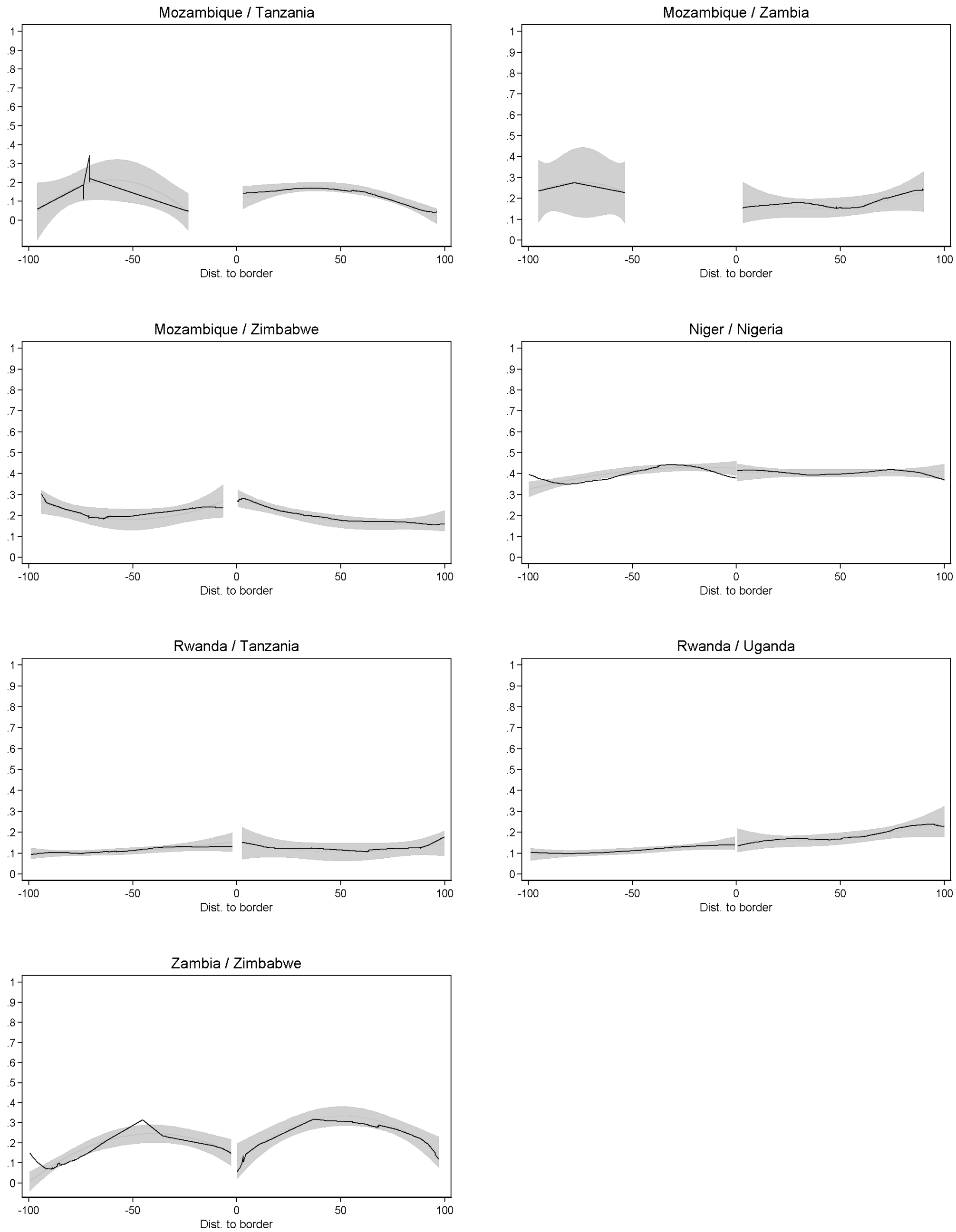
.3
.4
.5
.6
.7
.8
.9
1
-100
-50
0
50
100


