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School of Economics and Management

Female Empowerment and Early Childhood Health Investments: The Long-Term Effect of Matrilineal Kinship in Sub-Saharan Africa

By

Eric Nordqvist

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Department of Economics

Lund University

Supervised by Gunes Gokmen & Therese Nilsson

Abstract

How we choose to invest in the future generations is becoming increasingly imperative as researchers learn more about the long-term consequences of early childhood. The early-life literature suggests that empowered mothers invest more into their children and that matrilineal females are more empowered than patrilineal counterparts. To further understand the role of female empowerment on early childhood investments, this paper combines these two insights and investigates the effects of ancestral matrilineal kinship organizations on contemporaneous early childhood health investments. In this pursuit, I bring the growing anthropological methodology into the health economics literature. I utilize Murdock's ethnographic atlas together with individual level cross-section survey data for 166,982 births in 26 sub-Saharan countries and find evidence that contemporaneous mothers with matrilineal ancestry invest more in their children's health than patrilineal counterparts. I do not, however, find support that this is due to female empowerment, or that matrilineal mothers are more empowered by their ancestry. Moreover, I conclude that the mothers' partners are more important than theory suggests, and that local geographical or demographic factors need to be controlled for in order to establish causality.

Keywords: Matrilineality, cultural persistence, female empowerment, child health investments.

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1. Introduction

In economics, it is a well-established phenomenon that healthy individuals are more productive (Strauss & Thomas 1998) and have higher earnings (Behrman & Rosenzweig 2004) than counterparts. Having a healthy population is, therefore, a goal for policymakers worldwide to promote economic development (Alleyne & Cohen 2002, Schünemann et al. 2018). Recent evidence has put forth early childhood health investments as an important determinant of long-run health (Campbell et al. 2014, Conti et al. 2016) and a range of other factors such as income and human capital formation (Almond et al. 2018, Garcia et al. 20019). The literature also illustrates that parental investments are of special importance (Heckman & Mosso 2014, Cunha & Heckman 2007), as these can either mitigate (Almond & Currie 2011), enforce (Almond & Mazumder 2013), or cause (Nilsson 2017) an early life shock.

While insight into what determines parental health investment in early childhood are limited, research suggests that mothers are of great importance and that there is significant heterogeneity between them. Not only does the characteristics of mothers tend to matter more for a child's development than fathers (Lundborg et al. 2014), mothers also tend to be the main investor in the health of the child (Case & Paxson 2001). In fact, the economics literature has on several occasions supported the hypothesis that mothers invest more in children than fathers (Doepke & Tertilt 2011, Thomas 1990) and that educating or otherwise supporting women is beneficial to children in the short to long run (Schultz 2002, Sievertsen & Wüst 2017). Moreover, there is empirical support for empowerment being an important factor of heterogeneity between mothers, regarding parental investments. Using data from developing countries, researchers have found positive effects of female empowerment on early childhood investments (Desai & Johnson 2005, Basu & Koolwal 2005, Janssens 2011, Hossein 2015), both directly and through externalities.

This paper investigates the role of female empowerment on early childhood health investments by combining collective insights on empowered mothers' role in promoting early childhood investments with anthropological methodology applying ancestral culture as a determinant for contemporary outcomes. Using such methods, researchers have found that females of matrilineal ancestry have different circumstances (Ferrara & Melazzo 2017), behaviour (Gneezy et al. 2009), and are more empowered (Lowes 2018, Loper 2019) than their counterparts in traditionally patrilineal cultures. Bridging the knowledge from these two strands of literature, I hypothesise that mothers of matrilineal ancestry invest more in their children's early life health than their patrilineal counterparts and that this effect runs through a higher degree of empowerment. Merging these strands of literature has not been attempted, leaving a vacuum within the economics literature. This paper aims to fill this gap and thereby contribute to the ever-growing collective knowledge of early life child investments.

My main findings are that while matrilineal mothers invest more in their children, this effect is not due to any differences in female empowerment. Moreover, I discern that the mother's partner might be more important than theoretically suggested and that the positive effect of matrilineal ancestry on health investments is driven by effects which are concentrated in ancestral matrilineal homelands. As such, geographic and demographic controls are crucial to be able to give any causal answers on why matrilineal mothers seem to invest more into their children. My main findings suggest that children born to matrilineal mothers receive higher investments through breastfeeding and immunization. I also find some evidence that these children have lower mortality than patrilineal counterparts. Lastly, I discuss and test the robustness of my findings and recognise that while the findings are generally robust, there are important unobservables which my controls do not cover.

I contribute to the cumulated insights by bringing the growing anthropological methodology into the health economics literature, as I try to merge conclusions from both. As such, this paper can be firmly placed within either of these two strands of literature. Using an updated methodology as well as a wide range of investment and empowerment indicators, I further test and expand upon prior conclusions regarding the role of matrilineal ancestry in promoting female empowerment as well as the role of female empowerment in promoting childhood investments.

2. Matrilineal kinship

In a culture with a matrilineal kinship, as opposed to a patrilineal one, kinship and inheritance are determined through female family members, as seen in figure 1. This means, among other things, that a woman and her children do not belong to her husband's kin as they would in a patrilineal society, but hers. Kinship is an especially important aspect to consider in a sub-Saharan African context as kinship groups are important political and social units of support and community (Fox 1934). The determination of kinship has important consequences within couples as well since it implies an increased relative female intra-marriage bargaining power. Since females and children are part of her kin instead of being integrated into the kin of the husband, a female which chooses to leave her husband bring her children with her, improving her outside options. Similarly, stronger ties to and support from her kin also implies better outside options. Moreover, since family kinship is traced through females, a man's heir is not his own sons, but rather his sister's. Likewise, a man may have substantial obligations to financially support the children of his sister. A matrilineal culture should however not be mistaken for a matriarchal one. Irregardless of the kinship structure these societies are patriarchies.

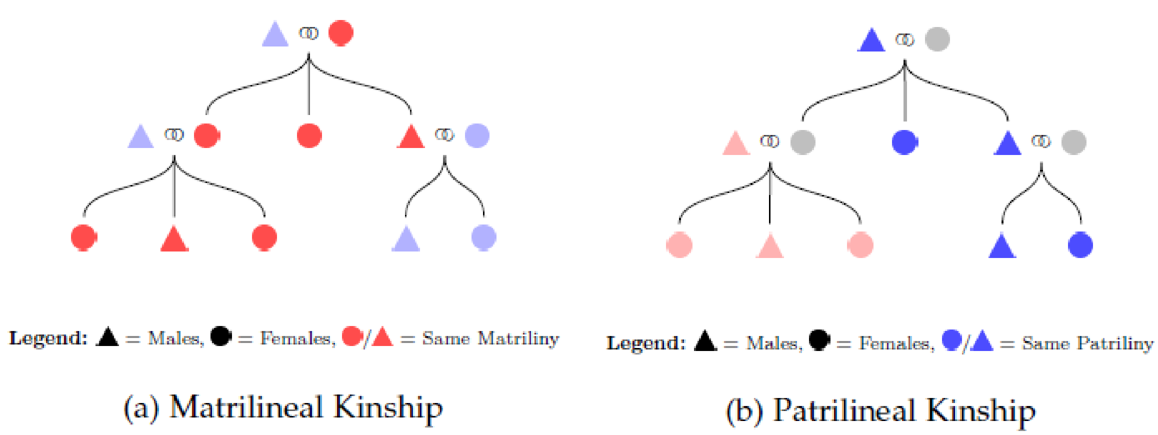

Figure 1: Kinship systems (Source: Lowes 2018)

Matrilineal culture is, and used to be, present throughout wide swaths of sub-Saharan Africa. Ancestral matrilineal culture was and is present throughout significant geographical variation, as visible from figure 2. With this geographical variation, my to-be-defined sample includes matrilineal females from a plethora of living situations, a variety of contemporaneous countries, and a wide range of ethnicities.

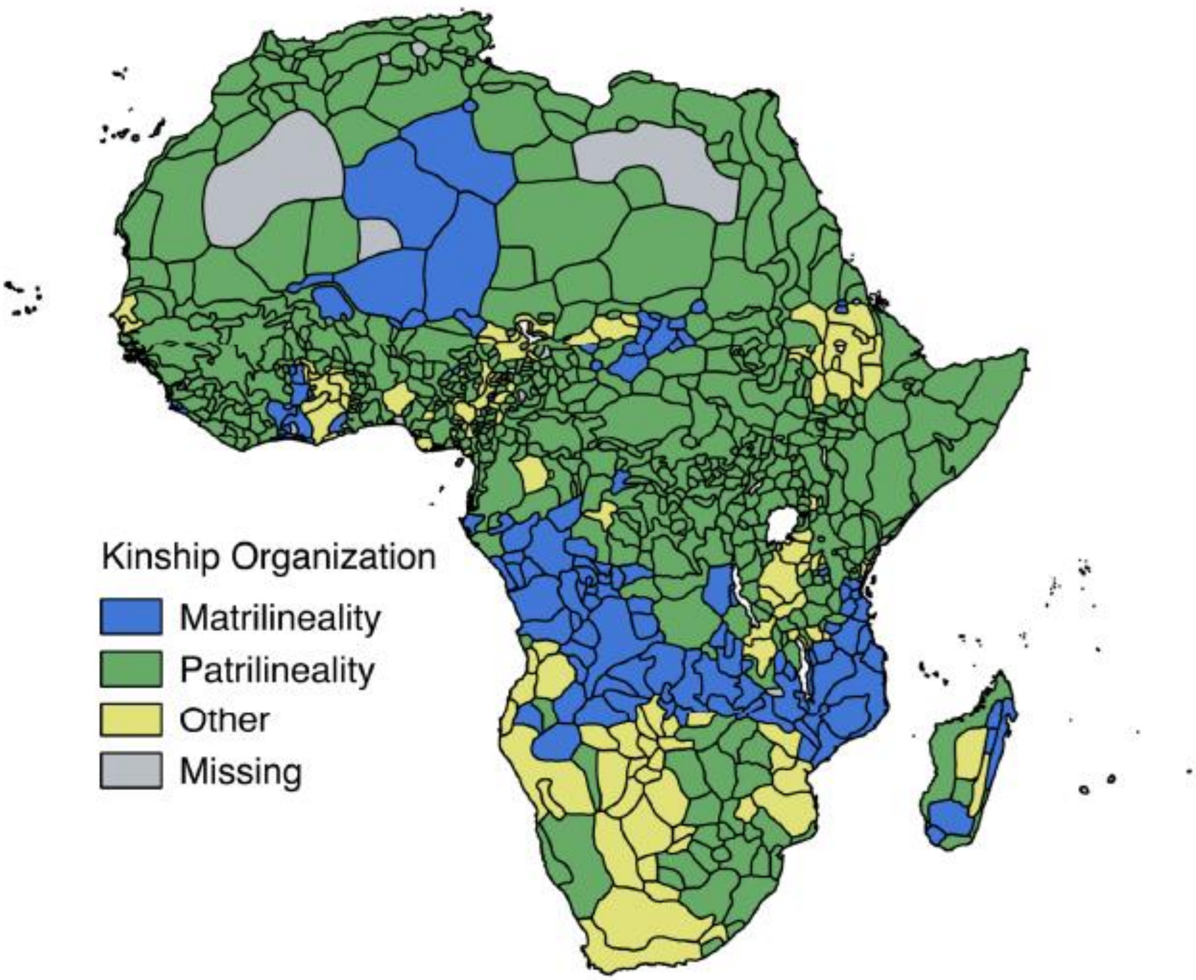

Figure 2: Ancestral ethnic homeland and kinship organization. (Source: Loper 2019)