Mozambique / Tanzania
Dist. to border
Mozambique / Zambia
Dist. to border
Mozambique / Zimbabwe
Dist. to border
Niger / Nigeria
Dist. to border
Rwanda / Tanzania
Dist. to border
Rwanda / Uganda
Dist. to border
Zambia / Zimbabwe
Dist. to border

Inequality and polygamy

	Dependent variable: Polygamous							
Cluster c.v. of wealth index	0.000***	0.000						
	(0.000)	(0.000)						
Region c.v. of wealth index			-0.000	0.000				
			(0.000)	(0.000)				
Cluster gini of wealth index					-0.436***	-0.035		
					(0.043)	(0.052)		
Region gini of wealth index							-0.009	0.188
							(0.151)	(0.142)
Estimator	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS
Observations	241,709	172,467	240,656	171,461	241,730	172,482	240,656	171,461
R-squared	0.090	0.144	0.090	0.144	0.091	0.144	0.090	0.144
Other cont.	None	Geo./Ind.	None	Geo./Ind.	None	Geo./Ind.	None	Geo./Ind.
F.E.	Cntry-rnd	Cntry-rnd	Cntry-rnd	Cntry-rnd	Cntry-rnd	Cntry-rnd	Cntry-rnd	Cntry-rnd
Clustering	Cluster	Cluster	Region	Region	Cluster	Cluster	Region	Region
	Dependent variable: Polygamous							
Cluster high/low skill ratio	-0.018***	-0.011***						
	(0.002)	(0.002)						
Region high/low skill ratio			-0.041***	-0.023				
			(0.013)	(0.015)				
Estimator	OLS	OLS	OLS	OLS				
Observations	435,846	263,521	464,675	281,248				
R-squared	0.002	0.103	0.003	0.104				
Other cont.	None	Geo./Ind.	None	Geo./Ind.				
F.E.	None	None	None	None				
Clustering	Cluster	Cluster	Region	Region				
	Dependent variable: Polygamous							
Historic class stratification	0.031***	0.029***						
	(0.012)	(0.009)						
Historic slavery			0.078**	0.086***				
			(0.035)	(0.025)				
Dist. to historic trade routes					-0.200***	-0.161***		
					(0.003)	(0.004)		
Estimator	OLS	OLS	OLS	OLS	OLS	OLS		
Observations	219,474	148,239	219,474	148,239	308,584	305,051		
R-squared	0.008	0.102	0.005	0.101	0.044	0.114		
Other cont.	None	Geo./Ind.	None	Geo./Ind.	None	Geo./Ind.		
F.E.	None	None	None	None	None	None		
Clustering	E.A. Ethnic.	E.A. Ethnic.	E.A. Ethnic.	E.A. Ethnic.	Cluster	Cluster		
	Dependent variable: Polygamous							
Log wheat sugar ratio	-0.116***	-0.117***						
	(0.002)	(0.009)						
Region c.v. of ag. constraints.			0.490***	0.188***				
			(0.105)	(0.071)				
Estimator								
Observations	305,051	305,051	314,247	305,051				
R-squared	0.031	0.102	0.005	0.101				
Other cont.	None	Geo./Ind.	None	Geo./Ind.				
F.E.	None	None	None	None				
Clustering	Cluster	Cluster	Region	Region				

Notes: *** Significant at 1%, ** Significant at 5%, * Significant at 10%. Geographic controls are absolute latitude, suitability for wheat, maize, cereals, oil crops, roots/tubers, pulses, sugar, cotton, and rain-fed agriculture, malaria suitability, ruggedness, elevation, distance to coast, and ecological zone, unless coefficients on these are reported. Individual controls are year of birth, year of birth squared, and urban.