2.1. The importance of culture

There is a growing body of literature examining the effects of ancestral culture on modern outcomes using anthropological methodology. To do so, researchers typically use what is called Murdock's ethnographic atlas (EA), a detailed anthropological account of precolonial characteristics for over 1250 ethnic groups worldwide (Spoehr, 1985). The intuition behind this method is that ancestral characteristics affects modern individuals via cultural persistence which transmits cultural beliefs through generations along ethnic lines. The modern culture or institutions which is a result of this transmitted culture may in term affect modern outcomes. The EA covers a large variety of precolonial characteristics (Michalopoulos & Papaioannou 2018) and has as such been paired with an array of different data sets to discover effects as diverse as ancestral agricultural practices on modern gender norms (Alesina et al 2013), European colonization patterns and modern development (Acemoglu et al. 2001, 2002), ancestral dowry practices on modern female educational (Ashraf et al. 2020) and the slave trade on female health outcomes (Bertocchi and Dimico 2019). A diverse methodology which can be quite cross-disciplinary indeed.

Using this method allows me to circumvent potential contemporary biases. As different individuals faced with similar choices might perform different actions based on culture, I need a tool to separate the effects of local institutions from the effects of culture inherited along ethnic lines. With this tool I am able to find causal evidence of the relationship between empowerment and early childhood health investments. Cultural differences between individuals are on the other hand not necessarily observed, in which case the I need to find a proxy for cultural beliefs (Fernández 2011).

2.2. Empowerment and matrilineal culture

Considering that matrilineal females have a larger degree of intra-marriage power, it is common to also believe that these females are more empowered. According to recent evidence, this seems to be the case. Authors have found that matrilineal women do have more intra-marriage bargaining power (Lowes 2018), as well as being more independent (Loper 2019) than patrilineal contemporaries. It is argued that this effect is due to an increase in female autonomy as husbands have relatively less authority over wives. These recent contributions use an anthropological approach to argue that these effects are due to cultural persistence which has solidified the more independent role of females within contemporary culture. Additionally, this literature also found evidence that females whose ancestors were matrilineal, and their children aged 6 to 13, are better educated and healthier, defined as if a respondent’s child had been ill in the last month.

3. Methodology

3.1. Data

I gather my individual level data from the Demographic and Health Surveys program (DHS). The DHS surveys a large number of individuals, roughly 5’000 to 30’000 households per country in each wave. The DHS collects individual level data on many factors including health indicators, beliefs, and opinions. Additionally, the DHS is using a highly standardized questionnaire, making the collected data comparable between countries and waves. (Demographic and Health Surveys 2020). The DHS dataset allows me to use individual level cross section data from different nations and years with relative ease, and as such increase my sample size along with its geographical variation. From the DHS I am using data on births within the last five years, as of the survey. The data is collected from an interview with the mother and as such it also includes data on her. Based mother’s self-reported ethnic identity, I can match them to their ancestral characteristics in the EA and collect a sample of 166,982 births, 22,046 of which were to matrilineal mothers. The data is collected from 26 sub-Saharan countries and cover 111 different ethnicities, 17 of which are matrilineal. I moreover use up to two waves for each country. A detailed list of which countries I use and for which years the surveys cover can be found in the appendix, table B1.

3.2. Early childhood health investments

A child’s development begins already in the uterus, and as such its susceptibility to outside influences (Almond & Currie 2011). Important at birth health indicators such as birth weight and mortality can be partly influences by who the mother is (Currie & Hyson 1999, Currie & Moretti 2007), her life situation (Carlson 2015) and choices she makes for her own access to prenatal care (Maitra 2004). These indicators (Bharadwaj et al. 2015) and outside influence while in the uterus has long lasting consequences (Almond et al. 2009, Liu & Lin 2014, Almond 2006).

Past birth, health investments can lower mortality among newly born babies (Almond et al. 2010, Bharadwaj et al. 2013) and within the first years of life (Bütikofer et al. 2019). Within this first year it is also possible to influence a child’s long-term human capital attainment (Venkataramani 2012). Similar long-term effects can be attained throughout childhood (Hoynes et al. 2016). Similarly, important indicators for parental investment often include breast feeding (Kronborg et al. 2016) and immunization (Vikram et al. 2012, Thorpe et al. 2016), for their positive impact on child mortality.

3.3. Investment indicators

To reflect the variety of indicators for both child health outcomes and parental child investments observed in the literature, I have decided to define ten dependent variables as my investment indicators. Each represent a different aspect of parental investments covered in the literature, from prenatal to early childhood.

To cover direct parental investments, I look at several distinct indicators and periods of the child's development: Prenatal care (Maitra 2004), immunization (Vikram et al. 2012, Thorpe et al. 2016) and breast feeding (Kronborg et al. 2016). First, I define a binary indicator variable for whether the mother received prenatal care or not. Investments into a pregnant mother's health is also to be considered as an investment into the child's health, as prenatal care affects birth weight and child mortality. Second, I define two binary indicator variables which equal one if the child has received either of two common childhood vaccines. These are tuberculosis and measles. Likewise, I define two additional continuous variables indicating how many vaccines the child has received for polio and diphtheria. Immunization is an important inclusion, not only because it is a very direct and measurable form of parental investment, but also because it has direct effects on a child mortality. Third, I use a binary variable taking the value one if mothers spent at least four months breastfeeding the child. This indicator of parental investments is heavily influenced by the work of Sievertsen & Wüst (2017) as well as Kronborg et al. (2016) who argue that breastfeeding is a reliable measure of early maternal investments into their children. Moreover, breastfeeding is important to develop a child's immune system and as such has a significant impact on mortality. Last, I define an indicator which takes the value one if the child was put to breast within the first hour since birth. This inclusion is added as the WHO recommends that mothers start exclusively breastfeeding within an hour from birth to reduce infant mortality, especially in sub-Saharan Africa where infant mortality is high.

To expand the analysis and include measures of parental investments which are not measured or captured by the DHL questionnaire, but however does contribute to the health of the child, I have decided to include three additional variables: one year mortality, five year mortality and birth weight. The mortality and birth weight of a baby is determined by several unobserved factors and potential child-parent interactions, as well as investments into maternal health. These two indicators therefore serve as an indicator for these unobserved parental investments. The two mortality indicators take the value one if the child died within its first twelve months or five years of life, respectively. Moreover, I define a continuous birth weight variable, also gathered from the DHS interview. The use of birth weight as a health measurement is commonplace in the health economics literature which can be affected by parental investments (Maitra 2004) and have lasting consequences for the child (Lundborg et al 2015). It is therefore an important metric to include.

3.4. Female empowerment

Female empowerment can be defined and interpreted in many ways, each suited to different circumstances. The mere concept could indicate vastly different social or legal norms for different individuals, countries, and broader cultures. As such, capturing the effects of empowerment in a single set of variables which would be applicable for a diverse region such as sub-Saharan-Africa is difficult at best. A frequent choice within the economic literature is therefore to define a range of empowerment indicators which capture different aspects of what is believed to cause empowerment (Hossein 2015). Two influential indicators which I focus on is the mother's perceived ability to participate in decision making and whether she is the head of a household. The advantage of using these two measures is that they could indicate empowerment in two distinct ways. Whereas the perceived ability to decision making is quite subjective, a mother being the head of household is a tangible metric. In this sense these two measures would complement each other and allow me to get a more thorough grasp of female empowerment.

My first empowerment indicator I define is a binary variable taking the value one if the respondent mother perceives that she is the sole decision maker regarding her own health. The degree to which a mother experience that she is involved in household decision making has been suggested and used as an empowerment indicator in the past. It has also been used to find positive effects on child investments (Ibrahim et al. 2015). Importantly as well, is that such results have been found using standardized DHS datasets (Basu & Koolwal 2005, Desai & Johnson 2005) when defining a mother's perceived decision power in matters concerning her own health as an empowerment indicator. Specifically, this recent evidence found that mothers who were more empowered to take decisions over her own health were more empowered to positively invest into the health of their children. Both on an individual level, and on a local level, indicating positive externalities of female empowerment (Desai & Johnson 2005).

My second empowerment indicator is a binary variable taking the value one if the respondent mother is the head of her household. It is inspired by econometric evidence indicating that female headed households do invest more into the health of its children (Buvanić & Gupta 1997, Maitra 2004), even when their resources are scarcer than their male headed counterparts (Kennedy & Peters 1992). Why having a mother as head of household would be better for child investments is relatively unclear, but reasonable it is because the mother is more involved in household decision making and therefore is able to influence the development of the children to a larger extent. If that is the case, interestingly, a mother being head of household could be interpreted as a non-subjective version of the first empowerment indicator previously defined.

3.5. Descriptive statistics

Comparing the defined indicators and additional factors between matrilineal and patrilineal births in the sample, table 1, a picture which supports my main arguments of this paper emerges. While the mothers do tend to be similar to each other, they differ in key areas. A matrilineal mother is less likely to have a partner, substantially less likely to be in a polygynous union and were more likely to visit a health clinic within the last twelve months. Most prominent however is the differences in literacy, years of education and use of modern contraceptives in which matrilineal mothers of the sample score substantially higher than their patrilineal counterparts. Matrilineal mothers also score better across all empowerment and investment indicators. Interestingly, this is despite patrilineal mothers of the sample being relatively wealthier and more likely to be urban residents. As such, even though one could argue that matrilineal mothers should have worse access to healthcare for themselves and their child because of these two last metrics, they still invest more into the health of their children.

This comparison suggests that females of the two kinship systems may live different lives when it comes to key social aspects and that, on average, matrilineal women are more able and willing to utilize modern healthcare. At the same time, being more educated, it is likely that matrilineal mother would have greater access to information regarding the importance of investing into, for example, vaccines. That there is a clear difference between the two groups again reinforces the need to include controls for these metrics in order to isolate the effect of matrilineal ancestry.

The ancestral indicators seem to suggest that inhabitants of the two ancestral kinship systems in many regards lived quite similar lives. This indicates that any results are less likely to be correlated with precolonial characteristics, instead of being a result of cultural transmission. It differs, however, when it comes to agriculture. In ancestrally matrilineal cultures, females were more likely to participate in agriculture while the intensity of, and dependence on, agriculture were lower. At the same time, these ethnicities were less likely to use animals and ploughs in their agriculture prior to colonisation. These results go in line with (Alesina et al. 2013) who found a link between ancestral agricultural practices and modern gender norms. Remarkably, the ancestral indicator for polygyny suggests that matrilineal ethnic groups would be more prone to it, while mother indicators on the contrary suggest that contemporary matrilineal mothers are less likely to be engaged in a polygynous union. These two metrics could potentially shine doubt on my methodology, as it seems that this cultural trait was not persistent throughout time. This could however also be a product of increased female empowerment, instead strengthening the methodology.

Put together, these summary statistics imply that there may be an effect of a mother’s ancestral kinship on her early childhood health investments. These indicators also support the proposed mechanisms and chains of causality proposed in this paper. Namely that contemporaneous mothers of ancestral kinship systems through cultural persistence and transmission are more empowered and therefore more likely to invest into their child’s health.

Table 1: Summary Statistics of defined variables. * symbolizes that one is equal to "yes".

	Patrilineal	Matrilineal
Child indicators	Mean	Mean
Sex of child (1=girl)	0.493	0.498
Age of child	1.913	1.952
Mother indicators		
Has partner*	0.898	0.847
Employed*	0.675	0.650
Urban resident*	0.297	0.197
Partner has multiple wives*	0.297	0.151
Visited health clinic last twelve months*	0.625	0.742
Using modern contraception*	0.207	0.409
Age	28.900	28.575
Age when first had sex	16.458	16.456
Wealth index (Scale 1-4)	2.865	2.584
Literate (Scale 0-2)	0.683	1.084
Education in years	3.683	4.949
Number of children	3.957	3.829
Ancestral indicators		
Political complexity (Scale 1-2)	1.450	1.627
Animal and plough agriculture*	0.054	0.000
Dowry payments*	0.833	0.983
Settlement complexity (Scale 1-7)	6.345	6.684
Intensity of agriculture (Scale 1-3)	1.235	1.000
Animal husbandry*	0.943	0.987
Dependence on agriculture (Scale 0-9)	5.984	5.576
Dependence on fish (Scale 0-9)	0.874	1.064
Dependence on gathering (Scale 0-9)	0.491	0.850
Dependence on hunt (Scale 0-9)	0.707	1.542
Clan organization*	0.206	0.174
Presence of polygyny*	0.303	0.940
Female participation in agriculture (Scale 1-6)	3.085	4.155
Empowerment indicators		
Head of household*	0.107	0.129
Can decide over own health*	0.385	0.475
Investment indicators		
1-year mortality	0.063	0.052
5-year mortality	0.078	0.066
Tuberculosis vaccine*	0.867	0.932
Measles vaccine*	0.633	0.715
Polio vaccines (Scale 0-4)	2.930	3.077
Diphtheria vaccines (Scale 0-3)	2.198	2.307
Breastfed for four months*	0.885	0.901
Baby put to breast within first hour*	0.585	0.779
Mother received prenatal care*	0.634	0.682
Birthweight (in grams)	3227.291	3239.528

3.6. Research design

The main econometric analysis of this paper use OLS. Building on previous work I define my main model according to the regression below.

$$i_b = \alpha Matrilineal_{m,e} + \beta X_e + \gamma X_m + \delta X_r + \theta X_b + \varepsilon_{b,e,m,r}$$

With i_b denoting each of the ten health investment indicators defined below, for each birth b in the sample. $Matrilineal_{m,e}$ is a binary variable taking the value one if the mother m who gave birth is identifying with an ethnicity e that is traditionally matrilineal according to the EA. X_e, X_m, X_r and X_b denotes ethnic, mother, regional-year and birth controls respectively. Finally, $\varepsilon_{b,e,m,r}$ is an error term.

Mother controls include age, age squared, religion fixed effect, education in number of years, a partner dummy, a dummy indicating if the mother is in a polygamous union, an employment dummy, a dummy for if the mother is an urban resident, a categorical literacy variable, a dummy indicating whether the mother has been to a health clinic within the past twelve months, a dummy indicating if the mother use modern contraception, number of children, age which the mother first had sex and a variable expressing the mother's wealth index on a scale from one to four. Birth fixed effects is the sex of the child.

To isolate the effect of matrilineal culture from other ancestral characteristics which may correlate with contemporary female empowerment and child health investments, I include a wide range of controls for precolonial characteristics gathered from the EA. These controls include dummy variables for the existence of dowry payments, polygyny, animal husbandry, use of animals and ploughs in agriculture and whether the ethnicity is organized in clans. Moreover, the controls also include indexed variables for political and settlement complexity, intensity of agriculture, dependence on agriculture for sustenance, dependence on fishing for sustenance, dependence on gathering for sustenance, dependence on hunting for sustenance and female participation in agriculture relative to males. Lastly, I control for when the ethnicity was added to the EA.

The regional-year fixed effect is a fixed effect for within country DHS regions which the surveyed mother lives in, interacted with survey year. The variable captures within country unobservable effects of the mother's regional environment and institutions on child health investments, such as living in a region which is relatively well endowed. This addition allows me to assess the effect of matrilineal versus patrilineal ancestry on individuals located in the same institutional, economic, and geographic environment. Likewise, this fixed effect captures difference due to the passing of time, due to which it might be natural to observe differences in health investments as well as female empowerment.

Lastly, previous literature has argued for the importance of clustering standard errors as to not underestimate p-values due to within group correlation. In accordance with Loper (2019) I therefore cluster standard errors on the ethnic group-DHS region-survey year level. Ethnicity, time, and region are three key groupings along which my main explanatory variables, as well as female empowerment may vary.

The above-mentioned lists of controls and fixed effects are included to facilitate a causal interpretation of the results. The concern for causality being that matrilineal ancestry, health investments, and even female empowerment is correlated with influential unobservables. The extensive mother and ethnic controls should alleviate these concerns. Furthermore, the inclusion of when the ethnicity was added to the EA mitigates potential concerns that some ethnic groups may have been more or less developed due to this time factor, for example. Meanwhile, subnational regional and time fixed effects allows me to also ease such concerns for a large set of potential unobservables on a national and subnational level, such as institutional, legal, or economic factors.

4. The long-term effect of matrilineal kinship on child health investments

My main results are depicted in table 2. In order to determine the importance of my controls I divide this table into five different panels and add controls in order to see how the results are reacting. Since columns one through nine represent the effect of one binary variable on another, these results can be interpreted as percentages. The tenth column is interpreted as the extra birth weight (in grams) which a child has, given that its mother is matrilineal and not patrilineal. The results in panel A include no fixed effects or controls and can therefore be interpreted as the pure correlation between a mother's matrilineal heritage and health investments. Essentially, this is an extension of table 1 but with correlation being clustered on ethnic group-DHS region-survey year level. Adding mother and birth level controls in panel B weakens these results, which is to be expected since a great number of unobservable are now brought into the model. This also indicates that the characteristics of the mother and child as unobservables are highly important. Nevertheless, results are still suggesting a positive and somewhat significant effect of matrilineal ancestry on child investments. Panel C includes only ancestral controls and is reinforcing the positive effects from panel A, especially when it comes to birth weight which spikes. Panel D introduces the DHS region-survey year fixed effects, as in panel B estimates are decreasing in magnitude compared to panel A. Proving that unobservable that are correlated on a regional, yearly and a religious level are highly important.

Running the full model in panel E generally confirm the results in panel A by showing that matrilineal mothers invest more in early childhood health. Apart from column ten (birth weight) which is an outlier in this regard, the estimates suggest that matrilineal mothers invest more into the early life health of their children. This is especially true when it comes to vaccinations (columns three through six), breastfeeding according to the WHO recommendations (column eight) and prenatal care (column nine). Estimates in columns one, two and seven are moving in the expected direction as well, lending some additional support. The magnitudes are however quite small and in all three cases lower than their standard errors. As such it is not a definite conclusion that these effects are different from zero. The anthropological methodology is however biased against finding any significant results, seeing as cultural persistence along family lines is just one of many possible explanations for contemporary culture, as well as contemporary health investments and outcomes, as also noted by Fernández (2011).

Table 2: OLS results for the ten health investment indicators.