Female productivity and polygamy

	Dependent variable: Polygamous					
Rainfed ag. suit.	0.017***	-0.005***				
	(0.001)	(0.002)				
Ag. constraints			-0.010***	-0.003*		
			(0.002)	(0.002)		
Wheat suit.					-0.069***	-0.037***
					(0.002)	(0.002)
Maize suit.					0.003	-0.001
					(0.002)	(0.002)
Cereals suit.					0.022***	0.011***
					(0.002)	(0.002)
Roots and tubers suit.					-0.003*	-0.017***
					(0.002)	(0.002)
Pulses suit.					-0.009***	0.006**
					(0.003)	(0.002)
Sugar suit.					0.016***	0.012***
					(0.002)	(0.002)
Oil suit.					-0.030***	-0.028***
					(0.002)	(0.002)
Cotton suit.					0.004*	0.008***
					(0.002)	(0.002)
Estimator	OLS	OLS	OLS	OLS	OLS	OLS
Observations	306,235	305,051	308,584	305,051	305051	305051
R-squared	0.006	0.100	0.001	0.100	0.039	0.100
Other cont.	None	Geo./Ind.	None	Geo./Ind.	None	Geo./Ind.
F.E.	None	None	None	None	None	None
Clustering	Cluster	Cluster	Cluster	Cluster	Cluster	Cluster

	Dependent variable: Polygamous				
Historic female agriculture	-0.091***	-0.064***	-0.141***	-0.263***	-0.201***
	(0.017)	(0.017)	(0.025)	(0.080)	(0.042)
Estimator	OLS	OLS	IV	IV	IV
Observations	207,757	139,499	139,499	139,503	139,499
R-squared	0.029	0.105	0.086	-0.076	0.058
Other cont.	None	Geo./Ind.	None	None	Geo./Ind.
F.E.	None	None	None	None	None
Clustering	E.A. Ethnic.	E.A. Ethnic.	E.A. Ethnic.	E.A. Ethnic.	E.A. Ethnic.
F test			13.19	14.13	15.42
Hansen p			0.0359		
Excluded instrument(s)			All crops	Wheat Suit.	Wheat Suit.

Notes: *** Significant at 1%, ** Significant at 5%, * Significant at 10%. Geographic controls are absolute latitude, suitability for wheat, maize, cereals, oil crops, roots/tubers, pulses, sugar, cotton, and rain-fed agriculture, malaria suitability, ruggedness, elevation, distance to coast, and ecological zone, unless coefficients on these are reported. Individual controls are year of birth, year of birth squared, and urban.

The slave trade and polygamy

	Dependent variable: Polygamous						
	Individual recode					*Household recode*	
ln(1+Atlantic slaves/Area), by location	0.042***	0.026**	0.006			0.028**	0.013
	(0.016)	(0.011)	(0.010)			(0.014)	(0.009)
ln(1+Atlantic slaves/Area), by name				0.022	0.005		
				(0.014)	(0.009)		
Estimator	OLS	OLS	OLS	OLS	OLS	OLS	OLS
Observations	304,328	300,795	300,795	195,453	129,529	259,506	257,130
R-squared	0.005	0.101	0.123	0.003	0.104	0.005	0.084
Other cont.	None	Geo./Ind.	Longitude	None	Geo./Ind.	None	Geo.
F.E.	None	None	None	None	None	None	None
Clustering	Ethnicity (by loc.)	Ethnicity (by loc.)	Ethnicity (by loc.)	Ethnicity (by name)	Ethnicity (by name)	Ethnicity (by loc.)	Ethnicity (by loc.)
	Dependent variable: Polygamous						
	Individual recode					*Household recode*	
ln(1+Atlantic slaves/Area), by location	0.443***	0.461***	-0.258			0.285***	0.245***
	(0.111)	(0.129)	(0.170)			(0.062)	(0.057)
ln(1+Atlantic slaves/Area), by name				0.290***	2.981		
				(0.087)	(9.826)		
Estimator	IV	IV	IV	IV	IV	IV	IV
Observations	304,328	300,795	304,328	195,453	129,529	259,506	257,130
R-squared	-0.481	-0.344	-0.095	-0.391	-26.112	-0.371	-0.138
Other cont.	None	Geo./Ind.	Longitude	None	Geo./Ind.	None	Geo.
F.E.	None	None	None	None	None	None	None
Clustering	Ethnicity (by loc.)	Ethnicity (by loc.)	Ethnicity (by loc.)	Ethnicity (by name)	Ethnicity (by name)	Ethnicity (by name)	Ethnicity (by name)
F test	18.60	15.16	2.452	12.67	0.0907	29.33	33.58
Excluded instrument(s)	ST distance	ST distance	ST distance	ST distance	ST distance	ST distance	ST distance