	(1) 1-year Mortality	(2) 5-year Mortality	(3) Measles Vaccine	(4) Polio Vaccines	(5) Diphtheria Vaccines	(6) Tuberculosis Vaccine	(7) Four months Breastfeeding	(8) Put to breast First Hour	(9) Prenatal Care	(10) Birth Weight
Panel A: No FEs or controls										
Matrilineal ancestry	-0.0103*** (0.00376)	-0.0122** (0.00557)	0.0820*** (0.0201)	0.147** (0.0620)	0.109 (0.120)	0.0650*** (0.0125)	0.0156** (0.00655)	0.195*** (0.0591)	0.0487*** (0.0181)	12.24 (11.22)
Observations	166,982	166,982	137,524	137,801	137,643	138,235	166,982	166,982	166,898	166,982
Panel B: Mother and birth controls										
Matrilineal ancestry	-0.000217 (0.00308)	0.000428 (0.00415)	0.0417** (0.0207)	0.0132 (0.0464)	-0.00624 (0.0965)	0.0368*** (0.00915)	0.00211 (0.00555)	0.124** (0.0526)	0.0368*** (0.0116)	7.510 (11.66)
Observations	126,325	126,325	102,679	102,810	102,704	103,104	126,325	126,325	126,268	126,325
Panel C: Ancestral controls										
Matrilineal ancestry	-0.0127** (0.00540)	-0.0163** (0.00735)	0.0546** (0.0222)	0.00407 (0.0760)	0.0534 (0.0971)	0.0288 (0.0175)	0.0153** (0.00756)	0.153*** (0.0503)	0.0142 (0.0199)	39.42** (18.24)
Observations	166,235	166,235	136,980	137,253	137,101	137,688	166,235	166,235	166,151	166,235
Panel D: Fixed effects										
Matrilineal ancestry	-0.000276 (0.00293)	0.000255 (0.00343)	0.00530 (0.00854)	0.0125 (0.0319)	0.0509* (0.0303)	0.00892 (0.00632)	-0.00176 (0.00374)	0.0170* (0.00877)	-0.00744 (0.00639)	-16.89** (7.892)
Observations	166,977	166,977	137,518	137,795	137,637	138,229	166,977	166,977	166,893	166,977

Panel E:
All controls and FEs

Matrilineal	-0.00122	-0.00326	0.0224**	0.104***	0.127***	0.0190**	0.00267	0.0334**	0.0175***	-26.98**
ancestry	(0.00417)	(0.00498)	(0.0110)	(0.0325)	(0.0399)	(0.00889)	(0.00584)	(0.0158)	(0.00571)	(12.36)
Observations	125,677	125,677	102,203	102,332	102,230	102,625	125,677	125,677	125,620	125,677

Notes: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Mother fixed effects include age, age squared, religion fixed effect, education in number of years, a partner dummy, a dummy indicating if the mother is in a polygamous union, an employment dummy, a dummy for if the mother is an urban resident, a categorical literacy variable, a dummy indicating whether the mother has been to a health clinic within the past twelve months, a dummy indicating if the mother use modern contraception, number of children, age which the mother first had sex and a variable expressing the mother's wealth index on a scale from one to four. Birth fixed effects is the sex of the child. Ancestral controls are measured on the ethnic level and include dummy variables for the existence of dowry payments, polygyny, animal husbandry, use of animals and ploughs in agriculture and whether the ethnicity is organized in clans. Ancestral controls also include indexed variables for political and settlement complexity, intensity of agriculture, dependence on agriculture for sustenance, dependence on fishing for sustenance, dependence on gathering for sustenance, dependence on hunting for sustenance and female's participation in agriculture relative to males. Fixed effects are included on a religious level as well as DHS region-survey year level. Standard errors are clustered on the ethnic group-DHS region-survey year level in all panels.

5. Mechanisms

My main results support the hypothesis that females of matrilineal ancestry are able to invest more in their children's early health. These results fit nicely into the previous literature which found both that matrilineal ancestry does produce more empowered females (Lowes 2018, Loper 2019) and that more empowered females tend to invest more into their children's early health (Desai & Johnson 2005, Basu & Koolwal 2005).

Thus far, I have argued that the connection between female empowerment and matrilineal culture can be made, without proving this relationship. Even though I include a variety of controls and fixed effects into my main regression and previous literature suggests this channel of effect to be viable, it is possible that the measured effect is not due to female empowerment at all. There may be other channels through which matrilineal ancestry correlates with early life health investments, which is not covered by these controls. If so, it is possible that female empowerment is not as important of a channel as theory suggests, if at all. In order to examine the robustness of my main findings, as well as my main intended channel of effect, I use this section to investigate the underlying mechanisms driving my results.

5.1. Female empowerment – the deciding factor?

Figure 3 is a flow chart of how I have hypothesised matrilineal ancestry to affect early childhood health investments. I am investigating the black arrows in figure 3, the effects of matrilineal ancestry on early life health investments that runs through an increase in female empowerment. Important to note is that while I am investigating this potential effect, the direct effects of both matrilineal ancestry (blue arrow) and empowerment (orange arrow) can work independently. Moreover, in an ideal world, my control variables pick up all the effect of matrilineal ancestry that does not run through female empowerment, such that the blue arrow fades away. The same goes if I include my defined empowerment variables. If female empowerment, as defined in the *Methodology* section, is an important intermediary factor, its inclusion in the main regression would remove or dilute the effect of matrilineal ancestry on early health investments as this effect instead would be captured by the empowerment variables.

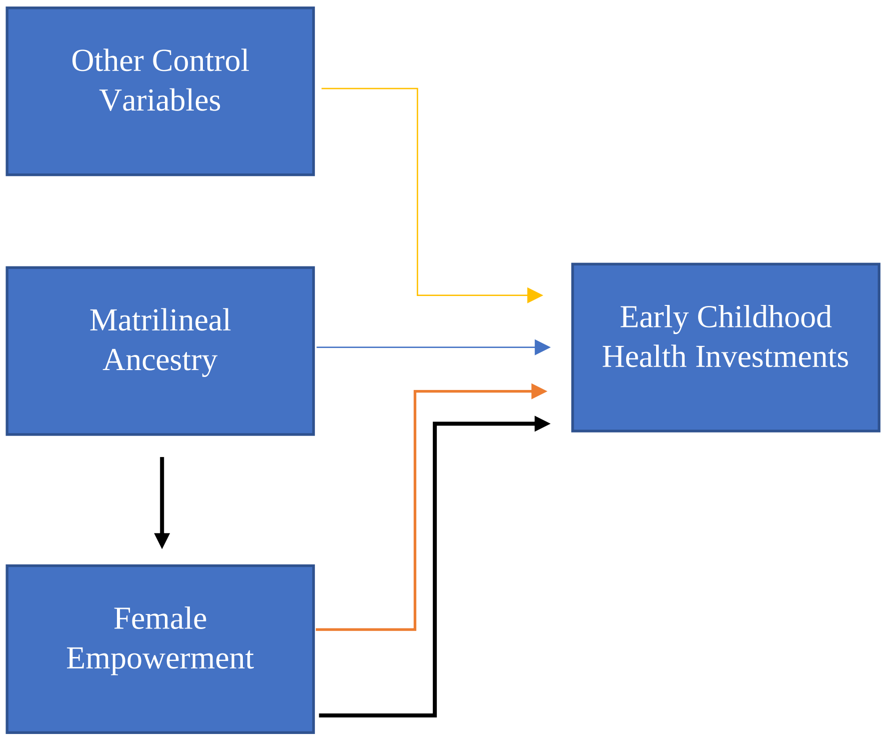

Figure 3: Flow chart of believed structural connection.

To investigate if the black arrows in figure 3 are of significance, I run the same regression as in panel E of table 2 but include different combinations of my defined empowerment variables. Results can be seen in table A1 of the appendix. Panel A includes no empowerment control and is the same regression as my main results in panel E of table 2. This is my baseline to compare if values change in subsequent panels. Panel B, C and D include controls for my defined empowerment indicators, separately and together. In all three panels, these controls are in themselves generally significant and in line with the hypothesis that more empowered mothers would invest more into their children. They do however not cause any noteworthy change in the estimates for matrilineal ancestry, indicating that the indirect theoretical relationship depicted as the black arrows in figure 3 is weak at best. Perhaps even non-existing.

To further test whether empowerment is a bridging factor between matrilineal ancestry and child health investments I define two other variables, with similar results as panels B, C and D. First, I define an empowerment dummy which takes on the value one if both of my two empowerment indicators are equal to one. In doing so, this variable isolates those mothers who are empowered according to both of my defined indicators. I separately also run this regression again, using an interaction variable between it and matrilineal ancestry. The picture is similar, the empowerment dummy itself has a positive impact on investments, while not noticeably altering the direct effect of the matrilineal ancestry. Second, I use principal component analysis to combine my two empowerment indicators into one. Using this variable, I run two separate regressions as with the empowerment dummy, including an interaction variable in one. Again, this variable by itself does affect investments positively, while not having an impact on the estimates for matrilineal ancestry.

To investigate whether matrilineal ancestry causes female empowerment, the black arrow running from "Matrilineal Ancestry" to "Female Empowerment" in figure 3, I run my full model but using my two defined empowerment variables as dependent variables. Results can be seen in table 3 below. As in table 2, panel A shows a clear and highly significant correlation between matrilineal ancestry and the dependent variables. This effect is however lessened and even reversed once mother controls and fixed effects are added. The effect is likewise supported by the addition of ancestral effects. The estimates from running my full fuller are displayed in panel E, which indicates that matrilineal culture has a weak positive effect on contemporary female empowerment, at best. In the second column, the estimate is reversely negative, albeit hardly different from zero. This is striking as previous research has been able to support the theoretical connection between empowerment and matrilineal ancestry. There may of course be many different reasons why this pattern does not repeat itself in my data, a main one being that the sample does differ both in timing, size and geographical make up.

These results open for a discussion on the concept of female empowerment. Undoubtedly, this is a difficult concept to capture and perhaps the defined definition fails to do so. Thereby, while this paper does provide evidence that matrilineal ancestry is beneficial for early life child health investments, it cannot place female empowerment as a causal mechanism. Instead, it seems as there is some other unobservable which drives this mechanism and that the effect of matrilineal culture which runs through female empowerment has not been isolated.

Table 3: OLS results for the effect of matrilineality on defined contemporary measures of female empowerment using different sets of controls and fixed effects as defined in the *Methodology* section.

	(1) Able to take decisions on own health	(2) Head of household
Panel A: No FEs or controls		
Matrilineal ancestry	0.0900*** (0.0299)	0.0222** (0.00969)
Observations	166,982	166,982
Panel B: Mother and birth controls		
Matrilineal ancestry	0.0333 (0.0311)	-0.00850 (0.00826)
Observations	126,325	126,325
Panel C: Ancestral controls		
Matrilineal ancestry	0.0966*** (0.0331)	0.0371** (0.0147)
Observations	166,235	166,235
Panel D: Fixed effects		
Matrilineal ancestry	0.0174 (0.0160)	-0.0189** (0.00867)
Observations	166,977	166,977
Panel E: All controls and FEs		
Matrilineal ancestry	0.0279 (0.0221)	-0.00687 (0.00932)
Observations	125,677	125,677

Notes: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. All controls, fixed effects and clustering of the standard errors are defined as in table one and the *Methodology* section. All panels include clustered standard errors.

5.2. Child gender – do parents differentiate?

Investments into children depending on gender is an interesting aspect to consider, especially considering that this opens up the door to another indicator of female empowerment. One option could be that parents of matrilineal ancestry invest more into girls simply because the girls are expected to have more responsibilities in adulthood, being the nod of the kinship and having a larger degree of bargaining power within the household. As such, higher parental investments into girls could be interpreted as a proxy for adult empowerment. Likewise, parents might want to prepare girls for a more independent lifestyle (Loper 2019). While my estimates from section 5.1 does not support female empowerment as a driver of effects, column one of table 3 does suggest that mothers do have a more independent lifestyle.