Notes: *** Significant at 1%, ** Significant at 5%, * Significant at 10%. Geographic controls include Absolute latitude, suitability for wheat, maize, cereals, oil crops, roots/tubers, pulses, sugar, cotton, and rain-fed agriculture, malaria suitability, ruggedness, elevation, distance to coast, and ecological zone, unless coefficients on these are reported. Individual controls are year of birth, year of birth squared, and urban.

Female education and polygamy

	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent variable: Polygamous					
Resp. Education Years	-0.024***	-0.017***	-0.013***	-0.012***	-0.007***	
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	
Estimator	OLS	OLS	OLS	OLS	OLS	
Sample	All DHS	All DHS	All DHS	All DHS	All DHS	
Observations	493,829	304,869	304,869	304,869	493,829	
R-squared	0.047	0.118	0.151	0.167	0.243	
Other cont.	None	Geog./Indiv.	Geog./Indiv.	Geog./Indiv.	Indiv.	
F.E.	None	None	Cntry-rnd	Region	Cluster	
Clustering	Cluster	Cluster	Cluster	Cluster	Cluster	
	Dep. Var.: Years of education			*Dep. Var.: Polygamous*		
Born 1970-75 X Intensity	0.666*	0.009**	0.031	0.048*	0.000	-0.012
	(0.374)	(0.004)	(0.159)	(0.025)	(0.000)	(0.008)
Born 1970-75	-0.180	-0.327	0.415	-0.108***	-0.095**	-0.043
	(0.515)	(0.606)	(0.447)	(0.036)	(0.035)	(0.037)
Intensity	-2.611***	-0.009	0.628***	-0.004	0.000	-0.019***
	(0.831)	(0.005)	(0.171)	(0.054)	(0.000)	(0.006)
Estimator	OLS	OLS	OLS	OLS	OLS	OLS
Sample	Nigerian women born 1970-75 and 1956-61.					
Measure of intensity	High / low	Dollars / 1953 pop.	Dollars / 1976 pop.	High / low	Dollars / 1953 pop.	Dollars / 1976 pop.
Observations	9,660	9,660	9,660	9,668	9,668	9,668
R-squared	0.364	0.349	0.376	0.080	0.080	0.085
Other cont.	Osili/Long	Osili/Long	Osili/Long	Osili/Long	Osili/Long	Osili/Long
F.E.	None	None	None	None	None	None
Clustering	1976 State	1976 State	1976 State	1976 State	1976 State	1976 State
	Dep. Var.: Years of education			*Dep. Var.: Polygamous*		
14 or below in 1980	1.279***	0.876***		-0.008	-0.001	
	(0.200)	(0.250)		(0.020)	(0.025)	
Age in 1980	-0.226***	-0.301***		0.002	0.003	
	(0.032)	(0.051)		(0.003)	(0.005)	
(14-Age in 1980) X Below 14 in 1980	-0.141***	-0.125*		-0.002	-0.004	
	(0.039)	(0.076)		(0.004)	(0.008)	
Estimator	OLS	OLS		OLS	OLS	
Sample	Zimb. "Full"	Zimb. "Short"		Zimb. "Full"	Zimb. "Short"	
Ages in 1980	6 to 22	10 to 20		6 to 22	10 to 20	
Measure of intensity	High / low	Dollars / 1953		Dollars / 1976	High / low	
Observations	6,362	3,897		6,367	3,901	
R-squared	0.130	0.097		0.002	0.001	
Other cont.	No	No		No	No	
F.E.	None	None		None	None	
Clustering	Robust	Robust		Robust	Robust	
	Dependent variable: Polygamous					
Teachers/capita, 1910-1928	-6.749***	-5.678**	-10.676***	-8.770**	-4.749**	
	(1.179)	(2.271)	(2.665)	(4.288)	(2.138)	
Estimator	OLS	OLS	OLS	OLS	OLS	
Sample	French West Africa					
Observations	98,890	98,890	98,890	98,890	98,890	
R-squared	0.001	0.062	0.065	0.063	0.073	
Other cont.	None	None	None	None	None	
F.E.	None	Attractiveness	Conquest	Precolonial	H-Geographic	
Clustering	District 1925	District 1925	District 1925	District 1925	District 1925	

Notes: *** Significant at 1%, ** Significant at 5%, * Significant at 10%. (indicated by lists of excluded instruments). Geographic controls are absolute latitude, suitability for wheat, maize, cereals, oil crops, roots/tubers, pulses, sugar, cotton, and rain-fed agriculture, malaria suitability, ruggedness, elevation, distance to coast, and ecological zone, unless coefficients on these are reported. Individual controls are year of birth, year of birth squared, and urban. Osili/Long controls are year of birth, and dummies for the three largest Nigerian ethnic groups (Yoruba, Hausa, Igbo), and the major religions (Muslim, Catholic, Protestant, other Christian, and traditional). Attractiveness controls are trade taxes in 1914. Conquest controls are date of conquest, length of resistence and its square, and indemnities in 1910. Precolonial controls are the presence of an ancient state, the presence of a European trade counter, and 1925 population density. H-Geographic controls are latitude, longitude, altitude, dummies for the river and coast, and average rainfall from 1915 to 1975.

Missions and polygamy

	Dependent variable: Years of education							
Distance to Catholic mission	-5.623***	-4.142***	-1.849***	-3.013***				
	(0.101)	(0.104)	(0.152)	(0.251)				
Distance to Protestant mission					-7.152***	-5.280***	-1.426***	-2.599***
					(0.112)	(0.104)	(0.120)	(0.212)
Estimator	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS
Observations	308,397	304,869	304,869	304,869	308,397	304,869	304,869	304,869
R-squared	0.077	0.262	0.383	0.429	0.112	0.276	0.382	0.428
Other cont.	None	Geo./Ind.	Geo./Ind.	Ind.	None	Geo./Ind.	Geo./Ind.	Geo./Ind.
F.E.	None	None	Cntry-rnd	Region	None	None	Cntry-rnd	Region
Clustering	Cluster	Cluster	Cluster	Cluster	Cluster	Cluster	Cluster	Cluster
	Dependent variable: Polygamous							
Distance to Catholic mission	0.201***	0.122***	0.069***	0.171***				
	(0.009)	(0.009)	(0.014)	(0.027)				
Distance to Protestant mission					0.241***	0.113***	-0.043***	0.031
					(0.011)	(0.009)	(0.012)	(0.025)
Estimator	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS
Observations	308,584	305,051	305,051	305,051	308,584	305,051	305,051	305,051
R-squared	0.008	0.102	0.143	0.161	0.010	0.102	0.143	0.161
Other cont.	None	Geo./Ind.	Geo./Ind.	Geo./Ind.	None	Geo./Ind.	Geo./Ind.	Ind.
F.E.	None	None	Cntry-rnd	Region	None	None	Cntry-rnd	Region
Clustering	Cluster	Cluster	Cluster	Cluster	Cluster	Cluster	Cluster	Cluster

Notes: *** Significant at 1%, ** Significant at 5%, * Significant at 10%. Geographic controls are absolute latitude, suitability for wheat, maize, cereals, oil crops, roots/tubers, pulses, sugar, cotton, and rain-fed agriculture, malaria suitability, ruggedness, elevation, distance to coast, and ecological zone, unless coefficients on these are reported. Individual controls are year of birth, year of birth squared, and urban.