On the other hand, it is paradoxically also possible that matrilineal parents opt to invest more into boys. The rationale behind this is that parents feel a greater need to prepare boys since they in adulthood would have less bargaining power relative to its female kin. Likewise, parents could be urged to invest more into the health and human capital of sons since they do not inherit directly from their parents. As such, parents can only prepare their sons for the future by investing into them directly. This might especially be a concern considering that boys are still expected to provide for future family, children and even sister's children if necessary.

Table 4 below depicts OLS results when investigating the importance of the gender of the child. Panel A holds the same results as in panel E of table 2, but also depicts the estimates for the gender of the child. From the second row of panel A, girls of the sample have a lower mortality, are more likely to receive the measles vaccine and are more likely to have been breastfed for six months starting during the first hour of life. Moreover, prenatal care is not affected by the gender of the child which is to be expected if one assumes that the technology to determine the sex of a child before birth is unavailable for much of the sample.

Panel B contains the estimates when running the same regression including an interaction variable between the child's gender and matrilineal culture. This interaction variable is interpreted as the differential effect of the baby being a girl while the mother at the same time is of matrilineal ancestry. The first row of panel B on the other hand can now be interpreted as the effect of a matrilineal mother on children of either gender. After the inclusion of the interaction variable, these estimates are barely changed from the main results in panel A. Additionally, the estimates in columns seven, nine and ten grow substantially larger, while diluting much of the effect in column one. Meanwhile, the estimates of the interaction variable are either not distinguishable from zero, or negative. The results indicate that the positive effect on child early life health investments found in table 2 are not driven by parent's differential investments into girls. Rather, the increase in investments is in general found irregardless of the gender of the child.

To further explore if parents are not differentiating between genders, I estimate the linear combination between the two coefficients for mother's ancestry and the interaction variable found in panel B to gain the total effect on girls. Results from this estimation can be found in the second to last row in panel B, "Total effect girl". The null hypothesis is that this sum is equal to zero. Comparing the estimates to the first row of panel B there are few noticeable differences in the first seven columns. While one-year mortality and probability of being breast fed for four months are lower, their estimates are also not significantly different from zero and immunization is remarkable unchanged between the two estimations.

There are however some noticeable differences in columns eight through ten where the estimates are suggesting that any differential treatment between boys and girls are in favour of boys, since the total effect for girls is both smaller and significant. Most notably, the estimates for prenatal care and birth weight indicates that parents invested more into boys while still being in uterus. This result is surprising since the pattern does not continue after birth. It is questionable whether a sizeable amount of mothers had access to knowledge of the sex of the child before birth such that they could change their behaviour accordingly, or if this result is indicating some bias or correlation which hasn't been picked up by the birth control. Considering that this preferential treatment does not continue after birth, the latter seems plausible. It could however also be an effect of cultural traits allowing mothers to rest more and eat better while being pregnant with a boy, since this is a future breadwinner within the household. In line with this argument these results could also be the effect of matrilineal mothers bettering their outside options, seeing as any children would accompany her in the event of a separation from her partner. However, this behaviour does again not continue after birth.

Table 4: OLS results for the ten health investment indicators defined in the *Methodology* section.

	(1) 1-year Mortality	(2) 5-year Mortality	(3) Measles Vaccine	(4) Polio Vaccines	(5) Diphtheria Vaccines	(6) Tuberculosis Vaccine	(7) Four months Breastfeeding	(8) Put to breast First Hour	(9) Prenatal Care	(10) Birth Weight
Panel A										
Matrilineal ancestry	-0.00122	-0.00326	0.0224**	0.104***	0.127***	0.0190**	0.00267	0.0334**	0.0175***	-26.98**
	(0.00417)	(0.00498)	(0.0110)	(0.0325)	(0.0399)	(0.00889)	(0.00584)	(0.0158)	(0.00571)	(12.36)
Child is girl	-0.0104***	-0.0107***	0.00531*	-0.00161	-0.00196	0.00184	0.00473***	0.00478*	-0.00177	-62.96***
	(0.00128)	(0.00151)	(0.00291)	(0.00764)	(0.00714)	(0.00184)	(0.00181)	(0.00248)	(0.00261)	(4.080)
Observations	125,677	125,677	102,203	102,332	102,230	102,625	125,677	125,677	125,620	125,677
Panel B:										
Matrilineal ancestry	-0.000730	-0.00323	0.0216*	0.100***	0.126***	0.0173*	0.00644	0.0376**	0.0226***	-8.454
	(0.00442)	(0.00539)	(0.0115)	(0.0348)	(0.0416)	(0.00933)	(0.00620)	(0.0163)	(0.00645)	(15.24)
Child is girl	-0.0103***	-0.0106***	0.00510	-0.00274	-0.00231	0.00135	0.00580***	0.00599**	-0.000339	-57.67***
	(0.00142)	(0.00168)	(0.00325)	(0.00848)	(0.00790)	(0.00208)	(0.00198)	(0.00277)	(0.00286)	(3.756)
(Matril. anc.* child is girl)	-0.000994	-7.02e-05	0.00154	0.00803	0.00245	0.00344	-0.00760*	-0.00856	-0.0102	-37.41**
	(0.00294)	(0.00352)	(0.00671)	(0.0192)	(0.0176)	(0.00373)	(0.00403)	(0.00619)	(0.00661)	(15.31)
Total effect girls	-0.00172	-0.00330	0.0232**	0.108***	0.128***	0.0210**	-0.00117	0.0290*	0.0124*	-45.86***
	(0.00442)	(0.00517)	(0.0115)	(0.0330)	(0.040)	(0.00883)	(0.00614)	(0.0159)	(0.00675)	(13.80)
Observations	125,677	125,677	102,203	102,332	102,230	102,625	125,677	125,677	125,620	125,677

Notes: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Panels A and B include the full set of birth, mother, regional, time and ancestral controls, as well as fixed effects and clustered standard errors, as defined in the *Methodology* section.

5.3. Partners – Do they matter?

This section is dedicated to expanding my analysis and include partners of the mothers in my sample. More specifically, the potential role of the partner's ancestral kinship. If a substantial number of matrilineal mothers has a partner which is patrilineal or vice versa, my main estimates could be either under- or overestimated. Moreover, I want to examine whether my main estimates run solely through females and to what extent the values of their partners factor in.

I again utilize the DHS data to define a new sample by matching DHS' couples recodes with kids recodes based on a wave, personal, household and birth identification code, which are consistent throughout these recodes. I keep the mothers of my sample who are registered together with a partner. These partners are matched against the EA, like the mothers previously were. Since not all mothers are registered together with a partner in the couples recode, my sample shrinks from 166,982 to 44,783 births. In the partner sample, I observe that 91% of mother has a partner who is of the same ethnicity, while 97% has a partner of the same kinship system. This observation lends support to the general methodology of cultural persistence between generations along kinship lines, which my methodology is resting on at heart. While this is good news for the general methodology of this paper, it does not make for excellent econometrics. As mother's and her partner's ancestries are correlated to such a high degree, any regression including both ancestries as control variables would most likely suffer from multicollinearity and therefore not yield accurate results.

I therefore focus this part of my analysis on couples were one party is matrilineal and the other one patrilineal, to see whether the positive effect from matrilineal culture endures. On one hand, matrilineal mother with a patrilineal partner might not be able to exercise her increased bargaining power as she may not be the deciding factor for the children's and family's kinship anymore. On the other hand, a matrilineal partner might accept a larger degree of bargaining power, even though the mother is patrilineal. Unfortunately, the supply of births who are of mothers whose partners is of a different kinship system is limited to 1293 births (600 by patrilineal mothers and 693 by matrilineal mothers). This rather small sample indicates that there might be biases from individual cases. Likewise, it is not clear whether OLS is able to find a statistically significant difference between the two.

Panel A of table 5 depicts the results of running the same regressions as in panel E of table 2, but for the partner sample. The purpose of running this regression with the partner sample is to see whether it is comparable to my main sample, since it is significantly smaller. For seven out of ten investment indicators the results are comparable and similar to those of table 2. For three indicators however (mortality and birthweight) results are not similar. This would indicate that I need to be careful when drawing general conclusions from this exercise, at least for these three indicators.

Panel B of table 5 shows the estimates for couples of different kinship systems. I have also included a dummy indicating if both mother and her partner are of matrilineal ancestry. The values are comparable to those of panel A, which reinforces the conclusion that correlation between them is high. My results in panel B moreover suggest that while a couple wherein both parties are of matrilineal ancestry invest the most into their children, couples where only the partner is of matrilineal ancestry does not lag far behind. Lastly, while a matrilineal mother with a patrilineal partner does indicate some positive effects to child health investments, these are much weaker.

This exercise suggests that one possible underlying mechanism to my main results are the values of mothers' partners. The hypothesis behind this paper, and indeed the theoretical foundation of it, suggests that any positive effects health investments would stem from mothers who are empowered. Seen from two different angles, the results in panel B of table 5 could either prove or challenge this hypothesis. This could entail that a matrilineal partner, by way of inherited cultural norms, is more accepting of female influence and bargaining power than their patrilineal counterparts, which in turn allows for a patrilineal mother to conduct similar health investments as matrilineal counterparts. These results could also imply that partners, fathers or otherwise, are more important for child health investments than the literature has captured so far. A third way in which this result can be interpreted is that there is some kind of cultural trait within matrilineal culture, which I have not been able to capture within either my controls or my empowerment indicators, that promotes a higher level of child health investments. I am however not able to travel closer to the truth of this underlying mechanisms.

Table 5: OLS estimates for the ten health investment indicators defined in the *Methodology* section, using a sample including partners.