Economic growth and polygamy

	Dependent variable: Polygamous (Cross Section)			
Ln GDP per capita: Age of marriage	-0.022***	-0.016***	-0.187**	-0.813
	(0.005)	(0.005)	(0.079)	(0.779)
Estimator	OLS	OLS	IV	IV
Observations	448,195	280,146	330,864	198,486
R-squared	0.001	0.141	-0.061	-0.067
Other cont.	None	Geo./Ind.	Geo./Ind.	Geo./Ind.
FE	None	Y.O.M./Country	None	Y.O.M./Country
Clustering	Country x Y.O.M.	Country x Y.O.M.	Country x Y.O.M.	Country x Y.O.M.
F test			15.37	1.182
	Dependent variable: Polygamous (Cross Section)			
Ln GDP per capita: Ages 12-16	-0.020***	-0.007	-0.220***	1.414
	(0.006)	(0.005)	(0.059)	(2.469)
Estimator	OLS	OLS	IV	IV
Observations	422,763	267,487	328,062	201,092
R-squared	0.001	0.137	-0.089	-0.705
Other cont.	None	Geo./Ind.	None	Geo./Ind.
F.E.	None	Y.O.B./Country	None	Y.O.B./Country
Clustering	Country x Y.O.B.	Country x Y.O.B.	Country x Y.O.B.	Country x Y.O.B.
F test			31.49	0.352
	Dependent variable: Polygamous (Artificial panel)			
Ln GDP Per Capita	-0.007***	0.001**	-0.066***	-0.094
	(0.001)	(0.001)	(0.020)	(0.137)
Estimator	OLS	OLS	IV	IV
Observations	2,779,853	2,779,853	2,249,635	2,249,635
R-squared	0.001	0.028	-0.045	0.006
Other cont.	None	None	None	None
F.E.	Age/Year/Country	Age/Year/Country	Age/Year/Country	Age/Year/Country
Clustering	Country x Year	Country x Year	Country x Year	Country x Year
F test			12.63	0.521

Notes: *** Significant at 1%, ** Significant at 5%, * Significant at 10%. (indicated by lists of excluded instruments). Geographic controls are absolute latitude, suitability for wheat, maize, cereals, oil crops, roots/tubers, pulses, sugar, cotton, and rain-fed agriculture, malaria suitability, ruggedness, elevation, distance to coast, and ecological zone, unless coefficients on these are reported. Individual controls are year of birth, year of birth squared, and urban. The excluded instrument in all IV regressions is the country-level rainfall estimate reported by Miguel, Satyanath, and Sergenti, E. (2004).

Economic shocks and polygamy

	Dependent variable: Polygamous					
	Cross Section				*Artificial Panel*	
Rainfall shock: Age of marriage	-0.113***	-0.027***				
	(0.005)	(0.004)				
Rainfall shock: Ages 12-16			-0.251***	-0.040***		
			(0.009)	(0.008)		
Rainfall shock					-0.023***	-0.004***
					(0.001)	(0.001)
Estimator	OLS	OLS	OLS	OLS	OLS	OLS
Observations	259,337	259,337	275,770	275,770	1,727,297	1,727,297
R-squared	0.002	0.257	0.003	0.258	0.000	0.063
Other cont.	None	Geo./Ind.	None	Geo./Ind.	None	None
F.E.	None	Y.O.M. / Cluster	None	Y.O.B. / Cluster	None	Year / Cluster
Clustering	Cluster x Y.O.M.	Cluster x Y.O.M.	Country x Y.O.B.	Cluster x Y.O.B.	Cluster x Year	Cluster x Year

Notes: *** Significant at 1%, ** Significant at 5%, * Significant at 10%. Geographic controls include absolute latitude, suitability for wheat, maize, cereals, oil crops, roots/tubers, pulses, sugar, cotton, and rain-fed agriculture, malaria suitability, ruggedness, elevation, distance to coast, and ecological zone, unless coefficients on these are reported. Individual controls are year of birth, year of birth squared, and urban.

War and polygamy

	Dependent variable: Polygamous					
	Cross Section				*Artificial Panel*	
Battle deaths: Age of marriage	-5.541***	0.615***				
	(0.134)	(0.138)				
Battle deaths: Ages 12-16			-9.904***	1.260***		
			(0.199)	(0.217)		
Battle deaths					-0.866***	0.095***
					(0.024)	(0.026)
Estimator	OLS	OLS	OLS	OLS	OLS	OLS
Observations	308,070	308,070	307,791	307,791	1,893,780	1,893,780
R-squared	0.004	0.254	0.006	0.253	0.000	0.062
Other cont.	None	Geo./Ind.	None	Geo./Ind.	None	None
F.E.	None	Cluster/Y.O.M.	None	Cluster/Y.O.B.	Age/Year/Cluster	Age/Year/Cluster
Clustering	Cluster x Y.O.M.	Cluster x Y.O.M.	Cluster x Y.O.B.	Cluster x Y.O.B.	Cluster x Year	Cluster x Year

Notes: *** Significant at 1%, ** Significant at 5%, * Significant at 10%. (indicated by lists of excluded instruments). Geographic controls include absolute latitude, suitability for wheat, maize, cereals, oil crops, roots/tubers, pulses, sugar, cotton, and rain-fed agriculture, malaria suitability, ruggedness, elevation, distance to coast, and ecological zone, unless coefficients on these are reported. Individual controls are year of birth, year of birth squared, and urban.

National bordersand polygamy

	Benin and Burkina Faso	*Benin and Niger*	*Benin and Nigeria*	*Benin and Togo*	*Burkina Faso and Ghana*	*Burkina Faso and Ivory Coast*	*Burkina Faso and Niger*	*Burkina Faso and Mali*	*Burkina Faso and Togo*	*CAR and Cameroon*	*CAR and DRC*	*Cameroon and Nigeria*	*DRC and Rwanda*
Border	0.849**	0.091	0.035	-0.030	0.123	-0.181	0.103	0.018	-0.014	0.122*	-0.074***	-0.197	0.023
	(0.385)	(0.084)	(0.139)	(0.051)	(0.080)	(0.123)	(0.134)	(0.082)	(0.105)	(0.069)	(0.022)	(0.122)	(0.035)
Obs	1,605	1,375	9,217	14,855	5,503	1,803	3,857	11,148	2,603	1,255	1,924	7,198	5,441
R-sq	0.056	0.111	0.078	0.054	0.069	0.042	0.074	0.061	0.029	0.040	0.018	0.029	0.020

	DRC and Tanzania	*DRC and Uganda*	*DRC and Zambia*	*Ethiopia and Kenya*	*Ghana and Ivory Coast*	*Ghana and Togo*	*Guinea and Ivory Coast*	*Guinea and Liberia*	*Guinea and Mali*	*Guinea and Senegal*	*Ivory Coast and Liberia*	*Ivory Coast and Mali*	*Kenya and Tanzania*
Border	-13.163***	-0.142	-0.065	0.132	-0.238***	0.010	-0.301	-0.010	0.207*	-0.243	-0.050	0.064	0.176*
	(1.358)	(0.174)	(0.049)	(0.113)	(0.089)	(0.043)	(0.354)	(0.089)	(0.114)	(0.207)	(0.075)	(0.146)	(0.095)
Obs	925	3,210	1,665	470	3,957	11,518	2,145	4,458	4,628	2,126	4,000	3,380	4,909
R-sq	0.014	0.023	0.023	0.067	0.057	0.056	0.073	0.048	0.077	0.107	0.022	0.082	0.029

	Kenya and Uganda	*Malawi and Mozambique*	*Malawi and Tanzania*	*Malawi and Zambia*	*Mali and Niger*	*Mali and Senegal*	*Mozambique and Tanzania*	*Mozambique and Zambia*	*Mozambique and Zimbabwe*	*Niger and Nigeria*	*Rwanda and Tanzania*	*Rwanda and Uganda*	*Zambia and Zimbabwe*
Border	-0.129	0.033	0.196***	0.118*	0.268	0.066	-5.122	0.000	-0.232	-0.122**	0.015	-0.027	-0.111
	(0.099)	(0.064)	(0.057)	(0.065)	(0.236)	(0.104)	(3.163)	(0.000)	(0.222)	(0.060)	(0.094)	(0.048)	(0.118)
Obs	3,362	16,673	3,027	7,019	887	2,208	1,678	574	2,875	12,252	4,448	5,433	1,639
R-sq	0.071	0.028	0.065	0.034	0.094	0.111	0.051	0.043	0.017	0.049	0.016	0.029	0.084

Notes: *** Significant at 1%, ** Significant at 5%, * Significant at 10%. All regressions are OLS, with polygyny as the dependent variable and standard errors clustered at the survey cluster level. Other controls are a cubic in distance to the border, interacted with a country dummy, and a quadratic in respondent age. The coefficient reflects the jump from moving to the alphabetically prior country.