	(1) 1-year Mortality	(2) 5-year Mortality	(3) Measles Vaccine	(4) Polio Vaccines	(5) Diphtheria Vaccines	(6) Tuberculosis Vaccine	(7) Four months Breastfeeding	(8) Put to Breast First Hour	(9) Prenatal Care	(10) Birth Weight
Panel A:										
Matrilineal ancestry (Mother)	0.0141*	0.0107	0.0275	0.112**	0.147**	0.0159	0.0112	0.0405**	0.0254**	-47.86**
	(0.00762)	(0.00857)	(0.0179)	(0.0463)	(0.0577)	(0.0128)	(0.00815)	(0.0177)	(0.0105)	(19.49)
Observations	38,770	38,770	31,437	31,509	31,443	31,575	38,770	38,770	38,743	38,770
Panel B:										
Matrilineal ancestry (Mother & partner)	0.0189**	0.0146	0.0444**	0.158***	0.187***	0.0333**	0.00768	0.0431**	0.0295***	-48.33**
	(0.00780)	(0.00903)	(0.0204)	(0.0524)	(0.0669)	(0.0142)	(0.00868)	(0.0185)	(0.0114)	(21.69)
Matrilineal ancestry (Only partner)	0.0210*	0.0143	0.0433*	0.138**	0.0636	0.0470***	-0.0124	-0.00707	0.0206*	2.306
	(0.0107)	(0.0126)	(0.0246)	(0.0588)	(0.0687)	(0.0135)	(0.0151)	(0.0218)	(0.0121)	(35.77)
Matrilineal ancestry (Only mother)	0.0183*	0.0109	0.00809	0.0778	0.0571	-0.00175	0.0118	0.0215	0.0321**	-43.25
	(0.0110)	(0.0121)	(0.0276)	(0.0691)	(0.0744)	(0.0181)	(0.0121)	(0.0254)	(0.0139)	(31.71)
Observations	38,770	38,770	31,437	31,509	31,443	31,575	38,770	38,770	38,743	38,770

Notes: Notes: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. All controls, fixed effects and clustering of the standard errors are defined as in table 2 and the *Methodology* section. Partner data is collected from the DHS "couples recode" and does only cover a section of the surveys used in this paper. All regressions are using the same controls, fixed effects, and clustering as in panel E of table 2.

5.4. Movers

Throughout this paper I have focused on cultural as well as behavioural mechanisms which may drive my findings. In this section on the other hand I wish to explore a spatial aspect. To do so I borrow from the epidemiological approach as described by Fernández (2011). The main focal point of this methodology is to use migration to find causal frameworks and to investigate the role of culture on actions and outcomes. The intuition, similar to the anthropological methodology, is to compare individuals who live in the same institutional setting and investigate whether potential differences in actions or outcomes is due to a difference in culture which prompts different responses to similar situations. Using migrants and cultural proxies from individuals' homeland, is one way of doing this.

The epidemiological approach is converted into the anthropological framework by Nunn & Wantchekon (2011) who discuss the importance of using migrants, so called movers, to determine the mechanisms at work and channels of causality. The rationale in this set up is to determine whether the observed effect is due to external or internal factors. Internal factors are culture and external factors local institutions or geographical characteristics which have not been captured by ethnic or geographical controls. In this case, finding that migrants who have moved away from their ancestral homeland still has a significant effect suggests that the measured effect at least partly is due to internal factors such as cultural persistence.

Inspired by Nunn & Wantchekon (2011), Michalopoulos et al. (2019) use geocoded DHS survey data alongside ancestral homelands, as defined in the EA, to determine whether a contemporary individual lives within or outside of their ancestral homeland. They define a binary control variable for whether an individual from their sample live ten or more kilometres outside of their ancestral homeland. As I use the same data sources, I am able to apply their work with geocoding the data to my sample. I thereby use replication files from Michalopoulos et al. (2019) and merge them with my main sample to acquire a new mover sample. Notably however, Michalopoulos et al. (2019) use fewer waves and countries from the DHS recode than I originally did, resulting in that I can only merge their work with a smaller part of my main sample. As such, the mover sample is substantially smaller. A full list of waves that are included in the mover sample can be found in the appendix, table B2.

Table 6 displays estimates form running my model on the mover sample. As in table 5, panel A of table 6 includes an identical regression to my main one, run in panel E of table 2, as to examine whether the two samples are comparable to each other. Results are comparable, although magnitudes are differing. The main worrying sign is the contradictory negative effect in column seven. Since the overall picture is in line with my main findings and since column seven consistently has provided the weakest results, I press on with the analysis and explore whether the mover sample suggests that the channel of effect for my main findings is due to cultural persistence within matrilineal norms or because of local external factors.

Panel B of table 6 holds estimates from running my main regression including a mover control, equal to one if the mother is living more than ten kilometres outside of her ancestral homeland, as well as an interaction between it and the mother's ancestral kinship organization. Within the second row of the panel, the majority of health investment indicators are weak or negative for children of movers, with higher mortality and birthweight as highlight. The latter being positive for the child. These results could indicate that the data does not substantially suffer from a mover bias in which movers have self-selected into migration in order to achieve opportunities in an urban environment. In fact, movers of the sample are substantially more likely to be urban residents (47% compared to 26%) and has a higher wealth index (average 3,1 compared to 2,8).The prospects of a mover bias is daunting and credible, since there is a risk that movers are not comparable to other individuals of the sample with which they share an ethnic ancestry. Moreover, the mover variable is defined in such a way that the mother does not need to be a first generation migrant, diluting any potential effect if the mother grew up within a non-matrilineal environment and received substantial cultural input from such sources. While this risk is not diverted or nullified, the weak results indicates that movers are prone to bias investments downwards and invest less, contrary to what one would think as movers are richer and more urban.

The estimates for the interaction variable are likewise suggesting that matrilineal ancestry do not affect child health investments positively among movers. Except for columns two and nine the estimates of the interaction variable are negative or hardly different from zero. Meanwhile, the first row, now depicting the effect of matrilineal ancestry for those who still live within their ethnic homeland, retains and even improves on the estimates from panel A.

These results imply that the positive effects on child health investments found in table 2 is due to local external factors within matrilineal ethnic homelands. As such, increased investments into children by matrilineal parents is not due to some internal norms or cultural traits which movers has inherited and brought with them. Rather, there are local institutions which has developed through geographical or other cultural traits which has facilitated these investments. This is in itself a quite broad statement and its importance is depending on if these institutions are caused by or correlated with matrilineal organizations. Either way, these results indicate that there are unobservables on a local level which my controls do not account for. Since both my mother and ethnic controls are extensive and covers a wide range of cultural, political, and historical aspects, the clear candidate for future research to complement this paper is to introduce more geographical and demographic controls. While I include regional fixed effect, one addition would have been geographic controls on an even smaller scale, such as village. Population density and weather conditions would also have been valid additions[1].

If external factors are caused by matrilineal ancestry, it would suggest that culture works as an externality within a set geographical area. Moving out of this area would cause some of the benefits of a certain trait to disappear, especially if institutions around individuals have been tailored to these traits. If this is the case, it is not necessarily surprising that movers are not taking such practices with them if they moved to a new region which hosts different customs, norms, or even laws. The problem in this case, is that I cannot discern what is actually causing these positive effects without further controls. If the external factors are instead correlated with matrilineal ancestry it would imply that perhaps matrilineal ancestry is not a causal factor when determining childhood health investments. Instead, there is somethings else in these ancestral homelands which causes this positive effect.

[1]Due to the limited scope of this paper, inclusions of an independent spatial analysis through which I could have defined such variables were not feasible and had to be excluded. As such, it is unfortunately also not within the scope of this paper to intensively scrutinize if it is the case that matrilineal ancestry is correlated with such geographic or demographic features.

Table 6: OLS estimates for the ten health investment indicators defined in the *Methodology* section, using a sample including movers.

	(1) 1-year Mortality	(2) 5-year Mortality	(3) Measles Vaccine	(4) Polio Vaccines	(5) Diphtheria Vaccines	(6) Tuberculosis Vaccine	(7) Four months Breastfeeding	(8) Put to breast First Hour	(9) Prenatal Care	(10) Birth Weight
Panel A:										
Matrilineal ancestry	-0.00406	-0.00556	0.0193	0.0654*	0.149***	0.00687	-0.000944	0.0131	0.0111	-23.33
	(0.00667)	(0.00781)	(0.0123)	(0.0365)	(0.0446)	(0.0101)	(0.00757)	(0.0170)	(0.00885)	(16.19)
Observations	48,803	48,803	44,228	44,404	44,321	44,424	48,803	48,803	48,771	48,803
Panel B:										
Matrilineal ancestry	-0.00304	-0.00211	0.0296*	0.0782	0.170***	0.00982	0.00301	0.0289	0.00506	-11.45
	(0.00668)	(0.00775)	(0.0152)	(0.0486)	(0.0515)	(0.0125)	(0.00881)	(0.0199)	(0.0103)	(18.20)
Mover	0.0120***	0.0144***	-0.00545	-0.0545	-0.0277	-0.0126	-0.00258	0.0122	-0.00104	45.06***
	(0.00371)	(0.00429)	(0.0126)	(0.0383)	(0.0416)	(0.0100)	(0.00483)	(0.0157)	(0.00878)	(12.16)
Interaction	-2.10e-05	-0.00526	-0.0252	-0.0406	-0.0535	-0.00937	-0.00978	-0.0347	0.0139	-19.01
(Mover*Ancestry)	(0.00813)	(0.00778)	(0.0173)	(0.0607)	(0.0598)	(0.0153)	(0.00811)	(0.0225)	(0.0117)	(21.82)
Observations	48,803	48,803	44,228	44,404	44,321	44,424	48,803	48,803	48,771	48,803

Notes: Notes: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. All controls, fixed effects and clustering of the standard errors are defined as in table 2 and the *Methodology* section. Mover variable indicates if an individual (mother) is living more than 10km outside of her ancestral homeland, according to coordinates in the DHS survey and ancestral homelands as defined in the EA. All regressions are using the same controls, fixed effects and clustering as in panel E of table 2.

6. Robustness

6.1. Viability of anthropological methodology

One of the pitfalls of this study was the viability of adapting the anthropological methodology to this particular setting. As cultural persistence caused by traits specific to matrilineal cultures is one of many ways in which ancestral characteristics, modern characteristics and modern health investments correlate, discerning causality of any significance can be challenging. As such, I spend much time on trying to isolate this effect. Still, the interpretation of my results is unclear. While I find little evidence of my hypothesised mechanism, female empowerment, I find that the positive effects on childhood investments are likely concentrated in ancestral matrilineal homelands. Within this analysis I also discuss whether local institution or characteristics are either caused by or correlated with a matrilineal kinship system. While these two options indicate different things for interpretations, both highlight one of the major weaknesses of employing the anthropological methodology. Since the methodology does require that some kind of ancestral cultural trait affects modern one, the methodology is prone to many biases. Clearly, an important norm such as kinship organization would affect many different aspects of society at the same time, while also being correlated with other cultural traits, as well as geographical, historical, and political realities. An econometrician who pursues this model needs to control away all these other factors, a momentous task at best. Research inherently becomes encumbered by a massive task of collecting, interpreting, and defining a wide range of cross disciplinary data. While the trend of increased data usage is a general one within economics research, it does however imply the need to be careful when interpreting results.