Child mortality and polygamy (country level)

	Dependent variable: Polygamous (Cross Section)			
Child mortality: Age of marriage	1.596***	0.756***	2.345***	0.933*
	(0.053)	(0.092)	(0.205)	(0.528)
Estimator	OLS	OLS	IV	IV
Observations	474,553	290,202	327,124	209,634
R-squared	0.044	0.142	0.009	0.109
Other cont.	None	Geo./Ind.	Geo./Ind.	Geo./Ind.
FE	None	Y.O.M./Country	None	Y.O.M./Country
Clustering	Country x Y.O.M.	Country x Y.O.M.	Country x Y.O.M.	Country x Y.O.M.
F test			217.7	28.95
	Dependent variable: Polygamous (Cross Section)			
Child mortality: Ages 12-16	1.570***	1.038***	2.215***	0.730**
	(0.056)	(0.095)	(0.223)	(0.355)
Estimator	OLS	OLS	IV	IV
Observations	456,024	286,453	241,589	164,921
R-squared	0.041	0.138	0.005	0.097
Other cont.	None	Geo./Ind.	None	Geo./Ind.
F.E.	None	Y.O.B./Country	None	Y.O.B./Country
Clustering	Country x Y.O.B.	Country x Y.O.B.	Country x Y.O.B.	Country x Y.O.B.
F test			147.4	107.8
	Dependent variable: Polygamous (Artificial panel)			
Child mortality	0.255***	0.103***	0.452***	-0.279**
	(0.010)	(0.023)	(0.038)	(0.134)
Estimator	OLS	OLS	IV	IV
Observations	2,984,448	1,825,936	1,875,666	1,221,446
R-squared	0.006	0.038	0.001	0.033
Other cont.	None	Geo./Ind.	None	Geo./Ind.
F.E.	Age/Year/Country	Age/Year/Country	Age/Year/Country	Age/Year/Country
Clustering	Country x Year	Country x Year	Country x Year	Country x Year
F test			157.3	36.38
	Dependent variable: Polygamous (Uganda only)			
	DHS		*IPUMS*	
Kigezi X Post (birth)	-0.050	-0.076*	-0.006*	-0.007**
	(0.035)	(0.040)	(0.003)	(0.003)
Kigezi	-0.082*	-0.239	-0.020**	0.033***
	(0.045)	(0.143)	(0.007)	(0.007)
Post (birth)	-0.064**	0.139	0.009***	0.124**
	(0.025)	(0.129)	(0.003)	(0.057)
Estimator	OLS	OLS	OLS	OLS
Observations	8,740	8,422	182,714	182,553
R-squared	0.006	0.087	0.063	0.067
Other cont.	None	Geo./Ind.	Rel/Urb/Eth	Rel/Urb/Eth
F.E.	None	Y.O.B./Dist.	None	Y.O.B./Dist.
Clustering	District	District	District	District

Notes: *** Significant at 1%, ** Significant at 5%, * Significant at 10%. (indicated by lists of excluded instruments). Geographic controls are absolute latitude, suitability for wheat, maize, cereals, oil crops, roots/tubers, pulses, sugar, cotton, and rain-fed agriculture, malaria suitability, ruggedness, elevation, distance to coast, and ecological zone, unless coefficients on these are reported. Individual controls are year of birth, year of birth squared, and urban. The excluded instrument in all IV regressions is the country-level rainfall estimate reported by Miguel, Satyanath, and Sergenti, E. (2004).