While at times problematic in interpretation and demanding in data for modelling, the anthropological method does constitute an opportunity to study topics which is usually riddled with biases and uncertainties, such as effects of culture. In the age of big data, this is also possible. Future research on the topic would however need to bring even more data into the analysis in order to further unravel the mechanisms and channels of causality. Authors should employ a spatial analysis such as research discontinuity design (such as Lowes 2018) or GPS local village level control variables (such as Loper 2019) to separate local institutions from culture further. Moreover, the concept of culture and especially empowerment need to be revisited. Perhaps by connecting to other survey datasets such as the world value survey, or further exploiting anthropological evidence to try and redefine what empowerment could look like in a sub-Saharan context. This second option does however imply a degree of author bias. Lastly, one interesting mechanism which has gone fairly unexplored throughout this paper is hereditary systems. As it is one of the major ways in which a matrilineal kinship system sets itself apart, one approach which should be explored by future authors is the effect of children not inheriting directly from their parents, while nonetheless having large responsibilities of sustaining a family. How this would affect the investments into children is unclear. In a similar fashion, research should continue exploring the value of outside options for mothers and what part this could play in the mother-child dynamic.

6.2. Data reliability

The DHS dataset which I have used for my main survey data is of high quality. The dataset is not only extensive, covering numerous individuals, countries, and regions, but also trimmed, controlled for irregularities, and cleaned before its release. What may be more questionable however, is the consistency in the quality of the EA. It is not unlikely that the process of collecting precolonial factors for over one thousand ethnic groups were marked by biases, errors, and prejudices as the vast scope of such a project necessitates a certain degree of generalisations, short cuts, and guesswork. This might be especially true for the definition of boundaries of ancestral homelands. Its scope is however also its greatest strengths, as any potential biases could be refrained from having a large impact on the end product in research like mine, in which data on 111 ethnic groups were utilized.

Where the EA does lack, however, is in its matching capabilities. Since the EA might differ in customs when it comes to naming or spelling of ethnic groups, a large number of individuals from the original DHS sample has to be discarded simple because they cannot be matched towards the EA. In the making of this paper my dataset decreased from 471,492 births to 166,982 births during the matching procedure. This is not only a waste of data which could have delivered additional clarity within my OLS, it also opens up to biases regarding which ethnicities are included and which are discarded. This issue could be solved if the researcher performs an investigation into historical ethnic names and their current counterparts, in order to include these and increase the variation of a given sample. Such attempts have been made in the past, however not by me for this paper.

Within my dataset, I am burdened by the lack of spatial data and more local geographic controls, as discussed previously. However, the geographical variation of matrilineal culture, as seen in figure 2, is substantial and helps to minimize any geographical biases. The same goes for the large number of ethnicities. As a final point of criticism to the dataset, it must however be noted that my matrilineal sample is heavily skewed towards one ethnicity. Of the 22,046 births to matrilineal mothers, 11,748 (roughly 53%) were to mothers of the same ethnic group. This heavy weight which has been put on one ethnicity could be the source of the geographic bias suggested by the *Movers* section. I run my main regressions from table 2 without this ethnic group and receive similar results, which suggest that this is not the source of the geographical bias. This point is however hard to either prove or disprove without more spatial components, as specified earlier.

6.3. Efficiency of controls

As argued throughout this paper, one crucial hurdle for the anthropological methodology which I have used, and indeed the interpretation of the results, is the potential bias caused by unobservables. I have added a long list of controls and fixed effects as to mitigate such effects and alleviate the concern that my interpretations of the results may not be causal.

6.3.1 Coefficient Ratio Test

In order estimate the efficiency of my controls in mitigating unobservables, I conduct a so-called Coefficient Ratio Test. This test was premiered by Altonji et al. (2005) but later adopted into the framework of the anthropological methodology by Nunn & Wantchekon (2011). The test involves calculating the ratio $\hat{\alpha}_F/(\hat{\alpha}_C - \hat{\alpha}_F)$, where $\hat{\alpha}_F$is my OLS estimate for matrilineal culture with a full set of controls and $\hat{\alpha}_C$ is the same, but with a selected set of controls. The intuition behind the test is to determine how much stronger the effect of unobservables need to be compared to that of my controls, in order for my result to be completely explained by unobservables. If the absolute value of the ratio is equal to one, for example, then unobservables would need to be at least as large as $\hat{\alpha}_F$ to explain away my observed estimates from panel E in table 2. One is therefore a natural benchmark, but the larger the absolute value the better.

The results of the Coefficient ratio test are displayed in table A2 of the appendix. The table is divided into four rows where the description indicates which controls or fixed effects are excluded. In general, values are above or equal to one in roughly half of the cases, rendering some conflicting evidence on the efficiency of the controls. As expected, the first row which excludes all controls and fixed effects is mostly below one, providing a strong indication that these controls and fixed effects are needed for a causal interpretation. Excluding this first row as to evaluate the efficiency of my controls, estimates are above one roughly two thirds of the time, lending stronger support. These three bottom rows also reveal a pattern in which the absolute value of estimates is mostly above one when DHS region-time fixed effects are included and mostly below one when they are excluded. This pattern exhibits the importance of regional and time specific factors such as infrastructure, geography, or institutions on health investments. While these results show some support for a causal interpretation of my estimates, they do however also support the conclusion from previous sections that geographical controls are important. As such, more geographic controls should be included in order to improve any future analysis on this topic.

6.3.2 Minimum Coefficient Lower Bound

As an alternative way to test efficiency and the predictive power of my main estimates, I conduct a Minimum coefficient lower bound test by calculating a bias-adjusted lower bound. Comparing these bias-adjusted estimates to my main OLS findings in table 2 allows me to interpret whether my OLS findings are likely to be affected by omitted variable bias. It can therefore also help me determine whether my main results can be interpreted as causal or not (Loper 2019). This test is based on the work of Oster (2019) in which she shows that $\hat{\alpha}_F - (\hat{\alpha}_C - \hat{\alpha}_F) * ((R^2_{Max} - \hat{R}^2_F)/(\hat{R}^2_F - \hat{R}^2_C))$ is a consistent estimator, if one assumes that unobservables has the same explanatory power as observables. The values $\hat{R}^2_F$ and $\hat{R}^2_C$ are gained from estimating my OLS with a full set of controls or excluding some controls, respectively. I moreover use the insights of Oster (2019) to define R^2_{Max}as $min\ (1.3\hat{R}^2_F\!: 1)$.

The bias-adjusted estimates in table A3 of the appendix generally support the main findings of this paper. They are mostly going in the right direction and have comparable magnitudes. These conclusions speak for the robustness of my results and that unobservables are not the main driver behind them. Another conclusion which could be drawn from this exercise is that my ancestral controls do make a difference, as their exclusion produces large fluctuations in magnitudes

7. Conclusions

Economic research is increasingly suggesting that there are lasting impacts of early life shocks. We are therefore becoming more aware of the opportunities and challenges which early life child health investments present. While, promoting health is a long-term goal for many policymakers worldwide, health care as we know it is ever evolving, requiring ever larger budgets and inputs from either public or private coffers. This poses a problem for many nations, perhaps most notably in developing nations which might already struggle to make ends meet. Parental responses become more important in this setting, especially so during early childhood when future generations are completely dependent on the current generation to mould it.

This paper explores the question whether more empowered mothers invest more in their children's health during early childhood by embracing an anthropological approach to econometrics. It tries to bridge recent evidence suggesting that more empowered women invest more into their children and that matrilineal women are more empowered. I find empirical evidence that matrilineal mothers invest more into their children than patrilineal counterparts. While female empowerment is a convincing force for such effects in theory, I do not find that my results work through this mechanism. I moreover find a lack of support for the notion that matrilineal females are more empowered.

I also explore alternative mechanisms and find that the positive effect of matrilineal culture is concentrated in matrilineal ancestral homelands. This insight indicates that there are traits within matrilineal homelands which are worth studying and exporting to promote early childhood health investments on a larger scale. This is also an excellent place for future research to add to my findings by further narrowing down the channels of effects and thus coming one step closer to bridging the gap between matrilineal ancestry and early childhood investments. I moreover find that early childhood investments are not differentiated based on their gender and that the ancestry of the mother's partner also is a driver of health investments.

Finally, conducting robustness checks I find evidence suggesting that my main results are somewhat robust, while also suggesting that there might be unobservables affecting my main results.

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Appendix A: Additional Tables

Table A1: OLS estimates when controlling for different measures of female empowerment.

	(1) 1-year Mortality	(2) 5-year Mortality	(3) Measles Vaccine	(4) Polio Vaccines	(5) Diphtheria Vaccines	(6) Tuberculosis Vaccine	(7) Four months Breastfeeding	(8) Put to breast First Hour	(9) Prenatal Care	(10) Birth Weight
Panel A:										
Matrilineal ancestry	-0.00122	-0.00326	0.0224**	0.104***	0.127***	0.0190**	0.00267	0.0334**	0.0175***	-26.98**
	(0.00417)	(0.00498)	(0.0110)	(0.0325)	(0.0399)	(0.00889)	(0.00584)	(0.0158)	(0.00571)	(12.36)
Observations	125,677	125,677	102,203	102,332	102,230	102,625	125,677	125,677	125,620	125,677
Panel B:										
Matrilineal ancestry	-0.00125	-0.00332	0.0219**	0.102***	0.126***	0.0187**	0.00270	0.0329**	0.0173***	-27.07**
	(0.00417)	(0.00499)	(0.0110)	(0.0326)	(0.0399)	(0.00887)	(0.00584)	(0.0157)	(0.00569)	(12.38)
Health decision	0.000995	0.00219	0.0124***	0.0453***	0.0248**	0.00894***	-0.00111	0.0183**	0.0102***	3.333
	(0.00164)	(0.00188)	(0.00366)	(0.0113)	(0.0101)	(0.00304)	(0.00240)	(0.00727)	(0.00264)	(5.014)
Observations	125,677	125,677	102,203	102,332	102,230	102,625	125,677	125,677	125,620	125,677
Panel C:										
Matrilineal ancestry	-0.00126	-0.00333	0.0225**	0.104***	0.127***	0.0191**	0.00273	0.0335**	0.0176***	-26.93**
	(0.00417)	(0.00500)	(0.0110)	(0.0325)	(0.0398)	(0.00889)	(0.00584)	(0.0158)	(0.00570)	(12.36)
Head of HH	-0.00595**	-0.00937***	0.0168***	0.0291**	0.0398***	0.00649*	0.0087***	0.0103	0.0103***	7.170
	(0.00232)	(0.00257)	(0.00562)	(0.0148)	(0.0124)	(0.00364)	(0.00292)	(0.00679)	(0.00389)	(5.891)
Observations	125,677	125,677	102,203	102,332	102,230	102,625	125,677	125,677	125,620	125,677

Panel D:

Matrilineal ancestry	-0.00130	-0.00340	0.0220**	0.103***	0.126***	0.0187**	0.00277	0.0329**	0.0173***	-27.02**
	(0.00417)	(0.00500)	(0.0109)	(0.0326)	(0.0398)	(0.00887)	(0.00584)	(0.0157)	(0.00567)	(12.38)
Health decisions	0.00116	0.00245	0.0119***	0.0446***	0.0238**	0.00878***	-0.00136	0.0181**	0.00994***	3.140
	(0.00164)	(0.00189)	(0.00368)	(0.0113)	(0.0101)	(0.00305)	(0.00240)	(0.00727)	(0.00263)	(5.011)
Head of HH	-0.00603***	-0.00955***	0.0159***	0.0258*	0.0380***	0.00585	0.0088***	0.00895	0.00953**	6.937
	(0.00233)	(0.00258)	(0.00564)	(0.0148)	(0.0125)	(0.00367)	(0.00292)	(0.00676)	(0.00387)	(5.872)
Observations	125,677	125,677	102,203	102,332	102,230	102,625	125,677	125,677	125,620	125,677

Notes: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. All panels include the full set of birth, mother, regional, time and ancestral controls, as well as fixed effects and clustered standard errors, as panel E in table 2 and as defined in the *Methodology* section. Panel A is the same regression as in panel E of table 2 and does not include any empowerment controls. Panel B, panel C and panel D control for mother being able to make health decisions, mother being head of household (HH) and both, respectively.

Table A2: Coefficient Ratio test for each included investment indicator.

$\hat{\alpha}_C$ **estimated excluding:**	(1) 1-year Mortality	(2) 5-year Mortality	(3) Measles Vaccine	(4) Polio Vaccines	(5) Diphtheria Vaccines	(6) Tuberculosis Vaccine	(7) Four months Breastfeeding	(8) Put to breast First Hour	(9) Prenatal Care	(10) Birth Weight
All FEs and controls	0.13	0.37	0.38	2.4	-7.1	0.41	0.21	0.20	0.56	-0.69
Mother & child controls	0.74	2.09	-4.67	-34.67	-373.62	-21.11	0.93	-3.41	-1.52	3.97
Ancestral controls	-244.46	-1.30	-2.00	-1.49	-2.05	-3.39	-0.69	-2.39	-1.48	-1.57
Fixed effects	-0.72	-1.09	-1.44	-0.41	-0.61	-0.82	-0.93	0.60	-0.75	-0.47

Notes: Values are calculated using the formula $\hat{\alpha}_F/(\hat{\alpha}_C - \hat{\alpha}_F)$, where $\hat{\alpha}_F$is my OLS estimate for matrilineal culture with a full set of controls and $\hat{\alpha}_C$ is the same, but with a limited set of controls.

Table A3: Minimum Coefficient Lower Bound test for each included investment indicator.

$\hat{\alpha}_C$**and** $\hat{R}_C^2$ **estimated excluding:**	(1) 1-year Mortality	(2) 5-year Mortality	(3) Measles Vaccine	(4) Polio Vaccines	(5) Diphtheria Vaccines	(6) Tuberculosis Vaccine	(7) Four months Breastfeeding	(8) Put to breast First Hour	(9) Prenatal Care	(10) Birth Weight
No FEs and controls	0.0015	-0.0006	0.0039	0.0910	0.1325	0.0048	-0.0012	-0.0202	0.0081	-38.75
Mother & child controls	-0.000015	-0.0021	0.0278	0.1087	0.1278	0.0206	0.00072	0.0059	0.0243	-17.75
Ancestral controls	-0.0014	-0.0973	0.1803	3.7476	1.3532	0.1092	0.0423	0.8188	0.6865	-690.45
Fixed effects	-0.0026	-0.0058	0.0322	0.2625	0.2574	0.0351	0.0046	0.0069	0.0606	-56.21

Notes: Values are calculated using the formula $\hat{\alpha}_F - (\hat{\alpha}_C - \hat{\alpha}_F) * ((R_{Max}^2 - \hat{R}_F^2)/(\hat{R}_F^2 - \hat{R}_C^2))$ where $\hat{\alpha}_F$ and $\hat{R}_F^2$ are gathered OLS estimate for matrilineal culture with a full set of controls while $\hat{\alpha}_C$ and $\hat{R}_C^2$are the same, but with a limited set of controls,. $R_{Max}^2$is defined as $min(1.3\hat{R}_F^2 : 1)$.

Appendix B: Data Descriptions

Table B1: List of countries and waves from DHS included in the main sample.

Country	**Survey years**	**DHS wave**
Benin	2001, 2017-2018	BJ4, BJ7
Burkina Faso	2010	BF6
Cameroon	2004, 2011	CM4, CM6
Central African Republic	1994-1995	CF3
Chad	2014-2015	TD6
Congo	2011-2012	CG6
Cote d'Ivoire	2011-2012	CI6
Democratic Republic of Congo	2007, 2013-2014	CD5, CD6
Ethiopia	2011, 2016	ET6, ET7
Gabon	2012	GA6
Gambia	2013	GM6
Ghana	2008, 2014	GH5, GH6
Guinea	1999, 2018	GN3, GN7
Kenya	2008-2009, 2014	KE5, KE6
Liberia	2013	LB6
Malawi	2010, 2015-2016	MW5, MW7
Mali	2006, 2018	ML5, ML7
Mozambique	2011	MZ6
Namibia	2000	NM4
Niger	1998	NI3
Nigeria	2008, 2018	NG5, NG7
Senegal	2010-2011, 2017	SN6, SN7
Sierra Leone	2008, 2013	SL5, SL6
Togo	1998, 2013-2014	TG3, TG6
Uganda	2011, 2016	UG6, UG7
Zambia	2007	ZM5

Table B2: List of countries and waves from DHS included in the mover sample.

Country	**Survey years**	**DHS wave**
Benin	2001	BJ4
Burkina Faso	2010	BF6
Cameroon	2004	CM4
Central African Republic	1994-1995	CF3
Democratic Republic of Congo	2007	CD5
Ethiopia	2011	ET6
Ghana	2008	GH5
Kenya	2008-2009	KE5
Malawi	2010	MW5
Mali	2006	ML5
Mozambique	2011	MZ6
Namibia	2000	NM4
Niger	1998	NI3
Nigeria	2008	NG5
Senegal	2010-2011	SN6
Sierra Leone	2008	SL5
Uganda	2011	UG6

B.3: List of defined variables from the Demographic and Health Surveys

- **Sex of Child** – Dummy variable indicating if the child is a girl. Based on variable b4.
- **Partner** – Dummy variable. Based on variable v501 (v501=1,2).
- **Employed –** Dummy variable**.** Based on variable v714.
- **Visited Health Clinic last twelve months –** Dummy variable. Based on variable v394.
- **Using Modern Contraception –** Dummy variable. Based on variable v364 (v364=1).
- **Age –** Continuous variable. Based on variable v012. Also included as a polynomial.
- **Age When First Had Sex –** Continuous variable. variable v531.
- **Relative Wealth Level** – Categorical variable. variable v190.
- **Literate –** Dummy variable. Based on variable v155 (v155=1,2).
- **Years of Education –** Continuous variable. Based on variable v133.
- **Total Number of Children** – Continuous variable. Based on variable v224.
- **Urban Resident** – Dummy variable. Based on variable v025.
- **Husband Has Other Wives** – Dummy variable. Based on variable v505.
- **Head of Household –** Dummy variable. Based on variable v150 (150=1).
- **Takes Own Health Decisions** – Dummy variable. Based on variable v743a (v743a=1,2,3).
- **Religion –** Categorical variable. Based on variable v130.
- **DHS Survey Region –** Categorical variable. Based on variable v024.
- **Ancestry –** Indexed variable. Based on variable v131.
- **Birth Weight –** Continuous variable. Based on variable m19.
- **Tuberculosis Vaccine –** Dummy variable. Based on variable h2.
- **Polio Vaccines –** Continuous variable. Based on variables h0, h4, h6 & h8.
- **Diphtheria Vaccines –** Continuous variable. Based on variables h3, h5 & h7.
- **Measles Vaccine -** Dummy variable. Based on variable h9.
- **Months of Breastfeeding -** Dummy variable. Based on variable m5 (m5>3).
- **Put to Breast Within First Hour -** Dummy variable. Based on variable v426 (v426<102).
- **Received Prenatal Care -** Dummy variable. Based on variable m2n.
- **1-Year Mortality -** Dummy variable. Based on variable b7.
- **5-year Mortality -** Dummy variable. Based on variable b7.

B.4: List of defined variables from the Ethnographic Atlas

- **Matrilineal Ancestry –** Dummy variable. Based on variables v74 & v76 (v74 & v76=2,3)
- **Jurisdictional Hierarchies** – Categorical variable. Based on variable v33.
- **Plough Cultivation Aboriginal –** Dummy variable. Based on variable v39 (v39=3).
- **Bride Price (Dowry) –** Dummy variable. Based on variable v6 (v6<3).
- **Settlement Complexity –** Continuous variable. Based on variable v30.
- **Year When Added to the EA** – Continuous variable. Based on variable v102.
- **Intensity of Agriculture** – Categorical variable. Based on variable v28.
- **Large Domesticated Animals –** Dummy variable. Based on variable v40 (v40>1).
- **Dependence on Agriculture** – Categorical variable. Based on variable v5.
- **Dependence on Fishing** – Categorical variable. Based on variable v3.
- **Dependence on Gathering** – Categorical variable. Based on variable v1.
- **Dependence on Hunting** – Categorical variable. Based on variable v2.
- **Organized into Clans** – Dummy variable. Based on variable v15 (v15=6).
- **Practicing Polygyny** – Dummy variable. Based on variable v8 (v8 = 2,4,5).
- **Female's Participation in Agriculture** – Categorical variable. Based on variable v54.